Marine Science and Technology for Sustainable Development

INTRODUCTION

The implications of the Law of the Sea Convention for the management of science and technology, at national, regional, and global levels, have been discussed in Chapter 1 of this monograph. To recall them quite briefly:

- science and technology have been assigned fundamental importance in the Convention: almost one third of the 320 articles touching on them, one way or another;
- While capacity building at the national level remains basic, international cooperation, both at the regional and at the global level is emphasised throughout;
- The new regime for the management of the marine sciences is a "consent regime" (its effectiveness is already partially overtaken by the most recent technological developments, especially in remote sensing);
- Marine scientific research is "reserved for peaceful purposes";
- The Intergovernmental Oceanographic Commission of UNESCO, UNEP, and FAO, and IMO, i.e., the institutions of the U.N. system most directly involved in the various branches of the marine sciences, are given new functions in the settlement of disputes involving scientific issues.
- The implementation of the new science and technology regime could be greatly enhanced by utilizing the UNCED Conventions and decisions, as shown in Chapter 3 of this monograph.

The purpose of this Chapter is to set this development into a broader context and to examine the role of science and the scientist in governance in the 21st century.

The Role of Science in the 21st Century

What has happened, over the past half century since the end of World War II, is that scientific information has become a basic and necessary element in the making of almost every political decision: this is obvious in the case of the environment, but since economic development must be integrated with the conservation of the environment in which it takes place, scientific information is basic for economic planning and decision-making as well. Economic growth,

furthermore, depends 85 or even 90 percent on technological innovation which is based on scientific research. Thus the linkages between science and economic development are fundamental. The same, of course, goes for the linkages between science and defence. The number of scientists working in the defence industry has been growing exponentially during the past decades, and scientists will be needed for the conversion of military establishments for peaceful purposes, for monitoring and surveillance and enforcement.

Implications

This basic importance of science and scientists for public life, for the conservation of the environment, for economic development, and for peace and security has three major implications.

Social Responsibility

First of all, it puts a tremendous intellectual, ethical and civic responsibility on the scientist. There are no more ivory towers to shield him or her.

Is science able -- will it ever be able -- to deliver the answers to questions which must be answered for sound political decisions to be made?

There is a lot to be modest about! Even a simple case study in the marine sciences, for instance, stock assessment, would encourage us to be modest. As knowledge increased, as fisheries biologists passed from linear projections of single species statistics to a deeper understanding of multi-species relationships and the interactions of man-made and natural causes, involving chemistry, hydrology, meteorology, ocean-atmosphere, etc., we came to the ineluctable conclusion that stock assessment will always include a considerable uncertainty factor, and that stock management will always remain, to a certain extent, the management of uncertainty. Science can reduce uncertainty, but not eliminate it. And this applies to the big issues, such as global warming, as well.

Development Gap

The second major issue that is arising from the growth in the social and economic importance of science is the tremendous unevenness in the distribution of science and scientists. Fairly recent statistics (by UNCTAD, UNIDO, and UNESCO) indicate that about 90 percent

of all scientific research and research and development is carried out in developed countries. The research gap between "North" and "South" is the worst of all development gaps. India and China have taken giant steps forward. They are training huge numbers of scientists, which will quickly alter the UNCTAD statistics. They will not alter the real situation in most developing countries, however, especially in Africa, and in the rest of Asia and in most of Latin America as well. Without the ability to conduct scientific research and industrial research and development, developing countries simply cannot develop; and they are in danger of increasing marginalisation, especially since the new phase of the industrial revolution in the "North" -- through miniaturization, dematerialization, automation and robotization -- is cancelling out the so-called comparative advantages of cheap raw materials and cheap labour, which are simply no longer needed.

Institutional restructuring

The third major issue arising from the new role of science in world affairs is institutional restructuring: More effective ways and mens must be found to enable the scientist to participate actively in decision-making.

Oceanography

According to Lord Ritchie-Calder (Perspectives on the sciences of the seas," *Ocean Yearbook 1*, 1978) marine sciences or oceanography has increasingly tended to become a planetary science, applying physics, chemistry, biology and mathematics to the study of the oceans in space and time. In this it is akin to meteorology, which studies the earth's atmosphere; to geology, which studies the lithosphere, the solid part of the earth; and to astronomy, which studies bodies outside the earth. Like these others, it is concerned not only with present manifestations but with events in the distant past -- a long history which is decipherable only with great difficulty. As with other branches of natural science, oceanographers build hypotheses and theories in explanation of observed phenomena. An oceanographic theory, while abstracting and schematizing processes relying on propositions in the natural sciences, and using mathematical analyses, can only be a consensus of views, subject to long-term observations with no means of experimental confirmation.

This, according to Ritchie-Calder, is inherent in the nature of the oceans. The medium itself is never still. Every drop of sea-water is constantly in motion, from the surface upheavals of the waves to the slow movements of the deep currents; from the flow of ocean-rivers, greater than any rivers on land -- like the Gulf Stream in the Atlantic, the Kuroshio off Japan, or the Humboldt Current in the Southern Pacific -- to the ocean rapids -- like tidal bores or straits races. Although, in general the average direction and volume of the major currents near the sea surface are familiar, changes in the currents from season to season cannot be defined with certainty. The Gulf Stream, for instance, meanders in its course, shrinks and expands from time to time, and changes speed and direction. In the interrelationship between the sea and the atmosphere, a deviation of an ocean current can affect not only temperatures but also the rain-bearing winds, deflecting them from areas where they are most needed, like the Sahel, or upsetting the monsoons of Southern Asia on which the food of hundreds of millions depend. There is not yet any way of controlling such planetary effects, though knowledge of them is essential to manage resources wisely.

The very nature of the oceans thus makes prediction and control of its processes difficult, if not impossible. Yet knowledge of oceanic parameters is essential if the marine resources are to be exploited in an optimal manner.

Dealing with the impact of new technology on advances in oceanography, John Woods ("New technology for ocean sciences," *The Second Mike Adye Memorial Lecture,* The Marine Technology Directorate Ltd., London, 1991) states that historically it is the development of new techniques that has led to major marine discoveries. He refers to information technology in this connection. In the classical approach to the understanding of the circulation of the oceans, a two-pronged method was followed: first the data was analysed statistically and then the results were diagnosed allowing for the laws of nature. The values of temperature, salinity, density, etc., were calculated from observations and then plotted on maps. Nowadays, the analytical process can be automated with the help of statistics packages available for computers.

Another new technology which has altered the whole concept of oceanography is remote sensing which enables synoptic measurements at the same instant of time over wide areas of the oceans. This, aided by ground truth data including data from the depths of the oceans, has led to the formulation of better and more comprehensive models of oceanic behaviour.

Marine science and technology have two-way interactions with each other, with technology leading to better science and scientific knowledge leading to improved technological development. In addition marine science is an essential input into the decision making processes, for model building and prediction, especially of tsunamis, cyclones, etc., for risk analysis and management, and for monitoring marine pollution. Marine technology is essential for the exploration and exploitation of marine resources, whether living or nonliving, and for improving efficient utilisation of resources thereby decreasing the stress on the environment.

Marine science, technology and sustainable development

Sustainable development, as already noted, comprises at least the triune concepts of equity, ecology, and efficiency (both technological and economic). In the context of management of the coastal ecosystem it should also include the concept of employment, for too often technological considerations, when considered in isolation from other factors, tend to overlook the socio-economic aspects, especially in so far as they concern the vulnerable sections of the coastal populations -- artisanal fishermen, indigenous communities, and women.

Considerations of equity lead to considerations of the so-called "North-South" divide in the contemporary sense and the needs of future generations in the time-continuum. As pointed out by Ritchie-Calder (loc.cit.), few nations are today capable of coping with the problems raised by the marine environment. Out of 113 coastal States (there are a few more today, but that does not alter the general picture) 49 have coastlines longer than 1,000 km while 19 countries have continental shelves equal to or larger than their land area. How do developing nations, which lack the educational base from which to undertake the scientific and technological responsibilities involved, tackle this problem? or, to put it differently, how can their scientific and technological capacities be augmented?

The ocean system being a single system, what happens in one part of that system can have consequences (often of catastrophic dimensions) in localities or in subsystems far removed. What happens in estuaries, in coastal waters, and on the continental shelf can determine the fate of whole species. A coastal State wanting to exercise protection over its commercial fisheries, even to the limit of 200 nm, will find that what happens in some other country's jurisdiction or on the high seas will affect it.

The issue of inter-generational equity, and equity as between genders, indigenous people and other vulnerable communities places a special responsibility on scientists and technologists. What would be their social responsibility in such cases? Would they be able to generate the necessary data to enable "correct" decisions to be made?

Dealing with science, the development of technology and sustainability, Mieke Boon and Joop Doorman ("Virtue and values of science, *The Transformation to a Sustainable Future)* attempt to answer the following questions:

- what is the role of science in a society aiming at sustainability?
- is science as practiced today appropriate for a sustainable society?
- is there an emerging methodology and paradigm relevant to sustainability?
- how can favourable conditions for science be created so as to lead to a sustainable society?

They go on to point out that two radically opposed points of view can be observed in contemporary discussions about the problem: some maintain the need for "alternative science"; others completely reject this idea.

According to the first point of view, a radically different approach to sustainability problems is required as compared to that of traditional science. This is Our scientific judgments are guided by the wrong values as well as a purely instrumentalistic approach towards nature. "New science" should, therefore, be based on either adopting a new value system or a new paradigm (Holism, New Age movement).

This approach, in the authors' view, inclines towards oversimplification of actual scientific and technological developments and practices as a consequence of the high level of abstraction at which this type of criticism of science and technology is formulated.

The opposite view maintains that science and technology in their present functioning are preeminently suitable for generating appropriate solutions to sustainability problems. Once scientists and engineers have sufficient financial and material means at their disposal, they can come up with fitting answers to problems. External research management only has to take care that the right priorities are set in dealing with problems. This view is based on the belief that since till now problems which confronted humanity were solved by scientific and technological means, there is no need for adoption of a new value system.

The authors take a somewhat middle position between the above two antagonistic views. They consider that sustainability as a value should guide actual research practice since that enables knowledge to be obtained in spite of limited financial resources. They also consider that the standard image of science as a knowledge acquirer needs to be transcended to concerns about new possibilities in the domain of methodology (e.g., for tackling the problems posed by uncertainty and complexity, thereby improving decision making) rather than searching for a new metaphysics or "alternative science."

Some of the aspects of ecological systems have already been dealt with -- their vulnerability, complexity and uncertainty. Sustainable development being a dynamic and ongoing decision process, the science of ecological systems has to fit into a decision making paradigm.

In dealing with uncertainty in decision-making, it was remarked at a recent conference ("Sustainable Development, Science and Policy -- the Conference Report," The Norwegian Research Council for Science and the Humanities, Oslo, August 1990) that it was "better to find out that we have been roughly right in due time than be precisely right too late." This concept of the precautionary principle is fundamental in all efforts to obtain sustainable development.

In other words, policies have to be made without complete knowledge as the basis for decisions, and of their effects. This also puts a time limit on scientific research if it is to be relevant to decision making. This is especially so since the Norwegian Conference on sustainable development, science and policy pointed out three different kinds of uncertainty:

. "trivial uncertainty," generated by insufficient information;

. "system uncertainty," due to inadequacy of understanding rather than knowledge; and

. "structural uncertainty," inherent in the phenomena being studied.

Knowledge of the ecological and social systems, or the system and structural parameters, will be incomplete for a long while. In addition these systems are undergoing continuous changes as a result of human activities' impact on the environment.

The different types of uncertainty, and the shifting social and technological framework, illustrate the need for the development of a strategic set of science and technology development tools to keep them relevant to decision making.

Efficiency in resources use is an important facet of sustainability. Environmental capacity -- the resources and the capacity of the environment to absorb and recover -- is limited and may

already have exceeded its limits. Three factors determine the future demand (D) on the environment by human activities, viz.

$$D = M \times W \times B$$

where W is average wealth per capita

B is population level

M is the "metabolism" or the socio-cultural claim on the environment per unit of wealth.

This approach, formulated by J.G. Speth ("Can the world be saved?" *Ecological Economics,* vol.1, 1878) gives a first order indication of the technological challenge in providing society with the technical means (embedded in culture and social structure) to meet its needs within the boundaries of environmental capacity. This first order figure, emerging from the above equation, gives an idea of the amount of increase in the "metabolic" efficiency required. This would depend on:

. assumptions with respect to the future development of population and wealth;

. assumptions with respect to the global distribution of eco-capacity across the world; and

. the specific socio-cultural and environmental factors under consideration.

According to Leo Jansen ("Towards a sustainable future enroute with technology," *The Transformation to a Sustainable Future)*, the inevitable conclusion is that in the "industrial North" -- even in case of conservative and moderate scenarios and assumptions -- the efficiencies of production with respect to the claim on the environment, the environmental efficiency factors, should increase by 5 to 50 (with an average of, say 20) in relation to the levels of 1990. To meet this challenge a fundamental shift in technological availability is necessary.

Future directions of marine scientific research

According to Gunnar Kullenberg (Kullenberg and Augustine Ayala-Castanares, "Regional cooperation in marine sciences, *Ocean Governance: Sustainable development of the seas,* Proceedings of Pacem in Maribus XIX, Tokyo: United Nations University Press, 1995) the coming into force of he 1982 United Nations Convention on the Law of the Sea, through the establishment of the Exclusive Economic Zone of 200 nm, has stimulated coastal States to increase their understanding of maritime areas adjacent to their coasts through the application

of marine science and technology. There is need of marine science to gain knowledge of this national resource.

Long-term systematic research and observation programmes need to be organised according to a globally coordinated strategy to monitor the changes in the state of the marine and coastal environment and of ocean processes, and their interaction with atmospheric and terrestrial processes. The results of the research and observations have to be widely disseminated through easily accessible data bases. As already pointed out, the gap between developed and developing countries needs to be bridged and steps have to be taken to ensure the development of scientific capability, especially in developing countries.

The solution to global problems is through international and intergovernmental cooperation. Decisions are necessary for collective scientific effort at national, regional, and global levels, to understand global change of which the ocean is a major element. Through improved knowledge of the ocean and its resources, on local, regional, and global scales, States can strengthen their capabilities for socio-economic progress while contributing to the well-being and sustainable development of humankind as a whole.

It is necessary for Government to make a long-term commitment to fund the necessary research and associated interpretation of results for management use. Global studies are beyond the resources of any single national authority. There must be a willingness on the part of Governments and scientists to work together over a long period of time. Cooperation will include shared operation of technical facilities such as ships, satellites and new automated devices.

Observations from satellites will revolutionize marine measurements over the next 20 years. These should be available to all scientists working on global and regional studies. The existing mechanisms for coordination and cooperation, in particular IOC, have played a major role in this development. However, exchange mechanisms are under-funded and in some countries they no longer operate.

What kinds of marine research are needed for sustained development? What are the needs of third-word countries in this regard? How can industrialised nations, the scientific community, and funding agencies cope with these needs? Where should the money come from and where should it go? Major restructuring of approaches to partnership and cooperation in the fields of marine science and services is needed if the problems are to be adequately addressed.

According to Kullenberg, the following major directions should be pursued to meet the challenges and optimise opportunities:

. Global climate research programmes and the associated large-scale oceanographic experiments to observe and understand air-sea interaction, the impact of the ocean on climate, and the impact of changing climate on the ocean;

. research and monitoring of marine pollution to measure and assess the effects of human activity, notably those resulting in degradation and contamination, especially in the coastal interface zones;

. study of the marine environment as a whole -- both coastal and open-ocean -- its physical and biological parameters and processes, with emphasis upon its role as a residence for living resources, its geological and geophysical properties, including nonliving resources in shallow and deep-ocean areas, and the interfaces between the ocean, its floor, and the atmosphere;

. accelerated development of ocean services, including observing and monitoring data exchange and product producing systems.

It should be noted that different countries have differing needs and opportunities in the fields of marine science and that the state of marine science development in a particular country may not reflect its overall stage of development. In some instances, developing countries have well established marine science capabilities. In most cases, spending is very limited and funding for research is largely directed to the investigation of immediate, resource-related problems. little is invested, either nationally or internationally, on strengthening the capabilities of these countries in addressing more broadly based research problems. Regional cooperation is a mechanism to help solve some of these problems, and to assist in the establishment of partnerships.

An important aspect of future directions in marine science must encompass the integration of open-ocean research programmes with those on shelf seas and in the coastal zones. Consideration of open-ocean processes in isolation or separately from the processes occurring in coastal zones will be counterproductive in the face of global climatic changes and sea-level rise. This needs to be taken into account in the regional cooperative programmes.

The challenge for marine science is therefore not only to address its current role but to redefine its objectives such that new goals and targets can be met expeditiously and

economically. This requires the establishment of linkages and support structures throughout the global scientific community; the provision of training opportunities and/or the necessary equipment to establish an indigenous capability in various aspects of marine science; the provision of ocean services such as hazard warning systems, observation and monitoring networks, baseline modelling and data systems with inbuilt data quality assurance and exchange mechanisms; and through such mechanisms contributing to the overall sustainable development goals and strategies of poorer nations.

Marine sciences and decision making

Better or more complete knowledge of coastal and ocean ecosystems is a prerequisite for more effective decision-making. There is a need, therefore, for a more complete understanding of how marine systems function, an ability to predict how the systems will respond to various activities, and some idea of the probable effectiveness of alternative management techniques.

There are many examples of severe social, environmental and economic consequences resulting from inappropriate development activities. Important development decisions are often made in the absence of this knowledge because it either does not exist or is not available to decision makers. This calls for better linkages between scientists and decision-makers.

A major issue arising from the increased importance of science and scientists for governance is this: If the importance of the scientist in public life, in economic development, in the conservation of the biosphere, in national and international security, is as crucial as it is, responsibility should imply a commensurate amount of influence and power: that is, the role of the scientist can no longer be purely advisory. That decision-making structure has become dysfunctional. Certainly there have been occasions when scientists have made constructive contributions to decision making -- e.g., through ICSU, in the elaboration of the Antarctic environmental protection regime -- and the emergence of "epistemic communities" is a sign of the times and indicates future directions. On the whole, however, the scientist, without decision-making power of his own, too often is simply bought off by the decision-maker. He produces the kind of science that is needed by the decision-maker to justify his political decisions. Or else, if the scientist cannot be bought off, his advice may be simply ignored.

In the world in which we are living, the scientist must be involved in decision-making, and this brings up two major issues.

Firstly, one should examine this development from the point of view of the scientist. How compatible are politics and science from his/her point of view?

Secondly, one should examine what institutional mechanisms are required to facilitate the participation of scientists in decision-making.

On the first question: do scientists want to take precious time from their work at the lab to devote it to political issues, attending meetings, listening to incomprehensible legal arguments, etc.? Efforts, even within scientific research institutions, to respond to the challenge of the new ethical and political responsibilities of the scientist, with the establishment of interdisciplinary "policy" programmes where social and natural scientists would work together on the new type of questions, have not always met with success.

In his last major piece of work, before his death, the great oceanographer and humanist Roger Revelle wrote:

> In spite of the breadth and depth of its interests, the Institution [he was writing about Scripps], in my opinion, is not broad enough. Though the staff deals with many problems of great concern to human beings, the human dimensions are pretty much left out of the picture. A greater effort in both research and teaching is needed on the way in which human beings and their institutions interact with the oceans and their living inhabitants. These interactions are the basis of government policies concerning the ocean realm at all levels of government, from the United Nations to local municipalities. To become a more useful institution to the larger society, Scripps needs to add to its staff some faculty and research staff members who will be able to develop a deeper understanding of how ocean policies can be formulated, implemented, and changed.

This, of course, applies to all scientific research institutions as it applies to Scripps.

Now, to the second question: How could government systems, whether local, national, or international, be organised so as to include scientists in the decision-making processes?

One of the most interesting models with regard to the participation of scientists in decision-making was the Yugoslav Constitution of 1958. The Yugoslav Parliament was a rotating multi-chamber system, a most original concept. There was one chamber, the political chamber, elected on a population basis, which was the fulcrum of the system. An affirmative vote of that chamber was required for any decision. But, besides this chamber, there was a Federal chamber of the Republics; there was a chamber of enterprises (managers and workers); there was a chamber of public health (representatives of hospitals, doctors, nurses), and there was a chamber of scientists. Decisions that required an input from the medical profession and/or affected the

public health system needed an affirmative vote by that chamber as well; any decision requiring a scientific input or affecting the science community of the country required an affirmative vote by the chamber of scientists together with that of the political chamber. The scientists were represented through their institutions, and it was within these institutions that the scientists defined their own views and reached their own decisions -- somewhat along the lines postulated by Roger Revelle.

The Yugoslav experiment was quite successful. If, in the end, it failed, it was for other reasons: certainly not the innovative decision-making formula of its Parliament.

The way scientists organise themselves and cooperate internationally is perhaps the most advanced example of global cooperation. This may be due to the very nature of science itself. One might say: all the building blocks are there. What is needed is a new architecture.

Ocean management and the effective implementation of the Law of the Sea Convention and of the UNCED decisions may provide the terrain on which to pioneer such an architecture.

Participation of scientists in decision-making in integrated coastal management is recommended by Agenda 21. Models are already on hand. They could be generalized. From the subnational and national level, they should be applied to the regional and global level.

Marine technology and sustainable society

Agenda 21, Chapter 34, has introduced the concept of "environmentally sound technologies." According to this concept, environmentally sound technologies

- protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they were substitutes;
- are "process and product technologies" in the context of pollution, i.e., they generate low or no waste, for the prevention of pollution. They also cover "end of the pipe" technologies for treatment of pollution after it has been generated;
- are not just individual technologies, but total systems which include know-how, procedures, goods and services, and equipment as well as organisational and managerial procedures.

Chapter 34 goes on to say that the above implies the consideration of human resource development, capacity building and the rendering of technologies compatible with nationally

determined socio-economic, cultural and environmental priorities. In other words, technology has social dimensions as well (Agenda 21, Chapter 34, para.s 34.1, 34.2, 34.3).

Environmentally sound technologies are to be embedded in different socio-cultural systems and structures. As Jansen points out, in the environmental debate attention is continuously focused on three elements:

. culture, which legitimates the nature and volume of social needs to be fulfilled as expressed in consumption patterns;

. structure, that is, the economic and institutional organisation of society;

. technology, which provides the technical means whereby needs are {to be} fulfilled.

(See Jansen, loc.cit, note 5).

These three elements, according to him, characterize the development of society in strong mutual interaction and interdependency and so changes in technology to improve environmental efficiency have always to take into consideration their interdependencies with "culture" and "structure."

The "acceptability" of environmentally efficient technical means is directly connected to economic conditions and to demands of society. In this context, it should be noted that these conditions and demands are not static but may change radically as a result of environmental developments and/or policies.

Against this background, it becomes clear that sustainable technology development cannot be realised without involving

. the culturally and structurally limiting conditions under which the technology must function, determining the possibility, the desirability and acceptability of an innovation;

. the cultural and structural requirements necessary for the effective functioning of the technology.

Conversely, however, technology alone will not be able to provide a solution to the problem of sustainability.

Communication strategy is necessary to diffuse such technologies. The mode of communication reflects the balance between culture, structure and technology. The

Technology that can meet the requirements of sustainable use must be subject to

. careful use, the operational challenge;

. improvement, the implementational challenge;

. renewal, the conceptual challenge through redefining actual technology development trajectories and defining new technology development trajectories.

Jansen thus develops a three-track strategy:

. operational by stopping leaks and streamlining the current production system, thereby leading to increases in environmental efficiencies by factors of 1.33 to 1.5 within a few years;

. implementational, i.e., the improvement and application of both "end" of process/product" and "process/product integrated" systems, leading to an increase in environmental efficiency by a factor of 1.5 to 4 in 20 years;

. renewal, i.e., development of new technological combinations and concepts by which increases of environmental efficiency should be by factors of 10 to 50 in a long-term (40-50 years) perspective (See Jansen, loc.cit.)

These three tracks are interconnected within a general framework, external conditions, but the internal drives and even qualities of the scientists and technologists have to be suited to the nature of each of the tracks. The general framework reflects the starting point, the goal and directions for technological search. The specific track-oriented items reflect the time scale, the level of certainties, and the specific object of development within the interdependence and interaction of culture-structure-technology.

It should be noted that this interlinkage differs from the conventional science, technology and capital interlinkage as the driving force that increases efficiency. The latter has generally been at the expense of the environment while the culture, etc., interlinkage specifically makes of environment a value premise.

Sustainable technology in an international context

Communication concerning technology development spans the globe. This has induced all countries which are highly developed in technology to "hope for progress" on the basis of more or less the same technology fields (see, e.g., G. Heaton, R. Repetto and R. Sobin, *Back to the Future*, Washington: World Resources Institute, 1992). Comparing lists of technologies considered critical by the US, Japan, and the EU, they found a very high degree of correspondence among them. The world-wide diffusion is a century-old phenomenon which has recently accelerated due to the activities of transnational corporations. This raises its own

dangers. Lack of diversity in technology development could lead to disastrous consequences only apparent with the passage of time.

The division of the world into "North" and "South" is a simplification of a complex international reality. Taking this complexity into account, the distribution of future eco-capacity and technology development require more region-specific responses, especially at the conceptual level of developing highly efficient and eco-friendly technologies. The increasingly unequal accessibility to environmental resources for development between "North" and "South" underlines the necessity of increasing environmental efficiency in the "North" to create room and accessibility to environmental production factors to develop the "South."

Nowadays high priority is given to transfer of environmental technology to the "South." In the UNIDO conference on Ecologically Sustainable Industrial Development (ESID), the option was to replace pollution control technology in the long run by prevention technology. The implicit assumption behind this approach is that (technological) development in the "South" should or will be a replica of the development in the "North." The question arises, however, whether the approach to development of sustainable technology should not be regionalized and diversified. In the "North" the development of technology is locked in the developed technological and institutional infrastructures which make fundamental shifts in technology trajectories extremely difficult. Should not the absence of such sustainability hostile infrastructures in the "South" be considered a boon in this regard?

Regional differentiation of technology development: a chance for sustainability

According to Jansen, a number of arguments plead for regional diversification. (loc.cit.)

First, the scales of specific environmental problems of technologies and of trade have to be taken into account. Various studies demonstrate the applicability of environmental scales from global down to local. This model can be extended to environmental production factors. Nevertheless there is no simple relationship between the scale of environmental threats and the scale of technological solutions. Compare, for instance, the global ozone layer problem originating from the use of CFCs in widespread small-scale technologies, and the continental SO_2 problem originating from concentrated power generation. In addition, a great deal of environmental resources and the damage in exploiting them is a result of use far from their

origin. The ecological capital thus being used forms the "shadow ecology" of the consuming economy. Frequently the use is in the "North" and the source in the "South"!

Second, there are differential requirements of technology. Whereas the "North" urgently needs a manifold improvement of the environmental efficiency of technology, the "South" is in urgent need of technology for development of sustainable technology. The difference results in seriously divergent perceptions of what sustainable technology should be.

Thirdly, the (physical) infrastructural situation is very different. In the industrialised countries centralised production, high energy intensity, and a massive and rigid infrastructure for transportation will for a long time restrictively determine the possibilities for technological renewal. In the low industrialised countries the lack of infrastructure opens the possibilities of less transportation-intensive production systems with more decentralised production, low-energy intensities and of a sophisticated scale of technology. UNIDO regards developing countries that are beginning the industrialisation process as having a unique opportunity to adopt cleaner and more efficient production systems.

Fourthly. there is a tremendous difference in availability and orientation of human resources such as labour, scientific infrastructure and organisational capacities, with the USA and Central Africa at the extreme ends of the scale.

The UNIDO conference, referred to earlier, concluded that the mutual interests between developed and developing countries provide a compelling argument for "North"-"South" cooperation and for supporting "South"-"South" cooperation. The opinion of Jansen is that this cooperation is very useful in the implementation and development of existing environmental technology. However, interesting opportunities to base sustainable technologies on the characteristic situation and chances of the "South" might become endangered if the technical cooperation with the "North" led to imitation and resulted in identical infrastructural drawbacks for future development.

MacNeill et al. (J. MacNeill, P. Winsemius and T. Yakushiji, *Beyond Interdependence*, New York: Oxford University Press, 1991) point to the phenomenon of reversing dependencies in this area. Economic interdependence increased the dependence of developing countries on industrialized countries. Ecological interdependence also increased dependence but in the reverse direction. The situation could be compared with that of the upper class in the late 19th century, when it found itself vulnerable to common contagious diseases the origin of which could be

taken away by waste management and the provision of drinking water for the sake of public health.

This reversal of interdependencies could result in a fundamental shift in geopolitical power relations between "North" and "South." New power relations could be a basis for interregional bargains when funding the development of technology for sustainability.

In summary, the status of development of sustainable technology in the international field can best be described as at the definition stage. At this stage, an international basis for development of sustainable technology can be laid by

. working out a philosophy of sustainable technology, based on regional differentiation;
. the creation, building and expanding of international networks to exchange views and experience;
. setting up international pilot projects to try out and compare different approaches on a regional basis.

Institutional restructuring

B. Bowonder and T. Miyake ("A model corporate innovation management: some recent high tech innovations in Japan, *R&D Management*. 22(4), 1992) have analysed innovative management in Japan. They come to the conclusion that the high innovativeness of Japanese firms is due to emphasis on the following parameters:

. applied research and development;
. incremental innovations;
. commercial rather than military application;
. process and production technology;
. component manufacture;
. development of predictable technologies;
. quality control;
. miniaturization
. standardization and mass volume production.

In contract, the US innovation system emphasized basic research, break-throughs, military application, new product design, system integration, software, less predictable technologies, new architectural design and customization. This model is general in nature, and

indicates the difference in orientation of innovation in the Japanese firms vis--a-vis the US firms, and the process of building up of competitive advantage in areas, such as random access memories and in liquid crystal displays over a short period of time.

They go on to point out, however, that the Japanese system is interlinked to Japanese folk arts and core values, thus emphasising the cultural dimension of Japanese management styles. But after considering all factors they propose a model which they hope to be more generally valid and applicable, starting with a scanning of world technological trends of organisational intelligence. This is followed by an assessment of the relevant technologies.

The next step is the acquiring of new technologies through technology transfer teams. Technology transfer teams are horizontal groups which facilitate functional integration. Next comes the assimilation of new technologies which, in turn, uses technology assimilation teams. This is followed by technology fusion and concurrent engineering, which leads to core competence building, new venture teams, separate business divisions, finally leading to new businesses. Organisational intelligence, horizontal information structures enhancing fusion; concurrent engineering and new business subsidiaries are some of the important elements of the Japanese innovation process.

On another plane, the International Ocean Institute in 1988 made a study on the modalities of establishing a regional centre for marine science and technology in the Mediterranean, or Meditech (See Krishan Saigal, "Regional centres for marine science and technology," in *Ocean Governance,* Tokyo, UNU Press, 1995). The study attempted to propose ways and means

- to implement Articles 276 and 277 of the Law of the Sea Convention;
- to build on the UNEP Regional Seas Programme;
- to take advantage of Europe's EUREKA/EUROMAR system and open it up to developing countries;
- thus to enable developing countries to acquire high technology;
- to introduce "technology-codevelopment" as the most cost-effective means of "technology transfer"; and
- to enhance "South-"South" and "North"-"South" cooperation.

These parameters were considered essential of the technology gap was to be bridged, sustainable development attained for the region as a whole, and unnecessary multiplication of institutions and duplication of efforts voided.

Pioneered in Europe, EUREKA and EUROMAR system, and the synergism it generated between private and public investments at the regional level, was successfully taken over by the Latin American countries in "Project Bolivar." The advantages for developing countries are obvious. Joint Research and Development has a built-in training factor. It is the most cost-effective way of technology transfer in this era of high technology. Technologies jointly developed, furthermore, will be "appropriate," i.e., they will not have to be "adapted" after having been "transferred."

The advantages for the developed countries should be equally obvious: A 50 percent reduction in the cost of R&D; spreading of risk; and creation of markets.

If the leaders of the developing countries have to be convinced of the fundamental importance of science and technology, the industrial and political leaders of the "North" must be convinced that it is in their own best interest to share the development of new high technologies with the "South."

This is mandatory in broad areas of high technology, if we are serious about "sustainable development" and the conservation of the global ecosystem. It should be stressed that the efforts in GATT to tighten intellectual property rights and the efforts of UNCED to facilitate technology "transfer" are diametrically opposed. If GATT wins, the environment loses. But it is unlikely that GATT will win in the long term.

The sharing of high technology is not only necessary, it is inevitable, due to the very nature of this technology, which is knowledge based, and knowledge will recognize no frontier: it is just a question of a little time. Technology today is "stolen" to the tune of billions of dollars a year; and if we do not design new ways of fair technology sharing -- probably best through new joint ways of financing joint research and development -- these figures are bound to rise: more and more will be "stolen."

The Mediterranean Centre posed some interesting design challenges since the countries of the Mediterranean vary from the most developed to those with very little developed marine technological capabilities.

Also the new emerging technologies placed heavy demands on skilled man-power. These skills relate not only to the science and technology fields but also to risk management, financial management in a complex, high-risk and uncertain field, and management of systems related to inter-organisational interfacing and networking. Validated modules for such appraisal systems not being available, skills in these fields cannot be acquired in a theoretical framework but require on-the-job experience which can best be provided in the environment prevailing in the developed "North." At the same time, the experience of dealing with high tech in the countries of the "South" would be more relevant to developing countries. Meditech thus had to establish its human resources development strategy in close cooperation and in harmony with both the "North" and the "South." it would also have to learn how to interface with the variegated cultural, scientific, and technological demands placed on it because of the need to interface simultaneously with developed and developing countries.

The study went on to develop a decentralised networking model. The structure and staffing of Meditech followed the expressed desire of the Mediterranean States for a lean and cost-effective centre. Meditech was conceived as an organisation that acted as a small hub of a network with operations as decentralised as possible. The objective of Meditech was not only to have joint development of technology through cooperation between the northern and southern States, but also to generate investments.

The Meditech model met the requirements for regional governance with the following parameters:

- political — by having universal participation including hinterland States;
- systemic: — by having a holistic, intersectoral and integrated approach;
- institutional: — by avoiding duplication and waste of resources;
- training: — by developing skills in the "South" to augment participatory capacity and underpin technological and economic development; and
- technological: — by having joint development of sustainable marine technology.

To sum up: The institutional models for sustainable technology development should probably have the following qualities:

- They should be based on a new value system, including a new concept of the continuity between humanity and nature;

- They should be geared for innovation, probably on the Japanese pattern as modified to fit into other cultures
- they should be imbedded in different cultures, preferably on the basis of regional organisation, decentralized, following the pattern of Meditech and the principle of technology co-development on which it is based;
- They should be structured in such a way as to mobilise investments by generating a synergism between public and private means at the regional level;
- they should emphasize human resources development and training as a major factor of technology development.

Analysis of the United Nations Convention on the Law of the Sea

INTRODUCTION

The purpose of this section is to:

- explain the legal framework in which all ocean activities are to be developed;
- emphasize the truly innovating parts of the Convention which may be fundamental for world order in the 21st century;
- examine in how far the dramatic changes that have been taking place in the world have already overtaken some parts of the Convention which will have to be updated;

While the Convention must be read as an integral whole, it consists nevertheless of distinct building blocks, some of which update and codify existing law as part of an ongoing process of updating and codifying (Parts I-X). Other building blocks are constitutive (Parts XI-XV): They embody new concepts, create new law, establish new institutions.

The most important innovations of the Convention are:

- The Exclusive Economic Zone
- The concept of "Sovereignty" in the context of the EEZ
- The Archipelagic State and the concept of Archipelagic waters
- The Common Heritage of Mankind
- The International Sea-bed Authority
- Comprehensive, global, international environmental law;
- A new regime for marine scientific research
- The most advanced framework for technological cooperation and development;
- The most comprehensive and binding system of peaceful settlement of disputes.
- Reservation for Peaceful Purposes

1. *The Exclusive Economic Zone*

The concept of the EEZ is a contribution of the developing countries. In Latin America it was first embodied in the Santiago Declaration of 1952 (a response to the Truman Declaration of 1945) and the Montevideo and Lima Declarations of 1970. The Latin American States called it "the patrimonial sea." In Africa, it was particularly Kenya that promoted the concept which, under the name of "Exclusive Economic Zone" was adopted first in Yaounde and then by the

Asian African Legal Consultative Committee in 1972.

The most important aspects of the EEZ concept are:

. It significantly increases the resource base of coastal States. For small island States, lacking land resources, this heralds a virtual revolution.

. It provides a *framework for management* for ocean space totalling almost 40 million square nautical miles and containing about 85 percent of all living and about 87 percent of all known and estimated hydrocarbon reserves. This management framework replaces the system of free-for-all laissez-faire that preceded, entailing resource depletion and pollution of the marine environment.

. It is a *multipurpose development zone*, covering all uses of ocean space and resources and taking into consideration the *interaction of uses* and the *interdependence of ocean problems*. It is this new concept that has given rise to the notion of *integrated coastal and ocean management*, with all its functional and institutional implications.

. It most effectively encourages scientific and technological development, since it is impossible for coastal States without scientific and technological capacity to enjoy the benefits which potentially have accrued to them with the acquisition of the EEZ. And there is a long way to go. As the U.N. Secretary-General's Report on the Law of the Sea (A/48/527, 1993) points out, with regard to the living resources,

> With respect to the distribution of world catch, there were widespread hopes that extended jurisdiction would lead to a significant redistribution of the seas's wealth in fisheries. In fact, although a small number of coastal States have reaped substantial benefits and a few distant water States have suffered large losses, such a great redistribution has not occurred. Over 80 percent of the total world catch is still taken by 20 main fishing nations. The major gains have accrued to the relatively few States whose zones of extended jurisdiction contain large or valuable resources, which they are either capable of exploiting themselves or which attract long-distance fleets.

The establishment of the EEZ also has generated some problems. On the whole, it has increased, rather than decreased, equality among States, giving more to the already well endowed richer States, and nothing to the poorest, among them, the land-locked States. It has created numerous boundary conflicts which have been costly to resolve; and, most important of all, it has become clear that not even the largest EEZ is a self-contained management unit, and

if resources and the environment are not managed beyond the 200 mile limit, they cannot be managed effectively within the zone either. The current negotiations on straddling and highly migratory fish stocks in the high seas make this amply clear. Perhaps the main lesson that we are gradually learning is that the drawing of boundaries in the ocean environment is not an effective means of solving problems. Gradually, the concept of "boundaries" may be overtaken by the more modern, dynamic, and management-oriented concept of joint development zones or joint management zones.

2. *Sovereignty*

This last statement is an appropriate bridge to a brief discussion of the evolution of the concept of sovereignty in the context of the EEZ.

Needless to say, the concept of sovereignty is much under discussion in the world situation as a whole. In the form we inherited it from the Westphalian Peace Treaty of 1648, it is not viable in a world of globalised production and financial systems and technological and environmental interdependence.

On the one hand, States are breaking up under the pressure of ethnic, linguistic or religious forces that may have remained dormant since the beginning of the age of nation States some three hundred years ago. On the other hand, States are entering new types of Unions and creating international if not supranational institutions, under the pressure of economic, environmental or technological forces and to solve problems which clearly transcend the boundaries of national jurisdiction and therefore cannot be managed by national institutions.

Often, these two trends are considered as puzzlingly contradictory. They are not. They are the two faces of the same coin. Sovereignty has an internal and an external face: the sovereignty of the ruler over the ruled, internally; the sovereignty of the State in relation to other States, externally, including the right to wage war against them. The internal face, historically, has been the more important one. Jean Bodin, in the 16th century, used internal sovereignty to defend the power of the French king over the rebellious feudal lords. Sovereignty was instrumental in the transition from feudalism to nationalism. It should be noted that it was a *unitary* concept. You had it or you did not have it. There was no in-between. The French Constitution of 1791 states:

Sovereignty is one, indivisible, unalienable and imprescriptible; it belongs to the Nation;

no group can attribute sovereignty to itself nor an any individual arrogate it to himself.

Democracy, internally, and the increasingly denser net of international treaties and conventions, externally, soon started to erode this unitary concept. Federalism proposed the theory of *shared sovereignty*. Léon Duguit, Hugo Krabbe, and Harold Laski, among others went further, advancing the theory of *pluralistic sovereignty*, shared by political economic, social and religious groups that may dominate governments at various times.

> But we must not think of federalism today merely in the old spacial terms. It applies not less to the government of the cotton industry, or of the civil service, than it does to the government of Kansas and Rhode Island, Indeed, the greatest lesson the student of government has to learn is the need for him to understand the significance for politics of industrial structures, and, above all, the structure of the trade-union movement. The main factor in political organization that we have to recover is the factor of consent, and here trade-union federalism has much to teach us...
>
> Harold Laski, *The Pluralistic State*, New Haven: Yale University Press, 1993

It is along the line of this evolution, from an absolutistic, unitary, and territorial concept to a pluralistic, participatory and functional one, that the United Nations Convention on the Law of the Sea occupies an advanced position, offering probably the most constructive approaches to the problems arising from the ongoing disintegration of the traditional concept of sovereignty in both its internal and external aspects. It is surprising that little reference to this phenomenon is found in the current literature about the Convention.

No doubt, there is some lip service paid to the traditional concept: the new legal order for the seas and oceans is to be established "with due regards for the sovereignty of all States" (Preamble). Article 2 declares that "the sovereignty of a coastal State, extends, beyond its land territory and internal waters...to an adjacent belt of sea, described as the territorial sea..." (Art. 2). The *sovereignty* of strait States (Art.34), archipelagic States (Art. 69) is equally stressed. It should be noted, however, that, more fundamentally, the Convention *limits, transforms, and transcends* the concept of sovereignty.

It *limits* sovereignty

. by making peaceful settlement of disputes mandatory and creating a comprehensive dispute settlement system, not as an optional protocol but as an integral part of the Convention binding for all parties;

. by subjecting "sovereign rights" over resources to the duty of conservation,

environmental protection, and, to some extent, even sharing.

. by imposing the *duty to cooperate* in matters concerning the environment, resource management, marine scientific research and technology development and transfer.

. by imposing *international taxation*, non only on resource exploitation in the international area but even in areas under national jurisdiction (continental shelf beyond 200 miles).

It *transforms* sovereignty

. by *disaggregating* the concept into a *bundle of rights* ranging from "sovereign rights" (Art.60) to "exclusive right" (Art. 81), "jurisdiction and control" (Art. 94), and "Jurisdiction" (Art. 79) which is shared. Sovereign rights and shared jurisdiction cohabit in the same space (the Exclusive Economic Zone, the continental shelf, the archipelagic waters) which adds a new dimension to Laski's "pluralistic sovereignty."

. by according equal, or almost equal, treatment to States and non-State entities. Reference is made, throughout, to "States and competent international organizations" -- again, an application of "pluralistic sovereignty"; non-State entities, companies ("juridical persons"), even individuals have a standing before the International Tribunal for the Law of the Sea (Sea-bed Disputes Chamber); non-State entities, like the European Union, are Parties to the Convention and subjects of international law.

It *transcends* the concept of sovereignty through the concept of the *Common Heritage of Mankind*: a concept of *non-sovereignty* and *non-ownership*. Article 137 states that

1. No State hall claim or exercise sovereignty or sovereign right over any part of the Area or it resources, nor hall any State or natural or juridical person appropriate any part thereof. No such claim or exercise of sovereignty or sovereign rights nor such appropriation shall be recognized.

2. All rights in the resource of the Area are vested in mankind as a whole on whose behalf the Authority shall act...

One might indeed go so far as to claim that this Article bestows Sovereign Rights to Mankind as a whole and makes it a subject of international law: the ultimate transcendence of the concept of the Sovereign State.

3. *Archipelagic States and Archipelagic waters*

The concept of the Archipelagic State and Archipelagic Waters is another contribution of the developing countries, particularly of the Pacific ocean countries. Even though it bestows somewhat all too generous advantages on the 16 States that have claimed archipelagic status, the concept is historically interesting and has global implications.

Nation-building was a difficult task for the newly independent oceanic States consisting of a multitude of islands separated by what was then High Seas, in which other States were free to move and act as they pleased with their fleets. To strengthen national unity, the oceanic States therefore looked at ocean space not as something external, separating island from island, but as an *integral part of their territory*. It was the unity of the State that gave to the waters their new status of *archipelagic waters*, common to all the islands.

One could think of the world at large as one single archipelagos, with the continents taking the place of the islands, the land-to-water ratio being 1 to 3. It is the growing unity and interdependence of this world of ours that gives to the waters, the world ocean that used to separate continents, a new status: that of the Common Heritage of Mankind. While this status has been recognized by international law thus far only to the sea-bed beyond the limits of national jurisdiction, future generations will have to extend it to ocean space as a whole, as proposed already in 1971 by the prophetic Arvid Pardo.

It is interesting to note, incidentally, that, ten years, five years, even three years ago, any speaker in a public forum who dared to refer to ocean space as the common heritage of mankind, was immediately called to order by some student of international law who was diligent to point out that the Convention applied this principle only to the seabed beyond national jurisdiction, not to ocean space as a whole. Today ocean space is generally described as common heritage of mankind -- even in official United Nations documents, although international law has not yet caught up with this evolution.

4. *The Common Heritage of Mankind*

Concepts akin to that of the Common Heritage of Mankind are known to almost all religions and some schools of philosophy of law. In international law, the concept of outer space as a "province of mankind" is a predecessor to the common heritage of mankind. It was, however, Arvid Pardo's merit to adapt the general idea to a very specific situation, to give it a legal and

economic content and to formulate it in terms of international law. He pointed out that, until now, there had been two ways of dealing with ocean space: the freedom of the high seas and national appropriation: the "national lake doctrine," i.e., to divide entire seas or oceans among coastal States. Neither approach, he contended, could cope with the problems of overfishing and pollution of the marine environment. Either one would lead inevitably to armed conflict. He suggested that a new principle was needed to deal with the problems eschewing the dangers both of uncontrollable freedom and national competition and appropriation. That was the principle of the common heritage of mankind. He defined it in precise terms, all of which found their way into Resolution 2749 (XXV) and then into various articles of the Law of the Sea Convention:

1. The Common Heritage of Mankind cannot be appropriated by any State or legal or physical person. It is nonproperty. The Roman-Law attribute of *ius utendi et abutendi* (the right of owners to use and abuse their property) does not apply.
2. In contrast to the situation generally prevailing with regard to "the commons," that is, lack of management entailing "the tragedy of the commons," the concept of the common heritage of mankind implies *management*, through an authority representing humankind as a whole.
3. This management must be based on three fundamental principles:
   - Benefit sharing, with particular consideration for the needs of developing countries;
   - Reservation for exclusively peaceful purposes;
   - Protection of the Environment and conservation for future generations.

Different interest groups have interpreted "benefit sharing" in different ways. In industrialised countries and their companies, a restrictive interpretation tended to prevail: benefit-sharing meant the payment of some royalties (as low as possible) but otherwise "business as usual" was to be left untouched. Developing countries gave a more comprehensive interpretation: to them benefit sharing was not restricted to financial benefits, but implied the sharing of managerial prerogatives and the sharing of technologies. This also implied the establishment of an Enterprise as the operational arm of the Authority, through which smaller and developing countries could participate in the management of the common heritage of mankind.

The principle of the reservation for exclusively peaceful purposes follows directly from the concept of benefitting humankind *as a whole*. For, if the common heritage were to be used

for purposes of warfare, it might benefit individual States, but certainly not humankind as a whole.

The principle of conservation for future generations equally flows from the concept of benefitting humankind as a whole. For humankind does not consist only of present generations but includes future generations as well. The care for future generations -- not to be used as a pretext for ignoring or rejecting the development needs of the present generations! -- implies resource conservation and the conservation of the environment within which the resources are to be exploited. It means harmonisation between short-term and long-term planning.

The concept of the Common Heritage of Mankind, thus defined, has a *development* dimension: It must be *developed* for the benefit of mankind as a whole; it has an *environment* dimension: Resources and environment must be conserved for future generations: and it has a *disarmament* dimension, in the principle of the reservation for exclusively peaceful purposes. The integration of *development* and *environment* dimensions make it the best available basis for "sustainable development," an otherwise dangerously underdefined principle, as we all know. The integration of *development, environment, and disarmament* dimensions make it the best available basis for *comprehensive security*, as developed first by Olof Palme, which, equally, has its military (disarmament), economic (development), and environmental components.

While there is already a broad consensus in today's world on *the philosophy of the common heritage*, much new thinking is still needed on *the economics of the common heritage*, which, based on the concept of non-ownership, will necessarily differ from, and transcend, both the free-market and centrally-planned economic theories of the past.

5. *The International Sea-bed Authority*

No matter what the present status and prospects of the sea-bed mining industry might be, the importance of the institution of the International Sea-bed Authority cannot be overrated.

- It is the first institutional embodiment of the principle of the common heritage of mankind.
- It pioneers a new type of international organisation which is itself economically productive and generates an international income;
- It introduces the principle of international taxation, not only on activities in the international area but even on activities in areas under national jurisdiction (the

continental margin beyond the 200 mile limit of the EEZ).

- It offers a framework for the genuine internationalisation of High Technologies, with the full participation of the developing countries; to fully utilize and develop this framework would not only enhance development, it would also be a confidence building measure of some magnitude, enhancing peace, security and disarmament: Technologies which are developed through international cooperation will not be developed under the auspices of ministries of defense for military purposes.
- It offers a framework, at the global level, for new forms of private/public international cooperation. More than a "code of conduct" for multinationals, which has remained on the drawing boards of the United Nations, it structures the private sector into the system and gives it legitimacy as a subject of international law (standing in the Dispute Settlement Chamber of the International Tribunal for the Law of the Sea).

This is not to say that Part XI of the Convention is perfect or that it could or should have been implemented fully on the day the Convention came into force on November 16 this year. As the most innovative part of the Convention, it posed more problems than any other part and, in many details, it reflects political compromise rather than managerial and economic realism. Analysis shows that the "Parallel System," creating both a licensing system for the private sector and a public international Enterprise, to compete with it in a "mixed economy,"is the most cost-ineffective system that could have been devised, causing problems relating to financial arrangements as well as technology transfer which have remained unresolved. The text, furthermore, is overburdened with details excogitated twenty years ago when really too little was known about the not yet existing sea-bed mining industry -- details which necessarily are already obsolete today. The too narrow focus on the manganese nodules in the international Area has been overtaken by the more recent discoveries of other mineral resources (sulfides and crusts) both in the international area and in areas under national jurisdiction. The whole picture is further complicated by he fact that commercial mining, expected to be practical when the Convention came into force, has been delayed, perhaps to the year 2010 or even 2020. This generates an "interim period," lasting from 1994 to the time when sea-bed mining becomes feasible. This will be dealt with in the Section 3, on Post-UNCLOS developments.

6. *Comprehensive International Environmental Law*

Part XII of the Convention contains the only existing, binding, enforceable, global, comprehensive environmental law. It covers pollution from all sources, whether oceanic, land-based, or atmospheric. It is of fundamental importance for Agenda 21. Chapter 17 of that agenda, dealing with the seas and oceans, is entirely based on this Convention, which provides the legal framework, the dispute settlement system, and the enforcement mechanisms for what would remain otherwise at the level of "soft law" and powerless recommendations.

It is clear, however, that Part XII must be read as a *framework* that must be complemented or filled by more specific agreements covering particular uses or particular regions of which there are already over a hundred today. Part XII relies heavily on IMO and UNEP initiated Conventions. But there is no other Convention, binding and enforceable, that covers *all uses and all regions*.

Chapter 17 of Agenda 21 is the link-pin between the UNCLOS and the UNCED processes. On the one hand, Chapter 17 depends on the legal framework of the Law of the Sea Convention. On the other, Chapter 17 is part of the Agenda as a whole which covers the global economic/environmental system as a whole and has already begun to impact on the restructuring of the United Nations system: adding a whole new Division and establishing the Commission for Sustainable Development. The linkage between the UNCLOS and UNCED processes facilitates the necessary extension of the UNCLOS process to the sea-land and sea-atmosphere interface. It explains the recent emphasis (even over-emphasis!) on "coastal management," including land- as well as sea-uses, and will lead to the inclusion of land-locked States in regional seas programmes, which is of particular importance for Africa. It also strengthens the role of the marine sector in the restructuring of the United Nations.

Until now, the opponents of the Law of the Sea Convention have attempted -- successfully in many cases -- to reduce the role of the Law of the Sea in the UNCED documents, as can be gleaned from the records of the UNCED Preparatory Conferences. Now that the Convention has come into force, this will be no longer possible. But a great deal of work and new thinking will be needed to maximize and institutionalize that role and see to it that the innovative concepts of the Convention find their way into the restructuring process.

7. *A New Regime for Marine Scientific Research*

Part XIII of the Convention, complemented by other Articles throughout the Convention, establishes a new regime for marine scientific research.

UNCLOS III was indeed fully aware of the fundamental importance of the marine sciences for the rational management of ocean space and its resources. Without marine biological research, fisheries and aquaculture could not be developed nor sustained; marine geology is an essential tool for the discovery and utilisation of offshore and deep-sea minerals; physical oceanography, including the study of ocean currents and waves and the interaction between water and atmosphere is essential for weather prediction, the understanding of climate change, the safety of navigation. All major uses of ocean space and resources depend today on marine scientific research.

It is indeed remarkable that out of the 320 Articles of the Convention, about 100, or almost one third, touch in one way or another on the marine sciences. In this regard, as in so many others, the Convention is a most modern, forward-looking document, more so than any national Constitution today. In view of the fundamental importance of science for modern industry, for peace and disarmament, for the conservation of the environment, for modern life *in toto*: its power for good or for evil, for destruction or the improvement of living, conditions, there has indeed been a great deal of discussion about the role of science in governance and the ethical and civic responsibilities of the scientist in our age. But this discussion is not yet reflected in the political structures of our time. The Law of the Sea Convention goes far in reflecting the importance of science in political decision-making.

The new regime for marine scientific research has some other extremely interesting features. One of the key words to describe it is "cooperation," and this cooperation is not just left to the good will of States: it is *mandatory*. The Convention establishes that States *shall* (not "should") cooperate. One scholar of international law, Christopher Pinto, goes so far as to consider the Convention as a source of a "new international law of cooperation."

Cooperation is favoured also institutionally: Research projects approved by competent international institutions -- in this case, the Intergovernmental Oceanographic Commission of UNESCO or the International Seabed Authority, are given a certain preference: Such projects do not need the explicit consent of the coastal State under whose jurisdiction the research is to be carried out, provided only that State is a member of the institution that approved the research

project and did not object at the time it was approved. This provision could be used to strengthen the internationalisation of research. One could envisage the competent international institutions developing into some sort of clearing houses guaranteeing the good faith of projects which then would not need the explicit consensus of individual coastal States, thus reducing bureaucratic red tape. The genuine internationalisation of marine scientific research, in which developing countries could participate as equal partners, would obviously benefit developing countries.

Another interesting feature is that marine scientific research is "reserved for peaceful purposes." We shall return to this at the end of this section. What is intended, in the context of scientific research, obviously is that military research or research for purposes of warfare does not enjoy the protection and promotion of the Convention. While this is logical, it will, in practice not be easy to implement. As the years of discussions in the Third Committee of UNCLOS III have amply clarified, practically any type of marine scientific research may have military as well as economic or scientific implications. To minimize the military implications of marine scientific research it is less meaningful to restrict research than it is to reduce the chances and the causes of warfare.

The new regime for marine scientific research established by the Convention is often called a "consent regime," because research in the now vast ocean spaces falling under national jurisdiction requires the "consent" of the coastal State under whose jurisdiction the research is to be carried out. Such consent is generally expected to be forthcoming, except in very few cases specified by the Convention.

On the whole, this system is beneficial to developing coastal States. They have the right to participate in the research and to share all results and samples and should maximize these opportunities for their own educational purposes. The consent regime potentially enhances cooperation between researcher State and coastal State in the selection of projects which should be of interest and use not only to the researcher State as in the past but also to the coastal State in question.

Since the 'Seventies, when this regime was designed, there have been many changes also in the field of marine scientific research. Remote sensing has made dramatic advances. It is becoming so accurate, with such a high resolution, that it can explore, directly or indirectly, almost anything that used to be explored by ships *in situ*. And it can explore far wider areas in

a far shorter time. Research from satellites is not subject to the regulations of the Law of the Sea Convention. The research thus carried out is "free." But it is reserved for the few and the rich. Thus the industrialised countries can, in many cases, circumvent the consent regime and the obligations it imposes on them. It is therefore advisable for coastal developing countries to maximize efforts at international cooperation and the internationalisation of research and minimize reliance on defensive measures and prohibitions in bilateral scientific relations.

8. *The most advanced framework for technological cooperation and development;*

The direct application of the marine sciences to the development of marine technology and the intensification and diversification of ocean industries is a dramatic spectacle. We may call it the penetration of the industrial revolution into the oceans -- with vast implications for the global economy, the environment, military strategy, national and international organisation. It is in this wider context that the marine sciences have assumed the fundamental importance they have today.

UNCLOS III was fully aware of this importance. The entire Part XIV of the Convention, supplemented by articles throughout the other parts of the document, is devoted to this subject. This part of the Convention should be read, furthermore, in conjunction with a resolution adopted by UNCLOS III together with the Convention (Annex VI, Final Act), calling on member States, both industrialised and developing, on the World Bank,the United Nations Development Programme, the United Nations Financing System for Science and Technology and other multilateral funding agencies, to augment and coordinate their operations for the provision of funds to developing countries for the preparation and implementation of major programmes of assistance in strengthening their marine science, technology and ocean services.

Technology development is to be carried out on three levels.

Of basic importance is the strengthening of national infrastructure, without which international cooperation remains illusory. If a State has no technologists, the importation of foreign high technology is sheer waste. Modern high technology cannot be "bought;" it must be "learned." Considering the amount of service, maintenance, training and upgrading involved, each "transfer of technology" today is a "joint venture," the donor and the recipient, the "producer" and the "consumer" working together as "prosumers," to use the expression coined by Alvin Toffler.

To strengthen the scientific/technological infrastructure in the less developed countries, two steps should be taken:

First of all the leadership in many countries should wean itself of the idea that science and technology are luxuries about which they might start thinking when the "basic problems" -- food, shelter, health and education -- have been resolved. Science and technology are not luxuries: in today's world they are the premises, the prerequisites for the solution of the "basic problems." It is enough to remember that about 85 percent of economic growth today does not depend on material inputs but on technological innovation based on research and development and scientific research. In many countries, a fundamental change of attitude towards science and technology is needed.

Secondly, in accordance with a recommendation by the Third World Academy of Science, every country should earmark a fairly high percentage of its educational budget to fundamental research, applied research, and research and development.

Only on such a basis can international cooperation be fruitful.

The second level of technology cooperation and development is the regional level. The Convention mandates the establishment of regional centres for the advancement of marine science and technology. While it describes some of the functions of these centres, it does not specify how they should be paid for, and at a time when existing international organisations are starved for funding, it is indeed difficult to imagine the financing of a whole slew of new organisations. The International Ocean Institute has undertaken a number of studies to look for answers to this problem. We analyzed the most advanced systems of technology cooperation and development and were particularly impressed by the systems developed in Europe such as EUREKA with its subproject EUROMAR, which have already been taken over and adapted to the needs of the Latin American countries, under the name of Project Bolivar. More than "Centres," in the sense of "brick and mortar" and new bureaucracies, these are "systems" -- new forms of cooperation between private and public sector and intergovernmental organisations which share in the funding of selected projects, reducing costs, spreading risks, and generating a synergism that has produced billions of dollars of investments in the short span of a few years.

The regional "centres" prescribed by the Convention should be conceived as such "systems" enhancing both South-South and North-South cooperation in joint technology development. They could be developed within the framework of regional seas programmes

whose functions and institutional structures will have to broadened and strengthened if they are to move forward from "Stockholm" to "Rio" and after and respond to the new challenges of integrating environment and development concerns.

The Government of Malta has taken up the proposal for the establishment of a Mediterranean Centre for Research and Development in Industrial Marine Technology, in the context of recent negotiations on the Revision of the Barcelona Convention. To this we shall return in Section 8. An analogous proposal is presently being discussed by the Indian Ocean States, and the Government of India has offered Madras as one of the sites for a Regional Centre (See Proceedings of Pacem in Maribus XXII, Madras, 1994).

The third level, finally, is the global level. The "competent international organisation" for technology development and cooperation is, in particular, UNIDO, whose capacity should be strengthened. With the coming into force of the Law of the Sea Convention, there will be a new instrument for technology cooperation and development: the International Sea-bed Authority. As pointed out under that heading above, sea-bed mining technologies involve practically each and all of the "High Technologies" known today, and the Enterprise, especially if conceived as a system of joint ventures, provides a splendid global framework for the internationalisation and joint development of these technologies.

9. *The most comprehensive and binding system of peaceful settlement of disputes.*

It is generally recognized that the dispute settlement system is one of the highest achievements of the Law of the Sea Convention. It is the most comprehensive, the most binding, yet flexible, system to which nations have ever agreed. It has been upheld as a new paradigm that should be adapted to other fields of international law, beyond the Law of he Sea, such as environmental law or the space law. In the context of restructuring the United Nations system, it might even be adapted to that system as a whole.

Perhaps the strongest feature of this design is that States which become Parties to the Convention, thereby *eo ipso* accept the obligation of binding peaceful settlement of disputes. What, in the Geneva Conventions of 1958 was an "optional protocol" has become a binding and integral part of the Convention, and this marks a big step forward in the development of international law.

States are free to choose the *method* of dispute settlement, and if they can settle them

politically through *negotiation* or *conciliation*, whether bilaterally or regionally, they have the right to do so. But if there is no such solution, then they are obliged to choose one of four possible fora: *Arbitration, the International Court of Justice* in the Hague, the newly established *International Tribunal for the Law of the Sea* in Hamburg, or -- and this is another interesting innovating feature -- "*Special Arbitration*" which, for the first time, brings the "competent international organisations," specifically identified only on this occasion as IMO, UNEP, IOC/UNESCO, and FAO, into the dispute settlement system (see Annex VIII of the Convention).

If the Parties cannot agree on the forum, then Arbitration is the method to fall back on.

Whatever forum is chosen, the judgment is final and binding.

Few are the exceptions exempting Parties from the obligations of peaceful dispute settlement, but they are important (see Article 298 of the Convention). They can be considered as "loop-holes" in the system, inevitable concessions to the concept of sovereignty as still perceived in the 'Seventies. There are, however, two encouraging developments. One is the innovative concept of "mandatory conciliation," in cases exempted from binding settlement. "Mandatory conciliation" (see Annex V) means that parties are bound to go through a conciliation process even if they are not obliged to accept the opinion of the conciliation forum. This procedure certainly exercises some degree of moral suasion and pressure. The second encouraging development is that precisely in the case of boundary delimitation, which is exempted from mandatory dispute settlement, States are in fact voluntarily resorting with increasing frequency to the ICJ for binding settlement.

As the concept of sovereignty is further evolving (see above, under this heading), it may be assumed that the "loop-holes" will eventually be closed.

The jurisdiction of the Convention's dispute settlement system is not limited to cases involving the interpretation and application of this Convention

but equally to the interpretation or application of any international agreement related to the purposes of this Convention which is submitted to it in accordance with the agreement. Thus this most advanced system might be further developed and applied to disputes, e.g., arising from the interpretation and application of the Treaty Banning Nuclear Weapons and Other Weapons from the Seabed or of any of the environmental agreements, many if not most of which involve the oceans.

10. *Reservation for Peaceful Purposes*

The concept of Reservation for Peaceful purposes was dealt with in connection with the *Common Heritage of Mankind* as well as with *Marine Scientific Research.* The Convention goes further than that: Also the High Seas are reserved for peaceful purposes -- a significant step forward from the 1958 High Seas Conventions. While not clearly spelled out -- Article 301, defining, in most general terms, the "peaceful uses of the sea," cannot be considered an adequate definition of "reservation for peaceful purposes," or "reservation for exclusively peaceful purposes (*Common Heritage of mankind)* -- the concept may be seminal. If elaborated, during the coming decades, by the International Law Commission and/or other institutions of international jurisprudence, It may be developed as the legal basis for the denuclearization of regional seas or the world ocean as a whole, or the designation of seas and oceans as zones of peace, enhancing both military and environmental security. It may provide the legal basis for regional naval cooperation for peaceful purposes (monitoring and surveillance, disaster relief, search and rescue, abatement of piracy and drug traffic, etc.). It may also encourage the establishment of a naval component of the United Nations peace-keeping system.

This brief survey of ten of the highlights of the Convention may give an idea of the unique importance of this document which truly marks the beginning of a genuinely new international and national order.

Post-UNCLOS developments

INTRODUCTION

The purpose of this section is

- To give an overview of the activities of the Preparatory Commission for the International Seabed Authority and for the International Tribunal for the Law of the Sea (1983-1994)
- To discuss the difficulties that have arisen due to (a) changes in the world situation; (b) the reluctance of industrialized States to ratify the Convention;
- to explain the Secretary-General's Consultations on the Law of the Sea (1991-1993)
- To analyze options for maximizing participation in the Convention regime and implementing it most efficiently.

Post-UNCLOS III developments in the Law of the Sea are diversified. State practice is having its influence, and new concepts, like "Large Eco-systems," or "the Presential Sea (*mar presencial*), which do not coincide with the Exclusive Economic Zone, will have to be dealt with. On the whole, these developments are covered in the annual reports by the Secretary-General of the United Nations to the General Assembly. Post-UNCED activities, which will be covered in the next Chapter, will undoubtedly contribute to the progressive development of the Law of the Sea. In this Section we will concentrate on developments in the Preparatory Commission for the International Sea-bed and for the International Tribunal for the Law of the Sea ("the Prepcom") and on the Secretary-General's Consultations.

1. *The Prepcom*

Together with the Convention, UNCLOS III adopted a number of Resolutions. Of particular operational importance are

- Resolution I, which establishes the Preparatory Commission for the International Sea-bed Authority and for the International Tribunal for the Law of the Sea;
- Resolution II, Governing Preparatory Investments in Pioneer Activities relating to Polymetallic Nodules.

The Prepcom had the normal tasks of preparing draft rules and recommendations for the principal organs of the Authority, headquarters agreements for the Authority and the Tribunal, and undertaking economic and environmental studies in relation to nodule mining and its consequences.

Resolution II covered the modalities of registering the "Pioneer Investors," the selection of "Reserved Areas" for the future Enterprise, and the implementation of the obligations of the Pioneer Investors in accordance with the Convention, including the establishment of a training programme to assist developing countries to acquire the expertise needed to participate effectively in the organs of the Authority --in particular the Enterprise.

The executing agency for the implementation of Resolution II was to be the Prepcom which was to

> exercise the powers and functions assigned to it by Resolution II of the Third United Nations Conference on the Law of the Sea relating to preparatory investment.

It is this linkage between the two Resolutions that has given to the Prepcom regime a unique character. Over a decade the Prepcom has in fact developed into a kind of pre-Authority exercising all the functions that could be exercised by the Authority as long as ocean mining was not practicable.

The Prepcom, presided over during the whole decade by Africa, organised its work through the establishment of four Special Commissions. It met yearly (11 sessions, usually divided into two periods).

The first Special Commission dealt with the problems of land-based producers of the metals that were to be produced from the seabed and whose economies would be seriously affected by this production. The Convention itself prescribes a number of measures which should alleviate these problems (initial production control; commodity agreements; compensation), but already before the end of UNCLOS III it was generally recognized that these measures might not be adequate and the problems needed further study.

The tasks of the first Special Commission became more and more difficult as commercial sea-bed mining receded into the future and it became increasingly difficult to predict its economic and financial consequences. Complications arise from the fact that the Convention practically limits its consideration to the consequences of nodule mining in the international Area. If, however, other minerals are mined, in areas under national as well as international

jurisdiction, how can the effects of nodule mining in the international Area on the export earnings of land-based producers be isolated and quantified? Losses in export earnings may be due to other causes: mining of other resources; mining in areas under national jurisdiction; or the collapse of commodity prices due to structural causes (New Materials, recycling, etc.). Adding to this the resistance of the industrialised States to making any commitments with regard to compensation, the Special Commission could not do much more than recommend further studies. Under the leadership of Ambassador Hasjim Djalal of Indonesia it prepared, in spite of all the difficulties, a long list of recommendations which will undoubtedly be useful to the Authority when sea-bed mining will be about to begin.

The second Special Commission, under the Chairmanship of Dr, Lennox Ballah of Trinidad & Tobago, was to deal with the Enterprise, its rules and regulations, its staffing, its modes of operation, its costs. It was to ensure that the Enterprise should be able "to carry out activities in the Area in such a manner as to keep pace with States and other entities" and see to it that every Registered Pioneer Investor should "provide training at all levels for personnel designated by the Commission" and "undertake before the entry into force of the Convention, to perform the obligations prescribed in the Convention relating to transfer of technology." These tasks were no less onerous than those of the First Special Commission, considering the uncertainties about the beginning of the nodule mining industry. The final results, nevertheless, were as positive as they could be under the circumstances. Its greatest success undoubtedly was the agreement on a training programme, already being implemented, by the Pioneer Investors in cooperation with the Prepcom, and to be continued by the Authority after the entry into force of the Convention. The programme is modest: Each Pioneer Investor trained up to four scientists and technicians. None of them had a programme for managers and project planners. But the training programme, as adopted and implemented is a promising beginning that should be further developed and integrated with other training initiatives within the United Nations system and outside of it. Volunteers have indeed already come forward to widen and complement this training programme. The Federal Republic of Germany has offered an additional programme for scientists and technicians, and the International Ocean Institute is conducting an annual programme, in cooperation with two of the Pioneer Investors (India and China), for Managers and Project Planners.

Another achievement of the Second Special Commission is based on the recognition that

the best way to get the Enterprise off the ground was through joint ventures. A first joint venture was envisaged in the form of the joint exploration, by three of the Pioneer Investors, of a first mine site for the Enterprise. For the time being, however, this project has been shelved.

The Third Special Commission had the task of preparing a "Mining Code," i.e., basically, to make rules and regulations implementing and complementing Annex III of the Convention. The Chairmanship of this Special Commission was entrusted to the group of "Western Europe and Others," and exercised throughout by the Netherlands. The work was complicated (a) by the fact Annex III undoubtedly is overloaded with detail much of which is already obsolete today;(b) by the uncertainty about the beginning of commercial sea-ed mining; (c) by the growing intransigence of the industrialised countries and their insistence of leaving matters to "the market forces." Further complications set in when a small group of States were invited by the Secretary General to consider changes in Part XI which should make the Convention "universally acceptable." It became indeed difficult for the Third Special Commission to make rules and regulations, e.g., for Technology Transfer, if this whole issue was being reopened by the Secretary-General's consultations. The discussions became repetitive and remained without conclusions. The final report of the Third Special Commission nevertheless is extremely comprehensive and informative.

The tasks of the Fourth Special Commission, presided over by the group of Eastern European Socialist States, as long as it existed and, during the last stage, by Ukraine, in a way were the least difficult. In making rules and regulations for the International Tribunal for the Law of the Sea, the Special Commission could fall back, in many if not most cases, on the precedents of the International Court of Justice and the European Courts. An exception, without precedent, was the Sea-bed Disputes Chamber which required original inputs.

Rules and regulations for the other organs of the Authority (the Assembly, the Council and its Commissions; the Secretariat) were covered by the Plenary of the Prepcom, while the problems pertaining to the implementation of Resolution II were entrusted to the General Committee, which, like the Council of the Authority, consists of 36 members, elected on the basis of equitable regional representation. Under the leadership, first of Joseph Warioba of Tanzania and then of Ambassador José Luis Jesus of Cape Verde, the General Committee was extremely successful in fulfilling its difficult and unprecedented mandate.

The first, enormously complex task was to resolve the problems of overlapping claims

among Pioneer Investors and between Pioneer Investors and potential Pioneer Investors (the companies and their certifying States which were operating outside the framework of the Convention). Negotiations lasted for several years and were positively concluded in the Arusha Agreement of 1987 which led to the registration, first of India, then of France, Japan and the Soviet Union, followed by China and the Interocean Metal Joint Organization (Bulgaria Czechoslovakia, Poland, Russia, Cuba), and, most recently, Korea.

The second, almost equally complex task was to articulate the agreement on the obligations of the Pioneer Investors. The outcome was two documents establishing the training programme and the programme for the joint exploration of the first mine site of the Enterprise, including a programme (not yet spelled out in any detail) for research and development and the upgrading of technology.

The Secretary-General's Consultations

This initiative was taken by the then Undersecretary-General Satya Nandan in 1990. The purpose was to create a forum where a dialogue on the Convention could be initiated between a restricted number of States and the United States which had boycotted the sessions of the Prepcom. The "dialogue" was to be structured around a number of "hard-core issues," introduced by the U.K.

. Cost to States Parties
. The Enterprise
. Decision-making, particularly in the Council
. The Review Conference
. Transfer of Technology
. Production Policy
. Compensation (" Economic Assistance")
. Financial terms (Finance Committee)

Basically this list of "core issues" covers the concerns expressed by the United States in its "Green Book" of 1981. To change Part XI with regard to this list of issues means essentially to rewrite the text. This is in fact what was done.

Negotiations moved through various phases.

The first phase was a round of negotiations on most of the issues listed, by a very restricted group of States, under the leadership of Undersecretary-General Satya Nandan. It

remained basically without results.

Upon the election of a new Secretary-General in 1992, the office of Mr. Nandan was abolished, and the Legal Counsel of the United Nations, then Mr. Carl-August Fleischhauer, was made responsible for Law of the Sea matters. He opened the Consultations to all States and considerably widened the scope of the discussions. It should be noted, however, that in spite of the new openness and liberalisation of the process, developing countries remained woefully under-represented -- due perhaps, to the fact that the Consultations were "informal" and many developing countries lacked the financial means to send an expert delegation to informal meetings; or, perhaps, it was a consequence of the waning interest in law of the sea matters, when many developing countries were overwhelmed by crises of various kinds and simply had other priorities.

Also this second phase remained inconclusive.

The third phase began with the introduction of the so-called "Boat Paper," a document floated anonymously during the August, 1993, round of the Consultations, which amounts to a rewriting of Part XI in the sense of the Green Book.

Due to the absence of any organised opposition, this document moved through several revisions, as though through a vacuum, until, on July 28, 1994, it was adopted by the General Assembly, in the form of a Resolution embodying an "Implementation Agreement" ("the Agreement"}. It was opened for signature the following day.

The vote was 121 in favour, 17 abstentions, while over 50 States did not participate in the vote.

The "Agreement" creates a number of problems, both procedural and substantive.

On the procedural side, it is indeed without precedent, that a Convention, duly adopted by a Conference of Plenipotentiaries and signed and ratified by the required number of States, is amended by a Resolution of the General Assembly. It is without precedent that forty States, which are not Parties to the Convention but express their consent to be bound by it on the basis of the changes proposed by the "Agreement," can in fact change that Convention. What is even more alarming is that the changes were to come into force *on a provisional basis* the day the Convention came into force (November 16, 1994) *for those States who have approved these changes*. In other words, when the Convention came into force, we had not one sea-bed mining regime as provided by the Convention, but two: a Treaty regime, which entered into force for

those States which had ratified the Convention and not participated in the vote adopting the Agreement; and a mini-treaty regime for those who did not agree to the treaty regime. Thirdly, there were a number of States (including Brazil and Mexico as well as the Scandinavian countries) which did sign the "Agreement" but do not recognize its provisional application. The mini-treaty regime will remain provisionally in force until November 16, 1998, but relations between the Parties to the Convention and the Parties to the Agreement are to be governed by the Convention, according to the Vienna Conventions on the Law of Treaties. The Agreement does not explain what is to happen if, at that date, the mini-treaty regime has not attained the required 40 ratifications.

The procedure prescribed by the Implementation Agreement is in contravention of the Vienna Convention on the Law of Treaties.

In his final statement, announcing the adoption of the Implementation Agreement and its opening for Signature, the new Legal Counsel of the United Nations, Mr. Hans Corell of Sweden, himself admitted that "the procedure may not live up to the highest standards of international law." he described it as a political arrangement that "may open the way" to universal acceptance and ratification.

Has it opened that way? It was doubtful from the beginning of these ill-fated Consultations, that it would. If "universal acceptance" was to mean "acceptance by the United States," it should have been noted that U.S. participation in the Consultations was, at all times, at a low bureaucratic level, and there was no guarantee whatsoever that this Convention, no matter how manipulated or changed, could be approved by two-thirds of the U.S. Senate. The Clinton Administration, while not hostile to the Convention as the Reagon/Bush Administrations had been, had other priorities. Now, after the November, 1994, elections and the sweeping victory of the Republicans, approval by the Senate is totally out of question, and this will undoubtedly put a damper on "universal acceptance." Germany has acceded to the (amended) Convention, but the other industrialised countries, as well as the Pioneer Investors, will not be in any great hurry. And why should they? In accordance with the Agreement, they may become "Provisional Members" of a "provisional regime" of "provisional universality." They have time until November 1998 to decide their final position.

It is likely that the United Nations Convention on the Law of the Sea will be in a limbo of legal ambiguity for the next four years.

On the substantive side, the Agreement establishes a Sea-bed Authority which is dysfunctional. The voting system gives a veto to three industrialised States over any decision of the Council; the Enterprise has been abolished, for all practical purposes, and the real power of the institution resides in a Finance Committee, dominated by the industrialised States, which may suspend any session of the institution's governing bodies on account of "cost-efficiency."

All this is remote from the spirit of the Common Heritage.

The International Sea-bed Authority was officially established in Jamaica on November 16, 1994, with a two-day, ceremonial meeting of its Assembly. Two working sessions of the Assembly are scheduled for 1995. The first working session, in March, 1995, ended without results. It was curious to note that this Authority is dominated by States who are not, and may never be, Parties to the Convention.

The establishment of the International Tribunal for the Law of the Sea, in Hamburg, has been postponed to 1996. it is hoped that, by then the number of ratifications of the Convention will have increased sufficiently to enable States Parties to elect a slate of Judges representing all regions and legal systems.

The practical task before us now is not to lament the past to try to regain lost momentum, to encourage ratifications, and to see what can be done to make this new International Seabed Authority still as useful as possible to the international community and especially to developing countries, and to revive the flagging spirit of the Common Heritage.

The first point that should be noted is that what has been changed once most certainly can be changed again. If the Authority turns out to be dysfunctional at the time seabed mining becomes economically and environmentally sustainable, its structure can and will have to be changed again, in spite of the fact that the "Agreement" abolishes the Review Conference mandated by the Convention. The review and revision will have to take account of economic, scientific/technological, and political circumstances which we cannot predict today. Hopefully, future changes will conform more closely to the highest standards of international law than the "Implementation Agreement" adopted in July, 1994.

Secondly, if our purpose is, on the one hand, to enhance international cooperation in seabed mining activities and, on the other, to make the Authority useful to the international community -- and if it were not to be useful, it should not have been established! -- we should stress two principles built into the "Agreement," in their interaction: *the principle of cost-*

effectiveness, and the evolutionary approach: That is, we will have to evolve an agenda that will contribute to making the Authority economically self-reliant. This would mean, to widen the scope of the activities as they are circumscribed initially.

The emergence of the pioneer regime, in response to the requirements of Resolution II, has been a most positive development. The Training Programme, adopted by the Preparatory Commission, as well as the joint programme for the exploration of a first mine site for the Enterprise, are exemplary: something to continue and build on. Here is the needed framework for international cooperation in deep-sea mining activities and the development of human resources. This framework should not be left to rest and rust, but should be utilized immediately.

The Training Programme should be expanded and coordinated with the other training efforts in the U.N. system. Seabed mining technologies are High Tech: and here is a mechanism to train persons from developing countries in High Technology which cannot be transferred in the traditional sense, but must be "learned." *Here, again, the implementation of the Convention could make a significant contribution to the Agenda for Development.*

Training, however, costs money. It does not bring an income to the Seabed Authority which, instead, should be generated as soon as possible, considering that one year after the entry into force of the "Agreement" -- if that is to happen -- any financial support through the regular budget of the United Nations would cease.

The Pioneer Investors, jointly, have skills and technology and services which could be utilized immediately: e.g., for the exploration for offshore oil and minerals in the economic zones and on the continental shelves of developing coastal States. This might be done in the context of the Agenda for Development. It could be paid for by low-interest or interest-free loans from Regional Development Banks or through equity participation agreements between the Pioneer joint venture and coastal States. It would be a useful, productive and remunerative activity and could be started immediately.

Another useful, productive, if not immediately remunerative, activity would be the implementation of a joint programme for long-term (at least five years) environmental impact assessment of ocean mining activities, in conjunction with the testing and upgrading of technology. The Federal Republic of Germany has proposed such a programme in two studies submitted to the Prepcom. Joint environmentally-oriented projects, between Germany, the U.S.,

France, Russia, and Japan are indeed already in course -- outside of the Authority and independent from it. If this sort of cost-effective joint undertaking were done under the auspices of the Authority, and open to the participation of developing countries, it would contribute to the evolutionary approach to Authority functions and structures.

Another joint activity of the Pioneer Investors and open to others might be the mapping of the deep ocean floor, of which less than 3 percent have been mapped thus far.

Joint R&D in deep-sea technologies, not limited to the manganese nodules which would make the Authority obsolete, but including -- why not -- R&D on OTEC or on the thermophile bacteria which inhabit the volcanic spreading centres and form the basis for unearthly chemo-synthesis based life discovered in recent years. These bacteria are already being recovered and cloned and are the basis of an industry that generates profits of some $800 million a year which is expected to increase to billions during the coming decades. These bacteria, too, belong to the Common Heritage of Mankind, and joint development of the required biotechnologies would benefit developing countries and international cooperation in general.

The Authority's Council should encourage, and help to negotiate, joint undertakings in these and similar areas. It would enhance the evolutionary approach as well as the cost-effectiveness prescribed by he "Agreement."

The only way of testing the Authority as established under the "Agreement" and of finding out where improvements will be needed is to *use* it: On projects here and now: to have it sitting there, and waiting, "monitoring," until commercial seabed mining becomes practical -- ten, twenty years from now, would be a colossal waste. It would leave ocean mining development completely in the hands of States and their companies, outside the framework of the Authority. It would be difficult to imagine how the Authority could effectively take over at the time mining becomes commercial, once all the preparatory work and investment would have been done under national auspices.

The task of rehabilitating the mutilated International Seabed Authority now will not be easy to fulfil. For the sake of the future it should be attempted nevertheless.