

Symposium on the International Regime of the Sea-Bed

SPONSORED BY THE ACCADEMIA NAZIONALE DEI LINCEI
AND
ORGANIZED BY THE ISTITUTO AFFARI INTERNAZIONALI

Proceedings

WITH A FOREWORD BY
BENIAMINO SEGRE
President of the Accademia Nazionale dei Lincei

EDITED BY
JERZY SZTUCKI
Scientific Secretary of the Symposium



ROME
ACCADEMIA NAZIONALE DEI LINCEI
1970

SYMPOSIUM
ON THE INTERNATIONAL REGIME
OF THE SEA-BED

Rome, June 30 - July 5, 1969

UNDER THE HIGH PATRONAGE
OF THE PRESIDENT OF THE ITALIAN REPUBLIC
GIUSEPPE SARAGAT

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PREFAZIONE

I mari e gli oceani hanno costituito da epoca immemorabile una linfa vitale per l'umanità, col suscitare ardimenti ed avventure, stimolare ed agevolare commerci e quindi anche scambi di idee, promuovere molteplici attività come quelle collegate con la pesca e con la navigazione, ispirare poeti e scrittori. L'uomo ha pure da tempo iniziato l'esplorazione dello zoccolo subacqueo circondante isole e continenti, nel quale è penetrato con strumenti scientifici, attrezzature per lo sfruttamento economico, armi offensive e difensive.

Oltre tale zoccolo, si stende tuttavia un immenso fondo marino, a profondità non ancora raggiungibili, il quale non risulta oggi proprietà di nessuno, e neppure è sottoposto alla sovranità di qualche stato nè ad alcuna legge internazionale. È però inevitabile che la curiosità scientifica, l'attrazione delle ricchezze enormi ivi esistenti anche se difficilmente raggiungibili, la tentazione di servirsi di quelle inesplorate regioni per scopi militari, abbiano a spingere presto l'uomo verso la conquista degli abissi oceanici.

Come procederà questa conquista? Sarà compiuta a vantaggio di tutti, o dei più forti, o dei più fortunati? Accrescerà le probabilità di pace o di guerra? Quali pericoli di contaminazione e distruzione della natura accompagneranno lo sfruttamento delle nuove ricchezze e come si potrebbe ovviare ad essi?

Queste tormentose domande hanno formato oggetto di meditazione e di studio da parte di cultori di numerose discipline in differenti paesi. Metteva quindi conto di istituire un raffronto ed un approfondito dibattito tra tali studiosi, allo scopo di giungere a delineare uno schema preliminare riguar-

dante il regime internazionale che sarebbe opportuno stabilire per il fondo dei mari, nell'interesse dell'umanità, della scienza, della pace.

L'Accademia Nazionale dei Lincei, riconoscendo l'importanza umanitaria e scientifica dell'iniziativa è stata lieta di accordare i propri auspici al Simposio sul Regime internazionale del fondo dei mari, promosso dall'Istituto Affari Internazionali e da essa ospitato a Palazzo Corsini dal 30 giugno al 5 luglio 1969. L'Accademia è ora convinta di fare cosa assai utile accogliendo fra le proprie pubblicazioni gli studi ad alto livello presentati in tale occasione, mettendo così a disposizione di un vasto pubblico un materiale estremamente interessante, che riuscirà di certo prezioso a chiunque vorrà ancora occuparsi delle suaccennate questioni.

BENIAMINO SEGRE
Presidente
dell'Accademia Nazionale dei Lincei

PREFACE

From time immemorial the seas and the oceans have constituted a vital lymph for mankind; they have led man to adventures and feats of daring, they have stimulated and opened up the way for trade and hence also exchanges of ideas, they have prompted a multiplicity of activities, such as those connected with fishing and navigation, and they have provided inspiration for poets and writers. Recently, man has also begun to explore the underwater shelf surrounding islands and continents, where he has penetrated with scientific instruments, equipment for economic exploitation and offensive and defensive weapons.

Beyond that shelf, however, there stretches an immense sea-bottom, extending to depths that cannot yet be reached, which belongs to no-one and is neither under the sovereignty of any state nor covered by any international law. However, inevitably, scientific curiosity, the attraction of the enormous wealth existing there, even if it can only be reached with difficulty, and the temptation to make use of those unexplored regions for military purposes will soon drive man to the conquest of the ocean abysses.

How will this conquest proceed? Will it be carried out to the advantage of all, or of the strongest, or of the most fortunate? Will it increase the probability of peace or of war? What dangers of contamination and destruction of nature will accompany the exploitation of the new wealth, and how can they be avoided?

These tormenting questions have formed the subject of meditation and study by experts of numerous disciplines in

different countries. It was therefore worthwhile arranging that these experts should meet and thoroughly discuss and debate the whole subject, with the object of outlining a preliminary scheme regarding the international regime that should be established for the sea-bed, in the interests of mankind, of science and of peace.

The Accademia Nazionale dei Lincei, recognising the humanitarian and scientific importance of the initiative, has been pleased to accord its patronage to the Symposium on the International Regime of the Sea-bed, promoted by the Istituto Affari Internazionali and held in the Palazzo Corsini from June 30th to July 5th 1969. The Academy has no doubts about the extremely useful purpose that will be served by the inclusion, among its own publications, of the scholarly studies presented on that occasion, thus placing at the disposal of a wide public a highly interesting corpus of material, which will certainly prove valuable to anyone wishing to pursue further the above-mentioned questions.

BENIAMINO SEGRE
*President of the
Accademia Nazionale dei Lincei*

FOREWORD

The Istituto Affari Internazionali, Rome, is proud to have been promoter and organizer of this Symposium. However, it would not have been able to accomplish this task without the help of the Accademia Nazionale dei Lincei, the Italian Foreign Ministry, the Fondazione Adriano Olivetti, the Fondazione G. Agnelli, the Johnson Foundation and the American Academy of Arts and Sciences, which supported us with the necessary financial means and to which are due the most heartfelt thanks of the Institute and of all those taking part in the Symposium.

All rapporteurs and debaters have contributed to the success of the Symposium, but among them I must mention here, in particular, Prof. Louis B. Sohn, Prof. Roger Revelle, Mr. Clark M. Eichelberger and Prof. Gaetano Arangio Ruiz, who have also helped me in its preparation by giving their time and imaginative assistance.

To coordinate the flow of papers, to see to their publication, to ponder over the records of the debates, and to edit this book was a task both complex and full of responsibilities. It has been very fortunate that Dr. Jerzy Sztucki, who had been obliged to leave his country and his activity in the Polish Institute of International Affairs, was able to assume the role of scientific secretary of the Symposium. To him the warmest thanks for those long months of dedicated work in our Institute.

ALTIERO SPINELLI
Director
Istituto Affari Internazionali

INTRODUCTORY REMARKS

The Symposium assembled 51 participants from 22 countries of all parts of the world, representing various disciplines. Twenty-five papers were presented by the rapporteurs, who sent us their respective works in English.

The Symposium proceeded partly in plenary meetings and partly in Working Groups. One item of the programme of the Symposium (The Configuration of the Ocean Floor and its Subsoil; Geopolitical Implications) was discussed at the opening plenary meeting, presided over by Prof. E. Amaldi (Italy). The remaining items were discussed in three Working Groups under the chairmanship of Prof. H. Eek (Sweden), Dr. A. Yankov (Bulgaria), and Prof. F. Münch (Fed. Rep. of Germany) respectively. Prof. L. J. Bouchez (Netherlands), Dr. N. Tirtaamidjaja (Indonesia), and Prof. D. P. O'Connell (Australia) served as rapporteurs of the respective Working Groups.

Each Working Group was to discuss all items of the programme, on the basis of the papers presented to the Symposium. Accordingly the Working Groups were so composed as to ensure, to a maximum possible extent, an equitable representation of both the geopolitical regions and the scientific disciplines. It was expected, however, that various aspects of the problem would receive different degrees of attention in each of the Working Groups, and that in each Working Group different questions would be raised by individual participants. Each Working Group held 5 meetings.

Reports of the Working Groups were presented to and commented upon at two plenary meetings, presided over by Prof. S. Oda (Japan) and Prof. J. Andrassy (Yugoslavia).

respectively. On this basis a draft final summary of the discussion was prepared by myself. Following discussion in the Steering Committee of the Symposium, this draft was presented to and discussed at the closing plenary meeting under the presidency of Mr. Altiero Spinelli, Director of the Istituto Affari Internazionali, together with the statement of conclusions prepared by the Steering Committee itself.

The papers presented at the Symposium constitute the main part of the present volume. The record of 54 hours of discussion had to be abridged, owing to space limitations. The volume contains, therefore, only a summary reflecting the general course of the discussion, and the general outline of the ideas presented and the views exchanged. For readers' convenience the statements in this summary are not presented in the order they were delivered but have been arranged topically under sub-headings — roughly the same for all the Working Groups. Whenever necessary, statements have been segmented so as to fit the respective sub-headings. Participants were not asked to authorise the summaries of their statements, and, consequently, no references to names have been made.

At least one explanation regarding the contents of discussion should be given here. Various terms were used during the discussion to describe areas of the sea-bed, such as "continental shelf", "sea-bed within the limits of national jurisdiction", "sea-bed beyond the limits of national jurisdiction", "deep sea bed", etc. Usually speakers used them only for the purpose of a general identification of the areas referred to — without necessarily attributing any specific definition to this or that term. Thus, the interchangeable use of various terms in this volume should be understood accordingly, unless it comes directly to discussing terminology or definition.

Reports of the Working Groups are not reproduced in the present volume. Some parts of these reports are quoted in the summary of discussion in order to amplify it, and they should be read as the integral part of the discussion. Reports of the Working Groups were not intended for approval either by the plenary meetings or by the Groups themselves; they served only as working drafts to facilitate the preparation of the Final Report. Similarly, the draft final report has been omitted.

As a consequence, the summary of discussion in principle does not include material of the last three plenary meetings devoted mostly to the comments on tests. Some statements made during these meetings, however, touched upon the substance of the matters, and such statements were placed under the appropriate sub-heading in the summary of discussion of the respective Working Group.

The volume closes with the bibliography which I prepared for the Symposium, with the list of the participants and with a detailed index.

The task of being scientific secretary of the Symposium and, subsequently, of editing this volume was entrusted to me by the Director of the Istituto Affari Internazionali, Mr. Altiero Spinelli, whom I here have to thank for the opportunity he offered me to take part in this intellectual enterprise.

JERZY SZTUCKI
Scientific Secretary of the Symposium

PART I

THE CONFIGURATION
OF THE OCEAN FLOOR AND ITS SUBSOIL:
GEOPOLITICAL IMPLICATIONS

THE CONFIGURATION
OF THE OCEAN FLOOR AND ITS SUBSOIL;
GEOPOLITICAL IMPLICATIONS

BY

Dr. ANDRÉ J. GUILCHER

*Professor of Oceanography, Institute of Geography,
University of Paris*

Introduction

The period extending after the Second World War has been characterized by a tremendous growth in the knowledge of the sea floor. This increase was obtained in many ways. The number of oceanographical ships rose considerably, especially in the USA and the USSR which stand now well before the others for the bulk of information gathered in oceanographical research, but also in many other western countries. The techniques of investigation have been and are still continuously improved. Besides the classic echosounding devices, various other apparatus penetrate more or less deeply beneath the ocean floor where they make seismic refraction and reflection measurements, or extend the data laterally as the Asdic. Observations bear also on the gravity and on the magnetic field over the oceans, and on the heat flow through the ocean floor, giving indications on the nature of the deep-seated rocks. Among these techniques, the continuous reflection profiling deserves a special attention since it provides graphic records showing sub-bottom reflectors and allowing interpretations of the subsoil structure and stratification. At the same time, more and more dredgings, corings and drillings continue to bring information on the nature, age and history of the surface sediments and solid rocks and can check a part of the geophysical investigations. The first geophysical data were mostly gathered on the continental shelves of the United States and Western Europe, but they are being progressively extended over many other

shelves as around South America and Africa, and over all parts of the deep sea floor in the Atlantic, Pacific and Indian Oceans and in the Mediterranean, the Carribean and the Arctic Seas. This worldwide extension of the knowledge of the ocean floor — although much remains to be done for this knowledge to be accurate in its all parts — results in an increasing interest of mankind in the resources which lie under sea, and in an examination of what could be done to precise or improve the international regime of this area.

The ocean floor can be divided into the following parts: the continental margin, the abyssal plains and hills, the mid-oceanic ridge, the other ridges, the trenches, and the seamounts. These parts will be successively considered here.

I. *The Continental Margin*

The continental margin is a submarine apron which runs around the continents and includes the shelf, or shallow platform, the slope beginning at the outer edge of the shelf, and the rise or lower slope down to the deep sea floor. Formerly the shelf surface was considered separately, but since the geophysical investigations allow a knowledge of the internal nature of the continental margin as a whole, it is worthwhile to consider it in its three dimensions. However, some preliminary data about the width and depth of the shelf, slope and rise may be useful.

Width and depth of the shelf, slope and rise. These three units cover approximately 23 per cent of the ocean floor. The width of the shelf differs considerably in various regions: as a rule, it is widest in areas where the emerged relief is low, as off northwestern Europe, eastern North America, southeastern South America, and northwestern Australia; it is narrowest in front of subaerial mountains, as off western North and South America. Its outer edge, or shelf break, is conventionally taken at 100 fathoms, or 200 metres: in fact, the average depth of the shelf break is 72 fathoms, or 130 metres, but it varies considerably and reaches exceptionally 300 fathoms, or 550 metres, or even more, around Antarctica. An unusual feature is the existence of two superposed shelves instead of one, as

off the southern United States where the so-called Blake Plateau lies at 800-1000 metres and is separated from the shelf proper by an upper slope and from the deep sea floor by a lower, very steep slope. Other such marginal "plateaus" have been discovered off Brazil and in West Africa off Angola and Ivory Coasts. If the conventional limit of 200 metres is accepted, the shelf covers 7.6 per cent of the ocean floor. The continental slope is much steeper than the shelf, since it extends approximately between 200 and 2,000 m, and covers only 8.5 per cent of the ocean floor. The extent of the continental rise is not precisely defined, because this unit slopes more and more gently and often merges smoothly into abyssal plains without any sharp contrast. The rise can extend down to 3,000 or 4,000 metres; but some parts of the oceans lying at comparable depths, or higher, are included in other units as the Mid-Oceanic Ridge and the seamounts (see below).

Nature of the continental margin. In spite of its variability in detail, the continental margin shows some general features which were pointed out recently (1968) by Worzel in a general survey including data available for the North and South American, European and African margins (geophysical transverse profiles are not yet available for the Asian margins). Worzel's conclusions will be summarized here.

The continental margins include most generally a sediment cover on a crystalline basement. The thickness of the sediments, however, is extremely variable, from the thinnest veneer to coverings of up to five kilometres. It is frequent to find the crystalline basement in surface or in subsurface in the innermost part of the continental shelves, as around the Armonican Massif and in places off northwestern Australia (e.g. off the Kimberley block). As we proceed outward, however, the basement is commonly concealed beneath more or less consolidated sediments, which may range from the Palaeozoic to the Pleistocene. This situation is well exemplified by the eastern North American margin, although considerable local modifications occur from Newfoundland to Florida. Off Florida the geophysical data have been checked by drillings which prove that the Blake Plateau bears actually a sedimentary Tertiary cover; such drillings down to great depths outside the shelf remain, however, exceptional. Two situations can exist on the slope: in some

areas, the sedimentary beds outcrop in order, the younger ones being the upper, in other words the strata are cut by the slope which is steeper than them; in other areas, the younger sedimentary beds are draped over the older ones on the slope face towards the sea basin, a fact which means that the sedimentation has continued to go on after the slope came into existence with its general present features. It happens, however, that the basement outcrops in the slope face and not only on the shelf, as off Corsica and California, or is only covered on the slope by a very thin quantity of sediments. The thickness of sediments over the basement on the slope may vary considerably along a single section, as in the Bay of Biscay. A common observation is that a larger amount of sediment exists beneath the continental rise than beneath the continental shelf and slope: the basement is often more depressed beneath the rise than beneath the shelf and slope, and it frequently rises again further offshore. As a whole, the bulk of the sediments in the margin is thought to have come from the continents. In addition, many authors think that the sedimentary thickening over the rise results from supply by turbidity currents running down the slope. This idea derives from the texture of sediments collected in corings (repetition of size gradings from coarse at the base to fine at the top). Slumping and sliding on the slope may have acted in the same way.

The shelf surface. Above the consolidated or semi-consolidated sediments, the shelf bears usually an upper cover of unconsolidated deposits, although in several areas where the tidal currents are strong, as in the English Channel, the sediments are swept and the solid rock outcrops on the sea bed. These unconsolidated deposits fall into two groups: a part of them was laid down under subaerial conditions, when the shelf was exposed; another part is of margin origin. This duality derives from the fact that during the Pleistocene the sea level shifted up and down as a consequence of glaciations and deglaciations. It is quite sure that it was depressed down to more than 100 metres below present time level; but the lowest limit of the Pleistocene regressions remains debatable, some geologists suggesting more than 200 metres, while others do not think that the 120 metres contour was much exceeded. What is beyond doubt is that more than one great regression occurred.

Consequently, the shelf bears continental deposits, as glacial deposits in countries where icecaps extended over the shelf during the glaciations, such as northeastern North America; and periglacial deposits showing traces of frost splitting in places as off Brittany where cold conditions without glaciers prevailed during the same periods. Freshwater peats have been dredged from many places, e.g. the North Sea and off New England. Another evidence of emersion is found in the submarine topography of the shelf, which is for a large part of subaerial origin. Submarine valleys continue those carved into the continent; ridges made of hard rocks stand above the general level of the shelf as on dry land, etc. Some submarine valleys have been filled with fluviatile sediments but can be recognized by geophysical prospecting. These features show that the shelf and the adjacent part of the continents belong to the same units and were shaped by the same erosional factors.

Along with the continental deposits, however, the shelf bears also marine sediments. Some of them are reworked from material supplied from land, either during the Pleistocene or in recent time; others consist mostly of shells of decayed marine organisms and are consequently of organic or skeletal nature. The latter deposits have a high calcium carbonate content, and can be found under various latitudes and not only in tropical seas. Nevertheless, the tropical belt is especially rich in calcareous sediments because of the coral reefs which thrive in it. The marine sediments are frequently accumulated on the sea floor by submarine currents in places where the currents slacken, as around the British Isles and Brittany, forming often giant underwater ripples. Off river mouths or in quiet areas, recent mud deposits can reach tens of metres in thickness. In shelf areas of cold regions where marine or freshwater floating ice drifts during the summer, the sediments derive partly from the melting of the ice depositing on the sea floor the material kept in it. Old beaches which were formed when the sea level was lower have been reported from many areas, especially between 34 and 40 metres below present datum.

A general result of the recent investigations is that the present time marine sedimentation has left unaffected many wide areas on the shelf. Especially the outer shelf bears often in surface coarse sediments which are remnants of Pleistocene

deposits, even in places as at the Northeast of the Mississippi Delta where a cover of present time sediments would have been expected. These observations show that the supply of sediments was larger during the last Quaternary low sea level than it is now.

The unconsolidated sediments lying on the shelf are most interesting because they bring data for the history of the shelf during the Quaternary; as a rule, however, the strata deposited during the last million of years are very thin when compared with the previous shelf deposits.

Slope and rise. The main feature which has been so far discovered on the slope consists of steep-sided *canyons* which are cut deeply (hundreds of metres) into it and extend down to more than 3,000 metres sometimes. They vary from a few kilometres to hundreds of kilometres in length. Some of them encroach upon the platform, or reach the present coastline as the Capbreton Canyon in the Bay of Biscay, or even penetrate into estuaries as the Congo Canyon, but this last situation is most unfrequent, whereas the canyons themselves are widespread in the world, although not universal (no canyon is known off Atlantic Morocco for example). A part of the knowledge on the geological structure of the continental margin comes from the sections cut into it by canyons.

The origin of the submarine canyons remains still controversial, although they have been intensively investigated in several areas, especially off both coasts of the United States, in the western Mediterranean and in the Bay of Biscay. To summarize the discussions we can say that three main explanations have been proposed. One is that the canyons have been cut by turbidity currents or by some other submarine process; the second one is that they are former subaerial valleys which were drowned by subsidence or some flexuration lowering the continental margin down to great depths; the third one is that they result from faults normal to the general trend of the slope. It may be that all these explanations are right in some areas, in other words that all canyons have not the same origin. The hypothesis of turbidity currents can be valid in shelves made of little consolidated sediments, as eastern North America. In shelves consisting of hard rocks, as in western Corsica where granite forms the canyon walls, the canyons would be old subaerial valleys. Faults are likely to be responsible for wide,

flat-floored canyons bounded by parallel escarpments, as the trough occurring off the Ganges River.

Anyway, it is highly probable that turbidity currents and/or slumping and sliding occur in the canyons and prevent them being filled by sedimentation. Sand falls have been observed by divers in the head of San Lucas Canyon, California. Thick accumulations exist at the lower end of a number of canyons (eastern and western North America, Congo, Ganges, Indus, etc) and are most probably fans built by successive mud flows or slumpings. The continental rise itself may result for a very large part of coalescences of turbidity current deposits or submarine slides. So far, however, the geologists have been unable to observe a big turbidity current in action: only small ones were reported by divers in bathyscaphs. The evidence favouring turbidity currents or slumping on the slope and rise is derived from experiments; from submarine cable breaks, especially at the South of Newfoundland and off the Algerian coast; and principally from continuous seismic profiling records, which show frequent contorted structures on the continental slope and rise, for example in the Bay of Biscay, in the Bering Sea, and in many other areas. Whatever their exact origin may be, these structures exist certainly in slope sediments and are a very important characteristic of this part of the sea floor. They strongly suggest that the strata are not deposited by a simple "rain" of particles in suspension in the water, but have been reworked by processes acting on the sloping bottom or in the shallow subsoil.

Main products of economic interest in the continental margin.

The continental shelves have long been essential for fisheries, because their shallowness has resulted in large populations of fishes in many areas and is most suitable for trawlers. Over-fishing, however, has considerably impoverished many shelf areas, especially those surrounding western Europe and bordering north-western Africa, and this impoverishment has led to an extension of trawling to hitherto unspoiled areas, lying off countries sparsely populated or where the fishing techniques were not yet advanced.

The exploitation of mineral resources of the continental margin has been, in a first mining stage, restricted to superficial deposits a few fathoms deep, as the shelly or calcareous algal

sediments dredged around Brittany to improve the agriculture, the oyster shells mined in San Francisco Bay for the manufacture of cement, other calcareous deposits dredged in Texas, etc. It is now being extended farther offshore and deeper, but such a utilization of the internal resources of the shelves is still found only in comparatively small areas as the Gulf of Mexico, the Persian Gulf, California, the North Sea; the prospection is going on quickly in many other places. The main economic interest in this respect lies in oil and natural gas resources. Exploration has proved to be very successful in the above-mentioned areas, where production is in progress. Some geologists have suggested that favourable oil structures could occur in areas where the young sedimentary beds are draped over the older ones on the slope face (see above), so that the oil and gas which could have been formed on the rise would have been able to migrate upward to the subsoil of the shelf, where they could be worked by drilling. On the contrary, the presence of submarine canyons cutting across the slope may have been unfavourable since the oil may have found there a gap to escape. In any case the continental margin as a whole is thought to include enormous oil reserves when it comprises sedimentary beds, as it does usually more or less. It is only when made exclusively of crystalline rocks that it cannot be an oil and gas reservoir.

Even in places where the shelf consists of a crystalline basement, dissected by valleys which were subsequently filled by sediments during the Quaternary low sea level, it is possible that this sparse alluvium fill proves to be useful for mining. In Indonesia, tin placers are already being worked offshore, and around Brittany several inland valleys have been found to contain tin ore in workable quantities, so that it may be that alluvial tin exists also under water. Gold placers in river channels probably extend under the sea floor off Alaska; and dredging has been started off Southwest Africa in order to mine outer extension of the diamond placers existing inland in the Orange River. Other shelf deposits useful to mankind are phosphorites which occur as nodules on the shelf off Southern California and on the Agulhas Bank off South Africa. In California, a preliminary evaluation has concluded that only 10 per cent of these deposits would be economic to mine, but this amount

would mean a reserve of 200 years at the rate of 500,000 tons per year.

Drilling and mining for economic use have not yet started on the slope and the rise and are restricted to the shelf; but drilling for prospecting has already been extended to the slope and can lead in the near future to mining also in that site, which could be later as productive as the shelf. These questions will be developed in another report of this symposium.

Geopolitical implications. Presently, the continental shelf is a unit of the ocean floor which is no more open to all nations for free exploitation. The reasons of this situation are obvious: vicinity of the continents, which led the adjacent countries to introduce claims over it; shallowness of the shelf, which allows utilizations more difficult to conceive in deeper areas. But, even on the shelf, the tradition of freedom of circulation at sea acts in an opposite direction.

Since several items in this symposium are especially devoted to these problems, it will be sufficient to recall here in a few words the general status of the law. A distinction must be made between fisheries and exploitation of the resources of the sea-bed and its subsoil.

So far as fisheries are concerned, the States may reserve the accessibility to their citizens within the territorial waters, which have been traditionally 3 nautical miles wide around most countries for a very long time. There has been recently, however, a tendency to extend more the territorial waters, which are now 12 miles wide around most countries. Some South American countries have even claimed for exclusive rights as far as 200 miles offshore without any consideration of depth, and these claims have not been seriously thwarted.

Concerning the other natural resources of the sea bed, a law of the sea has been defined for the continental shelf in the Geneva Convention of April 1958. This convention defines curiously enough the continental shelf as the area extending down to 200 metres, "or, beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources of the said areas". Within these limits, each country is allowed to work the resources of the sea bed with some restrictions concerning navigation, scientific research, etc., or to give concessions for it. The boundaries between States

on the shelf are clearly defined by "median lines", and this principle has received a little later a detailed application in the North Sea. The Convention on the Continental shelf has been ratified or acceded to by 30 states including the USA, the URSS, the United Kingdom, the socialist republics of Europe, etc., but a large part of the nations, even belonging to the United Nations, have not yet ratified it. It might happen that countries would want to extend their boundaries down to the deep-sea floor outside the continental margin, arguing of the fact that the development of the technique has permitted to utilize the natural resources lying there. Nevertheless, it must be remembered that the 1958 convention has been made for the continental shelf, and that an extension of the "shelf" to the deep sea ocean would be a nonsense, a negation of the definitions of the units forming the ocean floor. In this respect, it is interesting to mention that a recent sentence for the International Court of The Hague, on February 20, 1969, tends to restrict the interpretation of "continental shelf" and seems to exclude from it the abyssal floor. This sentence deserves certainly much attention.

2. *Abyssal Plains and Hills*

Extension and physiography. Abyssal plains and hills are a unit extending approximately between 3,000 and 6,000 metres, although these limits may be regionally exceeded upward and downward. They occupy oceanic basins. The plains are flat-bottomed and their slope is less than 1:1,000. They alternate with hills where the topography is gently undulated, the height of the hills ranging from a few fathoms to a few hundred feet. Isolated hills also rise in the abyssal plains. These features are located between the base of the continental rise and the midoceanic ridge, or other ridges as the Walvis Ridge in the South Atlantic. Examples of abyssal plains are the Madeira-Cape Verde Plain off Northwest Africa, the Alaskan Plain in the Gulf of Alaska, the India and Ceylon abyssal plains in the northern Indian Ocean. Wide abyssal plains exist also in adjacent seas as the Mediterranean Sea, the Gulf of Mexico and the North Polar Sea. Two neighbouring abyssal plains

may be separated by a sill, but others communicate by gaps which interconnect them. Off Spain, the Biscay and Iberia Plains are thus connected by Theta Gap. Abyssal hills, on the other hand, are common in the Pacific, and on both sides of the Mid-Atlantic Ridge. Examples of isolated hills may be found in the Sigsbee Knolls in the middle of the abyssal plain of the Gulf of Mexico.

A feature associated with the abyssal plains is the *midocean canyons* and *deep-sea channels*. These elongated depressions resembling big river beds are much flatter than the canyons cutting through the continental slope. They do not exceed some tens of metres in relative depth, but may extend for more than 2,000 kilometres in length. They are commonly bordered by levees on both sides. Typical examples are the Cascadia Channel off Washington State, northeast Pacific, and the Mid-Ocean Canyon running roughly North-South in the North Atlantic between the Mid-Atlantic Ridge and northeastern North America. The Mid-Ocean Canyon system seems to include many tributaries. Other deepsea leveed channels are reported from the Indian Ocean, the equatorial Atlantic, etc.

Sediments. The abyssal plains are covered by a general mantle of sediments, which explains their flatness. The isolated hills rising in the plains are thought to be preexisting heights which have not yet been buried under the sedimentary cover. According to most marine geologists, the abyssal plain sediments belong to two great groups.

a. The first group consists of *turbidites*, that is, sediments laid down by turbidity currents (Heezen). This interpretation is supported by their detailed structure (graded bedding) which is known by corings as on the continental rise. Turbidites are located in parts of the abyssal plains which can receive turbidity currents originated on the continental slopes and rises. Many authors think that turbidity currents can spread for hundreds of miles at least off the base of the continental rise. The Iberia Plain would thus be fed from the Biscay slope and rise through the Biscay Plain across the Theta Gap (see above). The deep-sea channels are considered to be feeders through which the currents have brought the sediments along the bottom, the lateral levees being depositional features on both sides as in the case of subaerial rivers. This interpretation

has been developed for example for the Gulf of Alaska (Hamilton), where the geophysical prospecting shows that the thickness of recent turbidites decreases with the distance from the sources of sediments, from 680 metres to 145 metres. The nearby Aleutian Abyssal Plain has now been cut from supply by the formation of the Aleutian Trench, so that no more turbidites settle in it since the middle of the Tertiary. The India and Ceylon abyssal plains are also fed by turbidites supplied by the Indus and Ganges deep-sea cones. It must be said, however, that the turbidite interpretation is not universally accepted, but only widespread, especially in America.

b. The second group consists of *pelagic sediments*, which are thought to settle under quiet conditions. These sediments do not show any graded bedding and are found in plains not accessible to turbidity currents, owing to the sea-floor topography. Pelagic sediments replace also turbidites in various places on abyssal hills and on rises occurring between the deeper parts of the plains. They are more frequent in the Pacific than in the Atlantic. These sediments, which do not show abrupt changes in lithology, may consist either of organic particles, as the Globigerina ooze (calcareous) and the Diatom ooze (siliceous), or mainly or wholly of mineral particles, as the red clay, which have been freely and slowly deposited on the bottom. The distribution of organic calcareous and mineral sediments in the deep-sea deposits is a matter of depth: calcareous ooze does not accumulate deeper than 4,000-4,400 metres, and is replaced lower by the red clay, probably because the lime is dissolved at great depths, so that the Globigerina shells which have not reached the bottom at higher levels cannot subsist. This boundary in deep-sea sedimentation is called the compensation depth. It has probably fluctuated in the course of time with the bottom temperature of the ocean, and was lower during the Tertiary.

c. A third group of deep-sea sediments has been recently proposed by Le Pichon under the name of *homogenous sediments*. They are fine sediments as the pelagics, not disturbed by turbidity currents, and are likely to have been deposited in the western parts of the oceans, where the content in suspended matter in the deep water seems higher than elsewhere, as a consequence of the intensification of circulation in the western boun-

dary currents. The homogenous sediments are thicker than the pelagic sediments.

In addition, the deep-sea sediments include enormous masses of *manganese nodules*, which seem more frequent in the Pacific than in the Atlantic, Indian and Southern Oceans, although they are not rare at all in the latter. The tonnage of manganese nodules in the Pacific Ocean alone has been estimated by Mero at 1,650 billions of metric tons, 900 of which lying in the central region, 350 in the eastern region, and 400 in the western region. The median size is 3 centimetres, but some nodules exceed 100 kg. The nuclei of the nodules may be any hard object, as shark teeth, otolites, cetacean bones, boulders of rock outcrops, etc. The classic type of accretion occurs as concentrically-shaped concretions, but manganese may also be found as grains, coating on solid rock, slabs, fillings of debris, impregnations of porous materials. Manganese is mostly associated with the red clay, but it may also occur among Globigerina oozes. The percentage of manganese grains in some samples of red clays may be as high as 5 per cent, and higher percentages are certainly possible. Nodules, grains and slabs include principally manganese and iron, but also opale, goethite, rutile, barite, nickel, cobalt, copper, etc. Several possible sources of manganese have been suggested: submarine volcanic eruptions, submarine springs, alteration of igneous outcrops on the ocean floor.

The surface of the sediments, as observed on underwater photographs, is often disturbed by burrowing organisms (mounds, holes, tracks), or affected by small waves or ripples, even when the deposits include manganese nodules, in which case the nodules tend to concentrate in the troughs of the waves. These scour marks indicate the presence of currents.

Rates of sediment accretion. Estimations of accretion rate in the deep sea have been proposed by many geologists. It is sure that the rates vary considerably according to type of sediment, place, and time. The rate of accretion in calcareous ooze is certainly much higher than in the red clay, and this difference results evidently from the fact that the red clay is a residual deposit from which calcareous particles have been excluded by dissolution. An average rate of 1 cm per 1,000 years has been proposed for the calcareous oozes, and 1 mm per 1,000

years for the red clay. The growth of the manganese nodules could be 1 mm per 1,000 years, but much less than this in many places (3 mm per 100,000 years has been proposed for the Southern Ocean). All these figures concern pelagic sediments. They must be much greater in turbidites and probably also in homogenous sediments. Anyway, the sediment accretion on abyssal plains and hills as a whole is much slower than on the continental margin, because the supply is reduced by the increasing distance from the continents. The sedimentary thickness in this unit of the ocean floor is generally of the order of hundreds of metres, not of thousands as frequently in the continental margin. In the South Atlantic for instance, Le Pichon gives the following figures: 200 to 300 metres at the base of the Walvis Ridge (homogenous sediments), 1,000 metres at the base of the Rio Grande Ridge (*idem*), more than 600 metres on both sides of the northern part of the Rio Grande Ridge (turbidites). In abyssal hills regions of the North Tropical Atlantic, Tertiary or even Cretaceous sediments have been reached in cores at a few metres beneath the ocean floor. It has been observed several times on geophysical records, especially in the Pacific, that the sedimentary thickness is systematically larger in depressions than on surrounding hills. The higher depositional rate in depressions is likely to come from smudging on hill slopes, which lead to a smoothing of the surface topography.

Crustal rocks beneath the sediments. The information on these rocks derives from the velocity of compressional waves in different layers, measured by the seismic refraction technique, since the velocity varies with the density of the rocks. Whereas in sediments the average velocity is less than 4 km/s, with differences related to more or less compaction, the underlying oceanic crust consists usually of two layers, the upper one having an average thickness of 1.7 km with a velocity of km/s, the lower one being approximately 4.9 km thick with a velocity of 6.7 km/s. They are respectively known as layer 2 and layer 3, layer 1 being the sediments, and layer 4 including the deeper mantle rocks with velocities averaging 8.1-8.2 km/s. The top of the layer 4 is the Mohorovicic discontinuity, which is much shallower under the oceans, lying at about 10-12 km below sealevel, than under the continental margin and the continents

themselves, where it falls at a depth of 30-40 km. The Mohorovicic discontinuity begins to deepen quickly as soon as the slope or even the rise is reached when coming from the ocean. This is a fundamental geophysical difference between oceans and continents. It shows that the continental margin is really a part of the continents. The crustal rocks of the layer 3 beneath the oceans are expected to have about the same composition as the gabbro, intermediate between acidic granite and ultrabasic dunite. The layer 3 is also called "oceanic layer".

Much has been said since Wegener in favour and against the hypothesis of the continental drift. This hypothesis implies that the abyssal plains and hills in the Atlantic are comparatively young since they would have been created progressively after the separation of America from Africa. This does not seem confirmed by the discovery of Tertiary and Cretaceous marine sediments in cores in these areas, as mentioned above.

Interest and geopolitical implications. The main economic interest in the sediments on abyssal plains and hills lies in their manganese nodules, which are, according to Muro, sufficient supplies of many metals for thousands of years at the present rate of world consumption, even if only 10 per cent of the nodules are economic to mine. The mining of surface sediments in the deep ocean floor has not yet begun, but it is technically possible since dredging at great depths for scientific purposes was carried out as early as the XIXth century. It remains to establish whether a technique competitive with the mining on dry land can be found. Drilling does not seem at first sight so promising as in the continental margin (but scientific drilling has been undertaken in order to try to reach the Moho discontinuity, and is also useful for improvements in the techniques of work in the deep sea in general).

Concerning the political side of the question, it remains to know precisely whether the right of property as defined by the 1958 convention for the continental shelf (see above) may be extended without any modification to the entire deep-sea floor. Until now it does not seem that any right of sovereignty has been claimed on abyssal plains and hills, so that this geomorphological unit is still a reserve available for mankind as a whole. If the 1958 convention on the "shelf" is applied literally, and if the 1969 restriction of the International Court

of The Hague (see above) is not taken into consideration, this would mean that a country owning a short stretch of coast along the ocean, as Togo and Gambia in West Africa, is allowed to demand the property of a section of the abyssal floor as far offshore as the middle of the Atlantic Ocean, while, on the contrary, countries such as Switzerland, Czechoslovakia, Hungary, Mali, Chad, Uganda, Paraguay, Bolivia, Belgium, The Netherlands, Germany, Sweden, Poland, Finland, lying inside the continents or bordering shallow adjacent seas, are definitively excluded from any deep sea property for mining.

3. *Mid-Oceanic Ridge*

Extension and physiography. The Mid-Oceanic Ridge is the longest and the broadest mountainous system in the world. It is an elevation covering approximately one third of the oceans. It was first discovered and described in the Atlantic Ocean, where it is known as Mid-Atlantic Ridge. It has now been recognised over 60,000 kilometres and runs across all the oceans. It occupies the axis of the Atlantic from North to South, whence it continues into the Southern Ocean around South Africa, and penetrates into the Indian Ocean as far North as the Gulf of Aden; another branch extends between Antarctica and Australia and in the South-East Pacific where it is called East Pacific Rise, and finally joins North America in California. From the North Atlantic the Mid-Oceanic Ridge enters the Norwegian Sea and the North Polar Sea, where it extends between Northeast Greenland and the Laptev shelf off the Lena Delta. The general elevation above the adjacent deep-sea floor is 1,000 to 3,000 metres, and the width ranges from 1,000 to more than 2,500 km. The Mid-Oceanic Ridge is generally submerged, but it bears a few islands as Ascension, Jan Mayen, Easter Island, and principally Iceland which is its largest area above sea-level. In addition, it has a considerable extension in the African continent from the Gulf of Aden southward into the Rift Valley province (Ethiopia, Kenya, Tanzania and adjacent countries). It may also be considered that it has two other continental extensions, the first one in the mountains of western North America, with which it coalesces, and the se-

cond one in the Verhoiansk Rift continuing into Siberia the Arctic section.

Heezen has stressed the fact that the Mid-Oceanic Ridge is accompanied in its axis by a narrow rift valley, which sinks in the highest part of the ridge. This is certainly true in most places in the Atlantic, and probable in the Indian Ocean. The eastern and western Rift Valleys in East Africa are similar features, and the central tectonic depression of Iceland is an emerged portion of the Mid-Atlantic Ridge. It seems, however, that the East Pacific Rise has no rift. In places where the rift exists, it is 25-50 km wide, and lies 1,000-2,500 metres below the adjacent peaks. A crest province may be defined, with a very rugged topography; flank provinces border it on both sides, with block mountains facing the crest in the North Atlantic, and intermontane depressions. Regional differences occur. The ridge is more rugged in the North Atlantic than in the South, and in the whole Atlantic than in the East Pacific.

Another general feature is that the Mid-Oceanic Ridge is accompanied throughout its length by shallow earthquake epicenters, in other words that the ridge is highly seismic whereas the oceans in general are free of seismicity except along the trenches and island arcs (see below). The seismicity is more especially focussed on the median rift, but it exists even in places where the rift apparently disappears. In the continental extensions the seismicity is distributed over wider areas. A magnetic anomaly is also found along the axis of the ridge.

Structure. The deep structure and the geology of the Mid-Oceanic Ridge are much better known in the Atlantic than in the other parts of the World Ocean, as a result of the research by the Lamont Geological Observatory and Le Pichon's thesis. In the Atlantic, the ridge is underlaid by a body of rocks with a velocity of 4.5 to 6.0 km/s, corresponding to the layer 2 occurring beneath the abyssal plains and hills, but thickening and bulging here to 3 km as an average. This bulge in the layer 2 forms the "basement" of the ridge and appears to be the main structural feature in the Mid-Atlantic. It consists most probably of volcanic rocks protruded through a central fissure and is the origin of the magnetic anomaly in the axis of the ridge. Beneath the layer 2, the layer 3 has been more or less invaded, in the axis of the North Mid-Atlantic Ridge at least, by the

layer 4 (mantle rocks) which is modified and not exactly so dense as usually (velocity 7.3 to 8.2 km/s). In the East Pacific Rise, on the contrary, the thickness of the layer 2 appears to be normal, although all layers tend also to bulge beneath the ridge as in the Atlantic.

Concerning the origin of the Mid-Oceanic Ridge, the best conception in the present state of knowledge seems to be to attribute the bulging to a convective upflow in the upper mantle (layer 4) related to a rise in heat in a layer of several dozens of kilometres in thickness. The rift would thus be a result of tension in the crest of the ridge. The East Pacific Rise is considered to be still in a young stage, while the North Mid-Atlantic Ridge is mature. An old, decayed ridge would be the Darwin Ridge which has sunk into the Central Pacific during the Tertiary and is no more prominent (see below in last section, seamounts).

Sediments. Sediments occur on the Mid-Atlantic Ridge in intermontane depressions which are typically flat-floored as the abyssal plains existing outside the ridge at lower levels. In the crest province, all unconsolidated sediments found until now are Pleistocene or recent. Outside the depressions the absence of sediments is common, or the deposits are extremely thin, consisting mostly of Globigerina ooze, often with manganese nodules. Manganese may also coat the volcanic rocks outcropping on the ocean floor. Rocky surfaces must be swept by currents in many places. An interesting finding is, in the crest province, the discovery of samples of brecciated sediments including Globigerina oozes partly metamorphized and associated with basaltic glass. Some of these Globigerina tests have been dated from the Miocene. This finding indicates that the ridge already existed in the middle of the Tertiary, and that the sediments deposited at that time have been disturbed by submarine volcanic activity. The most recent sediments have, on the contrary, escaped generally from metamorphism.

Possible utilization. So far as we know, the Mid-Oceanic Ridge would probably be of little use for mining or drilling purposes. Its sedimentary cover is shallow, very discontinuous, partly metamorphized. It is true that manganese could be dredged from the ridge, but its rough and uneven topography is not at all so favourable as the flat, extensive abyssal plains.

It seems that the Mid-Oceanic Ridge is more interesting for scientists than for economists. But this opinion could perhaps be modified by further research. The political incidences are the same as in abyssal plains and hills.

4. *Other Ridges and Fracture Zones*

Ridges. Many broad elevations other than the Mid-Oceanic Ridge exist in the oceans. They are shorter, although they can exceed 2,000 km in length. A general characteristic is that they are aseismic, differing greatly in this respect from the Mid-Oceanic Ridge. In the South Atlantic, the Walvis Ridge and the Rio Grande Ridge may be quoted on both sides of the central ridge. They rise respectively to 892 metres and 646 metres below sea level, whereas the basins on their sides are as deep as 5,000-6,000 metres. In the Arctic, the Lomonosov Ridge and the Mendeleev Ridge (the latter being also known as Alpha Ridge) stand similarly at thousands of metres above abyssal plains and connect the Canadian archipelago with the Siberian shelf. In the Indian Ocean, the Mascarene Plateau may also be classified as a ridge. It lies between Madagascar and the Mid-Oceanic Ridge and has an arcuate form. It runs from the Mascarene Islands (Réunion and Mauritius) to the Seychelles, and is exceptional since the Seychelles are of granitic, i.e. continental, while the oceanic floor outside the continental margin is practically always made of volcanic rocks. The Seychelles may be interpreted as a continental raft on the basaltic floor. Madagascar in the vicinity is also a fragment of continent, or even a sub-continent. Another ridge in the Indian Ocean is the Ninetyeast Ridge, along the ninetieth meridian; it seems to be the longest and straightest ridge so far discovered in any ocean. Near its southern end, the Broken Ridge runs at right angles toward southwest Australia. In the North Pacific, the Emperor Ridge runs for more than 3,000 km from the Commodore Islands (East of Kamchatka) southward. It does not rise to the surface.

On the contrary, the Pacific Ocean includes many other ridges which bear numerous volcanic islands or atolls. All

these ridges have similar orientations, running between West-North-West and East-South-East, and North-North-West and South-South-East. The main ones are, from North to South, the Hawaiian Ridge, the Line Ridge, the Marshall Ridge, the Gilbert and Ellice Ridge, the Phoenix and Tokelau Ridge, the Samoa Ridge, the Tuamotu Ridge, the Society Ridge, the Cook and Austral Ridge. These ridges, which are all volcanic (basaltic), are generally younger at one end than at the other one, because the volcanism has migrated in them in the course of time (Chubb). The younger end lies in the East, except in the Samoa where it is in the West. The Hawaiian Ridge, for example, includes active volcanoes in the Great Hawaii Island at the easternmost end of the ridge. The older end has sunk after the volcanic activity has ceased, and bears atolls (see below in last section). Some ridges are divided into parallel sub-ridges, as in the Marshalls and in the Tuamotus.

Fracture zones. The fracture zones (Menard, Heezen) are structural disturbances extending over several thousands of kilometres in the eastern Pacific, and are also found in the Atlantic and the Indian Ocean where they are usually shorter. Their general trend outside the Indian Ocean is West and East, but in the Pacific they are slightly arcuated and tend to follow great circles of the Earth. They transect the Mid-Oceanic Ridge in the three oceans. The names of the main fracture zones in the Pacific are, from North to South: Mendocino, Pioneer, Murray, Molokai, Clarion, Clipperton, Galapagos, Marquesas, Easter. They consist of a combination of escarpments, asymmetrical ridges, troughs, and seamounts, and are much more mountainous than the sea floor in general. The regional depth of the sea floor on either side is different. The Mid-Oceanic Ridge is laterally displaced to the right or to the left by the fracture zones. For example, the displacement by the Mendocino Fracture Zone is 1,100 km to the West at the North of the fracture; the Murray Fracture Sone caused a displacement of 160 km to the East at the North of the fracture. In the Atlantic, the largest displacements of the Mid-Oceanic Ridge by fracture zones occur in the equatorial zone and at the latitude of the British Isles. In the Norwegian Sea, the Jan Mayen Fracture Zone has offset the ridge to the East at the North of the fracture. In the Indian Ocean, the Rodriguez, Amsterdam

and Owen Fracture Zones may also be quoted with similar effects.

Age. The age of the aseismic ridges in the oceans seems to be variable. According to Le Pichon, the Walvis and Rio Grande Ridges would have been formed during the Pliocene. The Society Ridge came into existence during the Neogene (Upper Tertiary), but a part of Tahiti Island is Jurassic. The Tuamotu Ridge was formed in the Lower Tertiary in its western section, but the eastern end is Neogene. The fracture zones are younger than the Mid-Oceanic Ridge since they displace it; but the ridge itself is more or less mature according to regions (see above). Heezen thinks that the fracture zones in the Norwegian Sea existed as early as the Mid-Tertiary; their development would have been associated with the expansion (widening) of the Norwegian Sea. Opinions on these problems are, however, more or less speculative, and the recent expansion of the Norwegian Sea is not universally accepted.

Possible use. The possibilities of utilization by man of these geotectonic units are much the same as for the Mid-Oceanic Ridge (see preceding section).

5. Trenches

Location. The trenches occupy only about one per cent of the total sea area, but these features have extremely special characteristics which deserve much attention. They are not located in the central parts of the oceans, but on their margins. They are generally accompanied by island arcs on their inner sides. They are usually more than a thousand kilometres in length, but their width in their deepest parts does not exceed 50 kilometres and is sometimes smaller than 5 kilometres. The depths in the oceans found in the trenches are: 11,022 metres in the Marianas Trench; 10,542 m in the Kuril Trench; 10,047 m in the Kermadec Trench. The other trenches have depths comprised between 6,200 and 10,000 m.

Most trenches are located on the eastern, i.e. outer side of the island arcs of the Pacific Ocean. They are, from North to South, the Aleutian, Kuril, Japan, Marianas, Admiralty, Vityaz, Tonga and Kermadec trenches. Between Japan, the

Philippines and the Marianas, however, other trenches lie parallel to the former ones on the eastern side of other island arcs: these are the Philippine Trench and the Nansei Shoto, or Ryukyu Trench. On the other hand, in Melanesia three typical trenches are situated on the western, i.e. inner side of island arcs, along New Britain, Bougainville, the Santa Cruz Islands, and the New Hebrides. In Indonesia also, one or two trenches are found on the inner side.

Outside the Pacific, other trenches accompany in the Atlantic the Antilles (Puerto Rico Trench), in the Indian Ocean the Java Arc, in the Southern Ocean the South Sandwich Islands or Scotia Arc. All occur normally on the outer side of the islands.

The last row of trenches is located, not along islands, but along the mountains of western North and South America on the Pacific side, off California, Guatemala, Peru and Chile.

Sediments. The bottom of the trenches, although narrow, is often flat and made of recent sediments. The thickness of unconsolidated sediments in trenches is variable. In the Japan Trench for example, the outer side is made of acoustically transparent sediments, some hundreds of metres thick, which have been affected by a series of step faults. Other geophysical investigations have shown that the Peru-Chile Trench has been completely filled in its southern section by a thick cover of sediments (more than 2 kilometres), whereas between 32°S and 8°S the thickness does not reach 500 metres; farther North it increases again up to 1,000 metres. The sediments in trenches seem to be supplied for a large part by turbidity currents originated on the slope of the island arcs bordering them (or on the continental slope for American trenches). Coarse gravels and stones dredged in some parts of them (e.g. in the bottom of the Philippine Trench at 10,190 metres) support this idea. Another point is that, in spite of their enormous depth, their waters are not devoid of oxygen and allow life down to the bottom, as shown by investigations in many places by Danish and Russian expeditions.

Structure and origin. The origin of the trenches is not yet well known. What is sure is that they correspond with negative gravity anomalies, while positive anomalies are observed on the adjacent island arcs, except for more complicated struc-

tures as in Indonesia where the negative anomaly lies over an outer arc separating two trenches instead of one. The negative anomalies point to an abnormal thickness of low-density rocks. On the other hand, trenches are seismic: deep-seated earthquakes are associated with them, having their foci on planes sloping steeply towards the continents from the bottom of the trenches (located, for example, beneath the Andes for the Peru-Chile Trench). The progress in geophysical knowledge seems to indicate that the trenches are due to tensional forces, as the rift in the Mid-Oceanic Ridge, and not to compression. Some twenty years ago it was thought that the trenches could be situated at the contact between the true oceanic floor and continental rocks underlying the seas between them and the continents. New data, however, have pointed to an intermediate nature of the bottom of the Eastern Caribbean between Puerto Rico Trench and America, the rocks resembling more those beneath the oceans than those beneath the continents: it would be a portion of the oceanic bottom which is being modified. Other measurements in the Philippine Sea, between the parallel Nansei Shoto and Marianas Trenches, have shown that the crustal structure of this area is not markedly different from the adjacent Pacific Ocean floor. The thickening of sediments beneath the Marianas Trench is not so conspicuous might have been expected. The significance of trenches lying on the inner side of island arcs remains obscure.

Possible use. Since more or less thick sediments occur in trenches, these features could prove in the future to be useful for mining or drilling. It must be recalled, however, that the great depth of the trenches increases considerably the difficulty in exploration by other means than geophysical investigation, so that they are likely to be left out until more accessible areas are worked.

6. Seamounts and Shallow Banks

Seamounts and atolls. The deep-sea floor is scattered with innumerable volcanoes rising up to variable depths. According to an evaluation by Menard, 10,000 volcanoes with a relief of more than 1 kilometre above the sea floor exist in the Pacific Ocean alone. Many others have been found in the Atlantic,

Indian and Southern Oceans. These seamounts fall into two types. In the first type, the original conic shape is preserved; the second type is flat-topped and has been named "guyot". Though the guyots lie at depths exceeding frequently 1,000 metres, it is now ascertained, in the Mid-Pacific and off western North America at least, that they are volcanoes which were built up to the sea surface, were truncated by waves, and subsequently subsided. This is proved by Cretaceous deposits and volcanic, well rounded pebbles, dredged on their surface. In still other cases, the subsidence of the volcano was not so rapid, so that corals growing on it in warm seas were able to keep pace with the collapse, and built atolls under which the limestone covering the volcanic rocks reaches currently several hundreds of metres, and more than 1,200 metres in places as Eniwetok Atoll, Marshall Islands. Atolls may in turn have been submerged, or raised above sealevel as Makatea near the Tuamotus, or the Loyalties near New Caledonia.

Seamounts and atolls are much smaller units than the other units previously mentioned. Their diameter on the deep-sea floor is usually comprised between 40 and 150 kilometres. Many seamounts are distributed apparently at random on the sea bottom and may thus be considered as individual features. Many others, however, are parts of huge units as oceanic ridges and fracture zones. It has been already said that all the Pacific ridges running North-west and Southeast consist of series of volcanoes, sometimes active as at the Great Hawaii and at Savai'i, Samoa, often extinct, often bearing atolls. Menard has thought that during the Mesozoic the central part of the Pacific Basin was occupied by an immense rise which was named by him the Darwin Rise, and which continued to exist into Early Tertiary. After that time the Darwin Rise collapsed slowly at a relatively constant rate to the present time. The guyots and atolls of the Mid-Pacific, the Carolines, the Marshalls, the Gilberts, the Phoenix, the Line Islands, the Tuamotu Islands, would be more or less a result of the slow collapse of the Darwin Rise, whereas some new volcanoes continued to appear around this central belt in the South Pacific (Samoa, Eastern Tuamotus) and in the Hawaii Islands.

Under the same heading we can mention the *shallow banks* rising in the deep in some areas, as in the Coral Sea between

Australia, New Guinea and New Caledonia, the South China Sea, the Carribean Sea, outside the Carribean in the Atlantic off Florida, Cuba and Hispaniola, and the Northeast Atlantic between Ireland, Scotland and Iceland. A part of these banks bear low islands as Chesterfield in the Coral Sea, the Paracels in the South China Sea, the Bahamas and Caicos in the tropical Atlantic; some others bear no island at all, as Rosalind Bank in the Carribean, or Lousy Bank and Bligh Bank in the Northeast Atlantic. The Bahamas, which have been intensively investigated, were formed by carbonate sedimentation during a long-continued subsidence, while deep stretches of water remained comparatively free of sedimentation between the banks.

Utilization and geopolitical problems. Although they cover small areas, the seamounts, atolls and shallow banks have already been used in many cases. When they bear islands, the problem of property is easily solved, except if the island is a rock or stack on which permanent human life is impossible, as Rockall in the Northeast Atlantic. We may mention here that several Pacific atolls have been recently used for nuclear experiments: Bikini, Eniwetok and Johnston Atolls by the Americans, Christmas Atoll by the British and the Americans, Mururoa and Fagatufa Atolls by the French. This utilization derived from their remote situation. When the banks bear no island at all, the problem of property may remain open if the bank is really surrounded everywhere by deep water, as in the Carribean. Such banks may be of interest for different purposes, as fishing crayfish in the Carribean, and trawling in the Northeast Atlantic, and difficulties may arise between ships belonging to distant countries and nearby States claiming for rights on the banks although they are not parts of the continental shelf adjacent to these States. Other types of utilization are conceivable on shallow banks and guyots, so that it could be useful to define more precisely their Juridical status.

QUANTITATIVE DATA ON THE AREA
OF THE CONTINENTAL SHELF IN THE AMERICAS

BY

Dr. H.W. MENARD

*Professor of Geology, Scripps Institution of Oceanography,
University of California, La Jolla, Calif.*

Introductory note

(from letter of Prof. Menard to the I.A.I. of May 19, 1960):

My associates have now expended about a man-month in attempting to put together useful quantitative data on the area of the continental shelf. It really is impossible to get significant numbers in most places before the extended boundaries between countries are available on a map, that is, political considerations are paramount. The situation is relatively straightforward in the Americas and therefore I have made up the enclosed compilation...

It should be obvious that there is no geographical or geophysical basis for defining the limits of the continental shelf in a way that will be universally accepted. Two hundred meters is a logical boundary in many places, a thousand meters is logical elsewhere. Preliminary estimates suggest that sea-floor terraces occur along 30% of the continental slope; they occur at different depths at different places. The existence of these terraces thus rules out a universal geographical definition which is not somehow arbitrary. My own feeling is that the diplomats ought to pick some arbitrary distance from the shore and draw lines on the map...

COUNTRY	LENGTH OF COAST		AREA TO 3 MI		AREA TO 100 FMS		AREA TO 1000 FMS	
	This study	Alexander	Sq.mi	%	Sq.mi	%	Sq.mi	%
Argentina	1,950	2,120	5,850	3.48	267,500.	12.62	415,800	12.25
Brazil	3,410	3,692	10,230	6.10	205,800	9.71	296,500	8.74
British Honduras	150	—	450	0.27	2,300	0.11	5,100	0.15
Canada	25,600	11,129	76,080	45.31	703,500	33.19	991,000	29.20
Chile	2,810	2,822	8,430	5.02	45,700	2.16	95,600	2.82
Colombia	1,020	1,022	3,060	1.82	17,600	0.83	37,400	1.10
Costa Rica	380	446	1,140	0.68	5,100	0.24	11,900	0.35
El Salvador	150	164	450	0.27	5,200	0.25	7,600	0.22
Ecuador	450	458	1,350	0.80	7,200	0.34	11,700	0.34
French Guiana	190	—	570	0.34	13,500	0.64	19,000	0.56
Guatemala	160	178	480	0.29	5,000	0.24	7,300	0.21
Guyana	230	232	690	0.41	13,400	0.63	18,400	0.54
Honduras	350	374	1,050	0.63	16,300	0.77	23,300	0.68
Mexico	4,720	4,848	14,160	8.43	105,700	4.99	232,200	6.84
Nicaragua	450	445	1,350	0.80	21,800	1.03	50,900	1.50
Panama	850	979	2,550	1.52	16,000	0.76	28,400	0.84
Perù	1,100	1,258	3,300	1.97	22,200	1.05	51,300	1.51
Surinam	220	—	660	0.39	16,800	0.79	27,500	0.81
Uruguay	280	305	840	0.50	22,200	1.05	32,600	0.96
U.S.A.	10,690	11,650	32,070	19.10	578,900	27.31	815,800	21.63
Alaska	(6,250)	—	(18,750)	—	(378,400)	—	(446,100)	—
Venezuela	1,050	1,081	3,150	1.88	27,900	1.32	56,400	1.66
TOTALS	55,970	—	167,910	—	2,119,600	—	3,394,320	—

SUMMARY OF DISCUSSION

Definitions of the Sea-Bed Areas

A group of geologists participating in the Symposium submitted for the discussion a working paper containing a series of terms and definitions. The corrected version of these definitions read as follows:

Continents: the large blocks of the Earth that stand well above (about 4-6 km) the general level of the Earth's rock surface owing to the low density of their rocks.

Ocean Basins: The two-thirds of the Earth's surface that form the floor of the deep oceans characterised by high density rocks.

Enclosed and Marginal Seas: These are usually shallower than the ocean basins and range from almost completely enclosed seas (such as the Mediterranean) through relatively open ones (such as the Gulf of Mexico) to open ones (such as the East China Sea). All are characterised by crustal densities intermediate between those of continents and ocean basins.

Continental Shelf: The zone around the continent extending from the low-water line to the depth at which there is usually a marked increase of declivity to greater depth. Where this increase occurs, the term shelf edge is appropriate. This shelf edge ranges in depth from less than 60 to more than 500 and it averages 130 m. Where the zone below the low-water line is highly irregular and contains depths well in excess of those typical of continental shelves (as off southern California), the term continental borderland is appropriate.

Continental Slope: The zone bordering the continental shelf that extends seawards from the shelf edge at declivities that average about 4°15' down to the depths of 1,200-3,500 m. Its outer edge approximately marks the boundary between the low density rocks of the continents and the high density ones of the deep ocean floor or the intermediate ones of the enclosed or marginal seas.

Continental Rise: The zone that borders the base of many continental slopes and has a smooth declivity that averages 30' to depth of 3,500-5,500 m.

Deep-Sea Trench: The long narrow trench that borders island arcs or some continental slopes and reaches depths as great as 11,000 m, roughly twice the depth of the deep-ocean floor.

Abyssal Plain: The extremely flat areas of the deep-ocean floor.

Continental Terrace: The combined continental shelf and continental slope.

Continental Margin: The combined continental shelf, continental slope, and continental rise.

For further details see the reports for I.A.I. by Menard, Guilcher, and Emery.

The following definitions are offered as substitutes for geomorphological terms redefined to suit legal objectives. Their limits are still to be determined according to political considerations.

Sea-Bed of Territorial Sea: The sea floor adjacent to the low-water line in which the coastal state exercises sovereignty as on land, with some limitations such as freedom of innocent passage.

National Sea-Bed: The area beyond the territorial sea in which the coastal state has sovereign rights for the purpose of exploring and exploiting its natural resources. Its outer limit can be defined by depth, distance from shore, or other considerations.

International Sea-Bed: The area beyond the national seabed.

One of the co-authors, in presenting this working paper, said that the present legal definition of the continental shelf is oversimplified. Geologist thought that it might be helpful to define some sea-bed terms which are used in the discussion. They considered also that a different sort of terminology should be used for legal purposes. Accordingly, they submitted three terms and definitions which do not necessarily correspond to geological features and may be based on the criterion of depth or of the distance from the coast.

Several international lawyers strongly opposed the term "national sea-bed" which might be construed as implying full

national sovereignty over the area in question. This is not how the Geneva Convention formulates the rights of the coastal states in this area. One of the speakers furthermore indicated that the definition of the "national sea-bed" as proposed applies, in fact, exclusively to the waters above. It was also said that the term "international sea-bed" might prove equally unacceptable - depending on what shall be done in the future with respect to the area in question. Some speakers felt that the whole series of the proposed legal definitions should be dropped.

One of the co-authors of the working paper pointed out that the most important part of the working paper is part I and not part II.

Another co-author added that some terms defined in part I of the working paper are about hundred years old, and that the use of them by lawyers at the Geneva Conference of 1958 was, in fact, a misuse. Especially, the notion of the continental shelf should be clarified.

In the further course of discussion attention was drawn to the fact that the Report of the UN *Ad hoc* Committee of the Peaceful Uses of the Sea-Bed also contained a series of geomorphological definitions, and what has been proposed now is somewhat different from what had already been accepted at the UN *Ad hoc* Committee.

A marine biologist expressed the view that the definitions contained in part I of the working paper seem to be generally acceptable. He felt that the main preoccupation of geologists has been that the Geneva Convention on the Continental Shelf used a geological term ("continental shelf") while its definition, contained in the Convention, does not correspond to the geological definition.

Some international lawyers pointed out that it is generally useful to have definitions and the problem is how to draw them. One of the speakers was of the opinion that the term "continental shelf" has been used in national and international legislation mostly for emotional and propagandistic reasons - to make claims better justified and more credible. It would be better to find another term.

Another participant proposed the following terms for the three undersea zones specified in part II of the working paper: sea-bed under the territorial sea (i.e. — that subject to the

regime of the Convention on the Territorial Sea and Contiguous Zone), adjacent sea-bed (i.e. — that subject to the regime of the Convention on the Continental Shelf), international sea-bed (as in the working paper).

A view was also expressed that the need for more precise legal terms and definitions should be recognised, and that in this connection the working paper submitted by geologists is a thought provoking effort, though the terms and definitions, as proposed, are subject to an open discussion.

Summarising the exchange of views, the Chairman indicated that lawyers appreciate the effort made by geologists, especially insofar as part I of their working paper is concerned. Different views were expressed but, in general, lawyers understand the concern and preoccupations of geologists. He also explained that the Symposium is not supposed to pass any resolutions or adopt any definitions.

Natural Features and Legal Boundaries on the Sea-Bed

A question was raised whether the modern geological definitions of the continental shelf (as only a part of the continental terrace), and of the continental terrace (as comprising both the continental shelf and slope) were known at the time when the Geneva Convention on the Continental Shelf was negotiated. If yea — that might be construed as a direct indication that the negotiators, by using the term “continental shelf” specifically intended not to provide for a possible extension of state jurisdiction beyond its limits (i.e. to the continental slope).

Three participants representing natural sciences clarified in reply to this question that the modern concept of the continental margin and the appropriate terminology started developing in 1939-40 and the terms were redefined in 1952-53. They were thus well known in the period when the Geneva Conventions on the law of the sea were negotiated.

An international lawyer who participated in the Geneva Conference of 1958 pointed out in this connection that for many reasons lawyers deliberately had to dissociate themselves from

the geophysical and geological definitions for the purpose of drawing the Convention — e.g. because some states have no continental shelf in the geological sense, but it was felt that they should not be deprived of equal rights. Thus the term “continental shelf”, as used in the Geneva Convention, is no more than a historic relic.

A geographer believed that it would have been better to define the subject of the Convention in its title as “limits of national jurisdiction on the sea-bed” rather than “continental shelf”. He stressed the fact that it is impossible to give a general definition of the continental shelf and slope, based on the depth criterion, since depths vary from place to place — average depth of the edge of the continental shelf is about 130 m (not 200 m as accepted in the Geneva Convention on the Continental Shelf).

Reference was further made to the recent Australian legislation, under which a large number of small uninhabited islands in the Coral Sea were incorporated into the Australian territory to create a legal basis for claims to the shelf around these islands, which is otherwise detached from the continental shelf of Australia. In this connection the question was raised about the legal status of the sea-mounts and guyots as a basis for claiming the continental shelf under the Geneva Convention. The speaker referred to the particular feature of coral islands which are exposed over the ocean only temporarily, by fortuitous action of wind and tide; corals would die if exposed permanently over the ocean. The speaker raised the question of considering these accidentally exposed island as baselines for measuring and claiming continental shelf. He felt that when the Geneva Conventions were negotiated, the notion of “island” was understood in terms of temperate zone, and no attention was paid to coral atolls and reefs.

Another participant felt that claims to the continental shelf based on biological processes are totally inadmissible. The next step on such a way would be to claim continental shelf on the basis of movement of fish. According to him, a claim to a portion of the sea-bed may be recognised only if it involves actual use of the area in question. However the claims in question were not substantiated by any exploitation of the area.

The other speaker, however, noted that claims to the seabed, based on the existence of coral islands, are a fact of international life, whether one likes it or not.

An international lawyer felt that if these claims were not contested, it is not because their grounds as such have been recognised but just because of the long distance of the areas in question from anybody who might contest that. He was of the opinion that if claims of similar nature were made in the Atlantic, in the North Sea, or in the Mediterranean — they would lead to a serious conflict. He noted further that there is a tendency in recent discussion to belittle the results of the Geneva Conference of 1958. Perhaps, with exception of the Commission IV, that Conference had a great deal of expertise, and it would be wrong to assume that there might be not a perfect understanding what "island" is.

Another international lawyer pointed out that the case of the coral atolls is just an example of what is likely to happen if international customary law will freely develop on the basis of unilateral claims.

It was also stressed that rocks and other similar features should not enjoy the status of island under the continental shelf doctrine.

In this connection, however, attention was drawn to over 2,000 islands off Norwegian coast. It was recalled that whether inhabited or not they have been considered as a part of land and have formed a baseline for all relevant measurements.

A view was also expressed that what was lacking during the period of the negotiations on the conventions on the law of the sea was not the knowledge but rather the communications between natural scientists and lawyers who preferred to discuss problems among themselves.

A navy expert expressed the opinion that with the development of technology the view of which part of the ocean is more important is subject to changes. It may happen that bathymetry, to which so much attention is devoted now, may become of little relevance in the future, and other measures may gain importance, such as acoustic and hydrodynamic characteristics, the soil mechanics, magnetic anomalies, etc. Interaction between legal considerations and considerations on natural features of the sea-bed seems to be extremely important

but should not be limited to bathymetry, geological structure, or economic resources.

An international lawyer noted that it is difficult for lawyers to agree, once natural scientists also express different views. However, this should not prevent an elaboration of a satisfactory regime for the sea-bed beyond the limits of present national jurisdiction. It is apparent that more scientific research in the ocean is needed. And whatever such a regime might be, it must stimulate scientific research.

Possible Uses of Different Areas of the Sea-Bed

Attention was drawn by a participant to seamounts and shallow banks which are quite numerous and in many cases quite close to the surface. Some of them cannot be associated in any way with the continuation of a continent. However, with the progress of technology an increasing number of them might become exploitable though they would not fall under the sovereignty of any state. Accordingly, there is a problem of establishing a regime for exploitable undersea areas which do not belong to any state.

Another participant pointed out that some banks are already being exploited, e.g. those between Honduras and Cuba, the depth of which is no more than 10-20 m. Fishermen go there and may get into conflict with the coastal states. The same problem may arise in the future in connection with guyots.

An oceanographer expressed the view that these elevated areas are not habitats for petroleum) this view was supported also by an oil expert) but in the Pacific they are covered by a great amount of manganese nodules which contain also a quite considerable amount of cobalt. As for fish, sedentary species are very scarce there. Mostly pelagic species concentrate in these regions but these species do not belong to the sea-bed — they are creatures of the high seas.

A question was raised whether the flat-topped guyots and sea-mounts would not lend themselves to military uses and whether this is not the first conceivable use.

A geographer was of the opinion that the sea-mounts and guyots are of little importance, although some of them (e.g.

those in the Carribeans) are already being exploited and some others (e.g. in the Pacific area) may become exploitable in the future. He did not think that elevations of this type could be very useful for military purposes. Atolls are better suited for military purposes than sea-mounts.

Another participant drew attention to the fact that shallow areas exist also elsewhere — in the Atlantic and in the Indian Ocean (e.g. near Madagascar).

A social scientist expressed the view that what makes some politicians worry about disturbing the existing strategic balance is not an actual possibility of using shallow banks and guyots for military purposes but rather their apparent use by others. This is why e.g. one U.S. senator recommended to occupy the Cobb Seamount.

Another participant pointed out in this connection that insofar as the United States is concerned, an authoritative statement was made by the solicitor of the Department of Interior the effect that the Cobb Seamount does not belong to the continental shelf of the United States and no one is giving a serious thought to occupying it.

An oil expert said that business companies carrying offshore operations suffer from the lack of weather information, especially in some areas, and therefore it has been contemplated to use seamounts and guyots for attaching to them bouys with an appropriate automatic equipment which would provide weather information.

The view was also expressed that one should not perhaps attach now so much importance to a possibility of military uses of seamounts and guyots, except perhaps for affixing monitoring devices for observation of shipping. But other uses are quite conceivable, such as e.g. placing scientific stations thereon. At least one company was also contemplating to use shallow banks for recreational purposes.

A geographer suggested that shallower banks and tops of seamounts close to the surface of the sea may be used for various purposes but this does not appear to be the case with the deeper ones.

National Interests and the Facts of Nature

It was pointed out that there seems to be a great variety of interests among states, based on natural and geopolitical facts, and these interests should be identified before an attempt is made to draw up an optimal arrangement for the sea-bed. E.g.:

1. There are 23 landlocked countries in the U.N. and their interests are apparently specific; but there is also a great variety of interests among the coastal states, resulting, i.e., from the different breadths of their continental shelves and slopes.

2. The character and amount of living and non-living resources likely to be found in the offshore areas of individual states vary widely, and this has a bearing on their position. E.g. fisheries regions are mostly located off the western coasts of the continents; on the other hand, oil and natural gas are likely to be found where there are great sedimentary basins and not where shelf and slope are volcanic or composed of metamorphic rocks.

3. The length of coastline also influences the interests of states.

4. Furthermore, different attitudes of developing and developed countries should be taken into account; the former are not in a position to participate in oceanographic research but they may be suspicious of others doing a research in their offshore areas.

5. Some states may extrapolate their land resources into the underwater areas and make an estimation of their interests in these areas (as, e.g., the United States, Canada, states on the Persian Gulf) but some other states may not (e.g. states on both African coasts).

More oceanographic research is therefore necessary, and it would be worthwhile to ensure the cooperation of the developing states in such a research.

Reference was made to the tabulation presented by Prof. Menard (see p. ...), especially to the percentage calculation of the sea areas adjacent to individual states of the American

continent, contained within the 200 m isobath and within the 2,000 m isobath. According to this tabulation, the richer the country the more it would gain from the outward extension of jurisdictional limits on the sea-bed, and vice versa. An outward extension of these limits would thus only add to the inequality of states. The tabulation also shows that extending the limits of national jurisdiction to the 2,000 m isobath would result in absorption of 16% of the area of the oceans by the coastal states. With reference to economic wealth as a criterion for the delimitation of national jurisdictions on the sea-bed, it was pointed out that thus far this criterion has been applied only in one case — the delimitation between Saudi Arabia and Iran in the Persian Gulf, which was based on estimation of equal values of oil deposits on both sides of the delimitation line.

A social scientist mentioned in this connection that the question at stake is not how much area a state would gain by extending the limits of its jurisdiction on the sea-bed, but rather how much in terms of resources may be gained through such an extension.

According to another view, while an appeal for more research is the most commendable one, it would be dangerous to wait for the consideration of a regime for the sea-bed. Otherwise, irreversible facts might occur. National laws regarding the exploration and exploitation of sea and sea-bed resources are also being promulgated before these resources are fully explored.

An international lawyer expressed the view that a number of difficulties arise from the fact that lawyers are not in a position to keep constantly in mind all facts of natural sciences, while natural scientists are not always in a position to see the implications of those facts with respect to international law and politics. It would be, therefore, useful to produce a map showing all data relevant for legal considerations (structure of the sea-bed, bathymetry, distribution of resources, their actual exploration and exploitation, etc.).

It was pointed out in this connection that some charts of this type do exist. However, it seems impossible to reflect on a chart the main problem — the economic one. The knowledge of resources is progressing but it is extremely difficult at any given moment to present the value of the economic wealth within a particular area.

This opinion was supported also by another participant who suggested at the same time that an arrangement is necessary to provide for an up-to-date current filing of data regarding resources of the sea and sea-bed. Sometimes exaggerated claims are based on the lack of sufficient knowledge in this respect.

PART II

THE ECONOMIC RESOURCES OF THE SEA-BED

AN OCEANOGRAPHER'S VIEW OF THE LAW OF THE SEA

BY

Dr. KENNETH O. EMERY

*Senior Scientist, Woods Hole Oceanographic Institution,
Woods Hole, Mass.*

Introduction

During the past two decades the rate of production of oil and gas from the ocean floor has increased tremendously. This increase has been accompanied by rather wild optimism about the likelihood of future recovery of many other minerals from the ocean floor. The optimism, in turn, has led coastal nations to demand greater widths of their adjoining ocean floor and the United Nations, on behalf of developing or interior nations, to want the control of ocean floors more or less distant from coasts of the world.

The time has come for a review of the potential value of offshore resources, of the nature of ocean-floor provinces, and of the effect produced by conflicting claims upon the investigation and exploitation of the ocean floor.

Resources

The mineral resource from the ocean floor that presently has the greatest annual value (Table 1) is oil and gas. Rising from only a few million dollars in 1945 to nearly \$ 4 billion per year in 1967-68, the ocean-floor production can be predicted to reach something like \$ 15 billion by 1980. Approximately \$ 1 billion worth of oil and gas per year comes from each of

Table I

ANNUAL VALUE OF MINERAL RESOURCES OF THE OCEAN FLOOR BEYOND
THE BEACH ZONE (1967-1968 PRODUCTION IN \$ MILLIONS) *

	WORLD TOTAL	OFFSHORE (EXCLUDING BEACHES)
Petroleum and Associated Materials		
Oil and Gas	26,000	3,900
Sulfur	340	15
Sand and Gravel	2,000	160
Heavy Minerals		
Gold	1,900	0
Tin	460	5
Platinum	150	0
Ilmenite (titanium)	54	0
Rutile (titanium)	16	0
Zircon (zirconium)	10	0
Monazite (rare earth elements)	2	0
Magnetite (iron)	4,300	1
Diamonds	290	4
Precious Coral	2	2
Phosphorite	400	0
Elements in Manganese Nodules		
Manganese	420	0
Copper	4,200	0
Nickel	800	0
Cobalt	30	0
Elements in Red Sea Hot-Brine Deposits.		
Zinc	70	0
Copper	4,200	0
Silver	340	0
Gold	1,900	0
Subsurface Consolidated Deposits		
Coal	18,500	335
Iron	4,300	17
Elements Removed from Solution	500	400
Food	260,000	7,000

* from Emery, 1966; Degens and Ross, 1969; D'Amico, 1968; Fye, Maxwell, Emery, and Ketchum, 1968; Committees of the National Academy of Sciences and the National Academy of Engineering, 1969; Commission on Marine Science, Engineering and Resources, 1969.

three ocean-floor areas: the shelf off Louisiana (U.S.A.), Lake Maracaibo (Venezuela), and the Persian Gulf. New offshore discoveries reported during 1968 include the shelves off southwestern Africa, western Africa, northern Java, the North Sea (oil in the Norwegian sector), eastern Italy, eastern Brazil, southeastern and western Australia, and western New Zealand. Finds are expected during 1969-1970 off northern Alaska, Alaska, western Canada, southeastern Thailand, northern Taiwan, western and southern South Korea, and elsewhere. Some of these new fields may also prove to be giant ones. In fact, there is a strong possibility that production on land and ocean floor may develop a temporary excess of supply over demand, leading to some reduction of exploration and exploitation. All ocean-floor production to date has been on the continental shelf, almost entirely the shallow inner half of the shelf. The great success there makes unlikely any immediate exploitation from areas beyond the shelf edge where costs are likely to be much greater, although some pilot production will occur in order to evaluate future prospects and costs.

Sand and gravel is the second most valuable ocean-floor resource (Table 1) in spite of its low per-unit price. The estimate of world production on land is very approximate, but that for the ocean floor (about \$ 0.16 billion per year) is fairly well based. About two-thirds of the ocean-floor production is from off the United States, with the rest mainly from off England; all of it is from the shallow inner part of the continental shelf. The growth of coastal megapoli insures increased production in the future and from off many coastal nations, reaching perhaps \$ 0.5 billion per year by 1980.

The heavy detrital minerals can be grouped into several categories: heavy heavy minerals (gold, tin, and platinum), light heavy minerals (ilmenite, rutile, zircon, monazite, and magnetite), and gems (mainly diamonds). The heavy heavy minerals occur chiefly in stream deposits within a few of their primary igneous and metamorphic source rocks. Only tin is produced in any quantity from the ocean floor, and the annual rate may reach \$ 10 million per year by 1980, chiefly from southeastern Asia. Gold and platinum are unlikely to reach production as great as \$ 1 million annually by that year. The light heavy minerals occur chiefly on beaches, where large

quantities are concentrated by the high energy of waves. Present production from submerged former beaches is almost negligible (Table 1), with production of iron sand off Japan even markedly decreasing because of its low grade and its interference with fisheries. Production of all light heavy minerals by 1980 is likely to be small, and, even though exploration is continuing, the high costs of offshore mining and concentration coupled with the small profit margin suggests that annual production of all of them can scarcely exceed \$ 3 million by 1980. The last group of heavy minerals, gems, is restricted on the ocean floor to diamonds, because most other gems are too fragile to withstand the rigor of the ocean environment. To date, the cost of mining diamonds from the ocean floor has exceeded their value; new methods of recovery may permit diamond mining to be profitable, but production by 1980 is unlikely to be much greater than at present. In summary, all heavy minerals now produced from the ocean floor are in shallow depths, near the shore except for some of the tin off southeastern Asia.

Precious coral occurs around some of the coral reefs of the equatorial western Pacific Ocean and probably in the Indian Ocean. It is gathered mainly by dredging, but its occurrence in crevices suggests that it will never be a mass product for mining. Increased interest in it may lead to annual production above the present estimated \$ 2 million (Table 1), but it can scarcely exceed \$ 6 million per year by 1980.

Phosphorite occurs on the ocean floor, mainly on bank tops off southern California, southeastern United States, Peru-Chile, South Africa, and probably northwestern Africa. Its presence has been suggested off India, but such an occurrence appears to be unlikely from present knowledge of the sediments there. The major requirements for phosphorite deposits appear to be abundance of marine life due to past or present upwelling of nutrient-rich ocean water, and an absence of diluting sediment either from land or from calcareous debris of marine animals. Although phosphate is needed in quantity for fertilizer and chemicals, the reserves on land are so great and the per-unit production cost is so low (about \$ 5 per ton) that mining from the ocean floor is considered marginal at best. Difficulties are due to the high initial capital investment for ocean-

floor mining equipment and the fact the phosphate content of known ocean-floor phosphorites is lower than that of the large land deposits. Serious production from the ocean floor is considered likely only several decades hence.

Much has been written about the value of manganese nodules on the deep ocean floor, their vast widespread distribution, and the faster rate of deposition of manganese than of present utilization by industry. Perhaps 30 tons have been recovered by oceanographic ships and by pilot mining ships. The nodules having the highest content of manganese (24% average for the Pacific Ocean), nickel (1%), copper (0.5%) and cobalt (0.5%) are in very deep water distant from land. Nodules from the Atlantic Ocean floor are about half as rich in these metals, owing to greater dilution by sediments from land and organisms. The manganese content of the best deep-ocean nodules is about half the minimum concentration in manganese ore of international commerce, and thus it may be considered as a waste component at present. Copper and nickel are in demand for metal products, and their concentrations in the nodules are high enough that they might be extracted if the nodules were cheaply accessible. For the present, however, the mining of the nodules appears to be too expensive for them to compete with land sources of copper and nickel, as well as of the other metals. The writer is of the opinion that large-scale ocean-floor mining of the nodules is unlikely for several decades pending greater depletion of land reserves of the metals and the development of ocean-mining technologies.

During the middle 1960's mineral deposits under hot brine pools on the floor of the Red Sea were discovered and partly investigated. The deposits are rich in certain metals, notably zinc (3.4%), copper (1.3%), silver (0.005%), and gold (0.00005%), that have a total estimated value of about \$ 2 billion if they could be mined and extracted at no cost. However, the cost of mining is apt to be great because the metals are most concentrated in a bed less than 2 meters thick beneath 5 to 10 meters of sediment having lesser value and beneath 2,200 meters of water. Separation of the valuable metals is made difficult by intergrowths of the desired minerals with valueless ones, by calcium carbonate in the sediments (neutralization of acid used in ore treatment), and by absence of energy sources in adja-

cent land areas. Pilot-scale extraction may occur, but large-scale production appears to be unlikely before 1980.

Coal is frequently mentioned as an ocean-floor resource, but in reality the coal is deeply buried beneath the ocean floor and is mined through shafts that are sunk beneath the adjacent land or beneath artificially constructed islands. It, plus some iron ore (Table 1), is best considered as land rather than marine resources.

The present total annual value of all marine mineral resources (except subsurface coal and iron) is less than \$ 4.1 billion. Only about \$ 0.18 billion (4% of the total) is independent of the oil industry. Chief of these is sand and gravel. In contrast, nearly \$ 0.4 billion worth of chemicals are extracted from solution in ocean water, and about \$ 7 billion worth of food (both animals and plants) are taken each year. Probably the annual value of oil and gas alone will exceed that of the food recovery by 1980, about \$ 15 billion versus \$ 10 billion per year. Mining of sand and gravel and extraction of dissolved chemicals may each increase to about \$ 1 billion per year. Unless cheap mining and extraction techniques are developed for phosphorite, manganese nodules, and hot-brine deposits, the total annual value for all other minerals from the ocean floor other than oil and gas plus sand and gravel is not apt to exceed \$ 0.1 billion annually by 1980.

Ocean-floor provinces

In 1869 De Pourtales (1872) noted that "the 100-fathom line --- marks the real contour of the continents", and the term continental shelf was used in Murray and Renard's (1891, p. 185) report on the deep-sea deposits collected by H. M. S. CHALLENGER during her cruise of 1872-76. The continental shelf, shelf edge, and borderland were more formally defined in 1952 by an international committee chaired by Wiseman and Ovey (1953) as: "The zone around the continent extending from the low-water line to the depth at which there is a marked increase of slope to greater depth. Where this increase occurs the term shelf edge is appropriate. Conventionally, the edge is taken at 100 fathoms (or 200 meters) but instances

are known where the increase of slope occurs at more than 200 or less than 65 fathoms. When the zone below the low-water line is highly irregular and includes depths well in excess of those typical of continental shelves, the term continental borderland is appropriate." The same definition was used by Guilcher, Kuenen, Shepard, and Zenkovich (1957) in their report for UNESCO in preparation for the 1958 Geneva Convention on the Law of the Sea. Seaward of the continental shelf is the continental slope, a declivity that averages about 4-1/4 degrees in steepness (Shepard, 1963, p. 289). Except where the continental slope is bounded by a trench, a continental rise laps against it. Continental rises have slopes that average about half a degree; depths at their landward edge range from about 1,200 to 3,500 meters and at their seaward edge from about 3,500 to 5,500 meters (Emery, 1969). Still farther seaward are abyssal plains that are among the flattest surfaces of the Earth.

Ocean-floor provinces having distinctive geology and mineral resources cannot be based upon simple depth or distance limits. For the convenience of the non-scientists at the conference, Gaskell, Guilcher, Ninno, and the writer prepared a list of simple geological definitions of ocean-floor terms that commonly are used or misused in a legal sense (Table 2).

Table 2

GEOLOGICAL DEFINITIONS OF SOME OCEAN-FLOOR PROVINCES

Continents: The large blocks of the Earth that stand well above (about 4-6 km), the general level of the Earth's rock surface owing to the low density of the rocks.

Ocean Basins: The two-thirds of the Earth's surface that form the floor of the deep oceans characterized by high density rocks.

Enclosed and Marginal Seas: These are usually shallower than the ocean basins and range from almost completely enclosed seas (such as the Mediterranean) through relatively open ones (such as the Gulf of Mexico) to open ones (such as the East China Sea). All are characterized by crustal densities intermediate between those of continents and ocean basins.

Continental Shelf: The zone around the continent extending from the low-water line to the depth at which there is usually a marked increase of declivity to greater depth. Where this increase occurs the term shelf edge is appropriate. This shelf edge ranges in depth from less than 60 to more than 500 meters and it averages

130 meters. Where the zone below the low-water line is highly irregular and contains depths well in excess of those typical of continental shelves (as off southern California), the term continental borderland is appropriate.

Continental Slope: The zone bordering the continental shelf that extends seaward from the shelf edge at declivities that average about $4\text{-}1/4$ degrees down to depths of 1,200 to 3,500 meters. Its outer edge approximately marks the boundary between the low density rocks of the continents and the high density ones of the deep ocean floor or the intermediate ones of the enclosed or marginal seas.

Continental Rise: The zone that borders the base of many continental slopes and has a smooth declivity that averages about 0.5 degree to depths of 3,500 to 5,500 meters.

Deep-Sea Trench: The long narrow trench that borders island arcs or some continental slopes and reaches depths as great as 11,000 meters, roughly twice the depth of the deep-ocean floor.

Abyssal Plain: The extremely flat areas of the deep-ocean floor.

Continental Terrace: The combined continental shelf and continental slope.

Continental Margin: The combined continental shelf, continental slope, and continental rise.

As shown by Emery (1966, 1968), the continental shelf consists of a wedge of seaward-dipping sediments several km thick and held in place by dams of tectonic, diapiric, or biogenic origin, or even by the effective angle of rest of the sediments. Where dams are present they commonly underlie the continental slope, although they may be buried under a blanket of sediment. In few places does the continental shelf contain outcrops of igneous and metamorphic rocks; thus it is more favorable for accumulations of oil and gas than are the adjacent land areas and it is far less favorable for hard minerals that are weathered from older rocks. The combined continental shelf and slope has an area of about 55 million sq. km, or about 11 per cent of the total area of the Earth.

The continental rise consists of many layers of sediment deposited partly grain by grain from suspension in the water, partly as sandy turbidites, and partly as slides from the steeper continental slope (Emery, 1969). Their area totals about 25 million sq. km, and their volume may be 100 million cu. km. Probably their only mineral resource is oil and gas, but detailed exploration and exploitation are likely to be so

expensive that production will be delayed for at least several decades.

Abyssal plains consist of sediments whose layers are variously formed by slow deposition from suspension, fast deposition by turbidity currents, and probably intermediate-rate deposition by organic debris and chemical precipitates. The total thickness is only a few hundred meters, and probably the only minerals of potential economic value are within manganese nodules. These nodules are most abundant on abyssal plains that are protected from the influx of detrital sediment from land by intervening trenches or ridges.

Lastly, ancient ridges or banks that rise above the general level of the adjacent ocean floor are the sites of the chemically precipitated deposits of manganese nodules (mostly deeper than 1,000 meters) and of phosphorite (mostly shallower than 1,000 meters).

All of the ocean-floor provinces, as well as those of the land, are subordinate to the two chief physiographic units of the Earth- the continents and the ocean basins. The average level of the continents is about 4 km above that of the ocean basins, simply because they consist mostly of lighter rocks (average specific gravity of about 2.7. versus 3.1 for the ocean-floor rocks). The exact height of continents above the ocean basins depends upon the thickness of the light rocks of the continents, the thickness of sediments in the ocean basins, and the degree to which equilibrium has been reached (isostasy) by lightening of the continents through erosion and weighting of the ocean basins by deposition of sediments. Properties of basement rock, such as their density (by gravity surveys), sound velocity (by seismic refraction surveys), and magnetism (by geomagnetic surveys), show that rocks characteristic of the continents underlie the continental shelf but not the continental rise. The boundary between the rocks of continents and ocean basins appears to underlie the continental slope, but the exact nature of the boundary is unknown. Certainly, the minerals, sediment types, and structures of the continents and the ocean basins are separated at or near the continental slope. In the absence of precise information about the details of rock and structure, the most reasonable and practicable geological boundary might be taken as some depth contour of the continental slope, such as 1,000

meters (Emery, 1967). The objection has been raised that depths are subject to change by deposition of sediment and by mass movements; nevertheless, depth is much more easily and accurately measured than is geographic position (Brockett and Hedberg, 1969) which with ridge crests, streams, and shorelines constitute the political boundaries on land.

Results of legal developments during the past decade

Redefinitions.

The 1958 Geneva Convention on the Continental Shelf, Article 1, stated, "For the purpose of these articles, the term 'continental shelf' is used as referring (a) to the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea, to a depth of 200 meters or, beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources of the said areas; (b) to the seabed and subsoil of similar submarine areas adjacent to the coasts of islands". This redefinition excludes from the continental shelf the nearshore zone that is termed the territorial sea, and it extends the outer edge of the continental shelf to whatever depth can be exploited--probably in time to depths of several thousand meters. According to this open-ended definition, the continental shelf eventually could include almost the entire ocean floor.

The writers of the Convention evidently underestimated the national interests in ocean-floor resources and the rapidity in development of marine technology. During the years since 1958 the underestimation has changed to overestimation of the potential profit of these resources, and the fear has arisen that exploitation will lead to conflicting claims and to a division of the deep-sea floor among only a few nations that have adequate financial resources and technologies advanced enough to exploit these areas. Under the Convention revision can be made five years after ratification by the required 22 nations; this date is 10 June 1969. As a result, proposals are being suggested to redefine the continental shelf as extending to a given depth, a given distance from shore, or to a given arbitrary line.

The Commission on Marine Science, Engineering, and Resources (1969b, pp. 145-156) suggested a seaward limit of any coastal nation's continental shelf beyond the territorial sea as 200 meters or 50 nautical miles, whichever yields the greater width. The Commission also suggested the creation of an intermediate zone having an outer limit at 2,500 meters or 100 nautical miles, whichever yields the greater width. In the first zone, the "legal continental shelf", the coastal nation has exclusive rights to explore and exploit the mineral resources; in the intermediate zone it has the same rights except that claims must be registered with an International Registry Authority. Farther seaward any nation may make claims for exploration and exploitation with registry and payments to the Authority. Off some coasts the depth limit of 200 meters would permit the "legal continental shelf" to be only a few miles wide. The 50-mile alternate limit is intended as a sort of equalizer, but off Peru and Chile it would permit the "legal continental shelf" to include the true continental shelf, the continental slope, a deep-sea trench (to 8,000 meters), and abyssal plains. Clearly, jurisdiction over geological resources must be based upon geological definitions, not oversimplified and thus confusing legal ones. Redefinition of a well-known, long-used, and perfectly good geological definition of the continental shelf to suit temporary legal desires is to be avoided; otherwise, the feature must be identified as the "legal continental shelf" or the geological (or illegal!) continental shelf. The legal definition is something of a subterfuge, about like the custom of stopping the clock in Congress in order not to legislate past a stated deadline. Are the lawyers so bereft of terminology that they must confuse geological terms by redefining them? Can they not find a suitable new expression for ocean-floor areas whose mineral resources are subject to national control? The law is highly dependent upon precedence; do lawyers fail to recognize precedence of usage in professions other than their own?

In order to avoid the confusion of applying well-known geological terms to legal objectives, the following terms are suggested as more suitable for legal use:

Territorial Seabed: The seabed under the territorial sea as defined by the Geneva Convention on the Territorial Sea and the Contiguous Zone in 1958.

National Seabed: The seabed beyond the territorial seabed in which the coastal state has jurisdiction over the seabed and its mineral resources. Its outer limit can be defined by depth, distance from shore, or other considerations.

International Seabed: The seabed beyond the national seabed.

Exclusion of Scientific Investigation

The Geneva Convention on the Continental Shelf in Article 5 (8) states, "The consent of the coastal State shall be obtained in respect of any research concerning the continental shelf and undertaken there. Nevertheless, the coastal State shall not normally withhold its consent if the request is submitted by a qualified institution with a view to purely scientific research into the physical or biological characteristics of the continental shelf, subject to the proviso that the coastal State shall have the right, if it so desires, to participate or to be represented in the research, and that in any event the results shall be published".

Many instances are known where permission has not been granted to scientific organizations to make studies of continental shelves. According to Revelle (1969) between 1963 and 1966 there were six instances in which other nations refused request from American vessels to conduct scientific research on their continental shelves or in their territorial seas, and during 1967 and 1968 (to September) there were 12 such refusals. The writer is aware of five examples during the first half of 1969. Still other instances are known in which German and Italian vessels similarly were refused permission to conduct scientific research on shelves. In some instances the permission may have been refused because of fear that the scientific study would reveal information of military value; presumably, it was not due to fear that valuable resources would be removed. Probably many failures to provide permission are due simply to lack of interest and understanding or to bureaucratic inertia of the government of the adjacent nation. In still other instances a request for permission cannot be effective if the nation of the oceanographic ship does not have diplomatic relations with the coastal nation adjacent to the continental shelf that is of interest.

The net effect of exclusion of scientific investigation from a given continental shelf is that the adjacent coastal nation (as well as the oceanographer) learns nothing about the shelf. The oceanographer can easily investigate a different, though apparently similar, shelf rather than waste time in further search for permission. Clearly, the trend is toward the gaining of more knowledge about the origin, composition and structure of continental shelves off nations that permit the making of studies and that have large coastal lengths. Since the usual sequence in science is *observation, understanding, prediction, and utilization*, it is obvious that the chances of eventual utilization are best where observation has yielded some information through free scientific investigation. Obviously, the bordering nation can easily control the exploitation (utilization) because of its proximity and because exploitation requires a long time and usually some permanent installations.

Article 3 of the Convention on the Continental Shelf states, "The rights of the coastal State over the continental shelf do not affect the legal status of the superjacent waters as high seas, or that of the airspace above those waters". This has sometimes been interpreted as meaning that the oceanographer may not sample the bottom, but that he may make geophysical measurements that have no direct contact with the bottom. This is a fine distinction, because more can be learned about the general composition and structure of the ocean floor by remote seismic, geomagnetic, and gravity measurements than by direct bottom sampling. Additional confusion in terminology is indicated by Article 5 (1), which states that exploration and exploitation must not "result in any interference with fundamental oceanographic or other scientific research carried out with the intention of open publication". Although geological investigation of continental shelves requires permission of the coastal state, the Convention on the High Seas preserves international fishing rights beyond an exclusive national fishery zone (usually 12 nautical miles wide, though 200 miles are claimed by several nations). Does this mean that rocks recovered in trawling for bottom fish are to be thrown overside without geological examination? It is to be hoped that the Convention will be revised so as to remove uncertainties about the words investigation, exploration, and exploitation and to permit scien-

tific investigation to be less easily blocked than by the 1958 Convention.

If the present control by individual nations over continental shelves is extended seaward into the deep ocean basins, it is bound to lead to further restriction of oceanographic studies and further failure to learn about the nature and origin of the ocean floor.

Delay of Exploitation

The present statements in the Convention on the Territorial Sea and the Contiguous Zone provide for boundaries between adjacent nations and opposite nations. Left to unilateral agreement are questions of preference for median lines versus lines of maximum depth between nations on opposite sides of open water. Cases of such situations occurring between the United States and Canada, and between Norway and Great Britain were decided in favor of the median line. Is such a decision reasonable for the ocean floor between the People's Republic of China (mainland China) and the Ryukyu Islands (Japanese, with temporary control by the United States)? The mainland and the chain of islands are separated by very deep water of the Okinawa Trough.

Islands can have an importance far beyond their land areas if median lines are to be based upon them; witness the large areas of deep-ocean floor thus controlled by Bermuda and the Hawaiian Islands. For this reason suggestions have been made that islands should control no more ocean floor than is equal to their area. Should not such a suggestion be applied to coastal nations as well?

There is no doubt that uncertainties in the law of sovereignty over the resources of the ocean floor are delaying the exploitation of these resources. A recent example is that of the National Republic of China (Taiwan) which awaits decisions on its boundaries with mainland China and with Japan before leasing ocean-floor tracts to oil companies for detailed exploration and exploitation.

On the other hand, the predicted excess of oil supply over demand in a few years may reduce the pressure for settlement

of ocean-floor sovereignties. A change from a seller's to a buyers' market should also reduce the ability of coastal nations to charge the high bonus payments and royalties that now are current. Moreover, it will reduce the need for oil companies to deal with some of the smaller and less stable governments of the world. Until the oil reserves on the continental shelf are rather fully exploited, the pressure for development of oil wells on the continental rise should be minor and thus not likely to demand immediate settlement of jurisdiction. However, the time will come when decisions about jurisdiction of the seabed in deep water will be needed.

Exploitation of sand and gravel and of heavy detrital mineral deposits is more a national than an international problem, because these resources occur mainly in shallow waters near the shore. Subsurface coal and iron mines belong in the same category, because they are worked from shafts sunk on land.

Phosphorite, manganese nodules, and hot-brine deposits of the Red Sea occur far enough from shore and/or in such great depths that jurisdictional disputes are likely to arise if the deposits can be exploited economically. Even though the economic values are still doubtful, settlement of jurisdiction would promote interest in advancing the technology of mining and extraction of metals in these deposits. All of these deposits appear to be thin-bedded ones that require mobility of the mining operation, not fixed installations as are needed for extracting oil and gas. For at least the manganese nodules, the area containing them is so vast and the economic demands relatively so small that mining operations can easily be shifted from area to area if bonus and royalty payments should become excessive, or if seabed claims of several exploiters should overlap.

References

- BROCKETT, E.C. and HEDBERG, H.D. (chairmen), 1969, Petroleum Resources Under the Ocean Floor: National Petroleum Council, Washington, D.C., 107 pp.
- COMMISSION ON MARINE SCIENCE, ENGINEERING AND RESOURCES, 1969a, Marine Resources and Legal-Political Arrangements for Their Development, Panel Report, vol. 3, U.S. Govt. Printing Office, Washington D.C.

- COMMISSION ON MARINE SCIENCE, ENGINEERING AND RESOURCES, 1969b, Our Nation and the Sea: A Plan for National Action: U.S. Govt. Printing Office, Washington, D.C. 305 pp.
- COMMITTEES OF THE NATIONAL ACADEMY OF SCIENCES AND THE NATIONAL ACADEMY OF ENGINEERING, 1969, An Oceanic Quest: National Academy of Sciences Publ. 1709, 115 pp.
- D'AMICO KATHLEEN J., 1968, Statistical summary: Bureau of Mines, Minerals Yearbook 1967, vols. 1-2, pp. 101-137.
- DEGENS, E.T. and ROSS, D.A. (editors), 1969, Hot Brines and Recent Heavy Metal Deposits in the Red Sea: Springer Verlag, New York, 600 pp.
- DE POURTALES, L.F., 1872, The characteristics of the Atlantic sea bottom off the coast of the United States: Rept. of the Superintendent for 1869, U.S. Coast Survey, Appendix 11, pp. 220-225.
- EMERY, K.O., 1966, Geological methods for locating mineral deposits on the ocean floor: Exploiting the Ocean, Trans. 2nd, Mar. Techn. Soc. Conf., June 27-29, pp. 24-43.
- EMERY, K.O., 1967, Geological aspects of sea-floor sovereignty: *in* Alexander L.M. (editor) The Law of the Sea: University Press, Columbus, Ohio, pp. 139-159.
- EMERY, K.O., 1968, Shallow structure of continental shelves and slopes: Southeastern Geology, vol. 9, pp. 173-194.
- EMERY, K.O., 1969, Continental rises and oil potential: Oil and Gas Journal, vol. 67, no. 19, pp. 131-243.
- EMERY, K.O., HAYASHI, Y., HILDE T.W.C., KOBAYASHI, K., KOO, J.H., MENG, C.Y., NIINO, H., OSTERHAGEN, J.H., REYNOLDS, L.M., WAGEMAN, J.M., WANG, C.S., and YANG, S.J., 1969, Geological structure and some water characteristics of the East China Sea and the Yellow Sea: Economic Commission for Asia and the Far East, Committee for Co-ordination of Mineral Prospecting in Asian Offshore Areas, Bangkok, Thailand, Tech. Bull. 2, pp. 3-43.
- FYE, P.M., MAXWELL, A.E., EMERY, K.O., and KETCHUM, B.H., 1968, Ocean science and marine resources: *in* Gullion, E.A. (editor) Uses of the Seas, The American Assembly, Columbia University, Prentice-Hall, Inc., Englewood Cliffs, N.J., pp. 17-68.
- GUILCHER, ANDRE, KUENEN, P.H., SHEPARD, F.P., and ZENKOCICH, V.P., 1957, Scientific considerations relating to the continental shelf: UNESCO, Conference on the Law of the Sea, 13/2 (mimeographed).
- MURRAY, JOHN, and RENARD, A.F., 1891, Deep-Sea Deposits: Report on the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873-76: Her Majesty's Stationery Office, London, 525 pp.

- REVELLE, ROGER, 1969, Scientific research on the sea-bed, international cooperation in scientific research, and exploration of the sea-bed: Symposium on the International Regime of the Sea-Bed, Istituto Affari Internazionali, Rome, June 30-July 5, 1969.
- SHEPARD, F.P., 1963, Submarine Geology, 2nd ed.: Harper & Row, Publ., New York, 557 pp.
- WISEMAN, J.D.H., and OVEY, C.D., 1953, Definitions of features on the deep-sea floor: Deep-Sea Research, vol. 1, pp. 11-16.

ON THE MINERAL RESOURCES OF THE SEA FLOOR
AROUND THE JAPANESE ISLANDS AND THE
PROBLEMS OF BANKS AND ROCKS SITUATED
OUTSIDE THE CONTINENTAL SHELF

BY

Dr. HIROSHI NIINO

Professor of Oceanography, Tokai University, Tokyo

1. *Topography and geology of the Japanese Islands*

The Japanese Islands are situated in the boundary area between Eurasia, the largest continent in the world and the Pacific, the largest ocean in the world. The Japanese Islands form a part of the festoon island arcs extended in the North Western Pacific and consisting mainly of the Japan arc proper, 1,300 km long, associated with a part of the Kurile arc in the northeast and the Ryukyu Arc in the southeast.

In addition, the Shichito-Mariana Island Arc extends from the north to the south crossing the Japanese Arc in center and Kyushu-Parau Ridge extends to the south of Kyushu. Between the festoon island arc and Asiatic continent, there are three marginal seas: Okhotsk Sea, Japan Sea, and East China Sea.

There is a remarkable difference in the submarine configuration of the sea floor in the continental shelf bordering the Asiatic continent and that of the island arc. The sea floor bordering Asiatic continent is broad and monotonous but that of the island arc is narrow and complex. The complexity is especially conspicuous in the tectonic region of the island arc, for example, Toyama bay and Suruga bay on the Fossa Magna—a famous tectonic line which divides the Japanese Islands into West and East.

Such characteristics of submarine topography due to the geological phenomenon occurred in the past as frequent crustal movement, active volcanism, multiple orogeny and repeated land connection with Asiatic Continent.

The main island of Japan called Honshu is divided by a magnificent rupture belt "Fossa Magna" traversing the middle part and separating the island into north-east Japan and south-west Japan, the latter in turn being divided by the median dislocation line trending parallel to the island arc into outer and inner zones. The outer zone is separated by two conspicuous strike fault lines named the Mikabu line and the Butsuzo line into the Sanbagawa, Chichibu and Shimanto terrains. The Sanbagawa terrain is composed of crystalline shist derived from Palaeozoic sediments, while the Chichibu terrain consists largely of less or non-metamorphic Carboniferous-Permian.

The Shimanto terrain is composed of folded Mesozoic and Palaeozoic sediments with some Neogene covers. In the inner zone, acid plutonics intruded the Palaeozoic and Mesozoic intrusives. Neogene basins are widely distributed especially in Honshu and Hokkaido, while the Palaeogene ones are mainly distributed in Hokkaido, Northwest Kyushu and the southern subbelt of the outer zone of southwest Japan.

Unlike southwest Japan, northeast Japan is covered extensively by Cainozoic sediments and volcanics. The Palaeozoic and Mesozoic form several isolated massifs such as the Kitakami, Abukuma, Ashio and Kwanto. Recent volcanoes are distributed mainly in Hokkaido, northeast Japan, Fossa Magna, the circum Japan Sea part of south Japan, Kyushu and Ryukyu inner arc.

It is a noteworthy fact that Fuji volcanic belt runs meridionally across the main arc of Japan along Fossa Magna, extending to Shichito-Mariana arc.

2. *Special submarine configuration around the Japanese Islands*

Many banks and submarine valleys exist on the continental shelf and adjacent sea floor around the Japanese Islands. Those banks and submarine valleys are interesting from the point of view of geology or oceanography. There is also a noticeable change in grade on the slope of the continental shelf around the Japanese Islands, simulating a terrace scarp on land. Those terraces appear at depth of 20 m, 140-180 m and 300 m., but vary locally. Also there are many volcanic cones along the sea floor near volcanic islands.

(a) Banks

1) Tectonic bank. Many islands and banks are aligned in northeast-southwest direction in the Japan Sea. Those banks consist of several parallel zones in which the depth of their tops increases step by step seaward from the Japanese Islands. The banks are arranged in a zone, but when examined in detail, the axis of each bank is oblique to the main direction of the zone. This arrangement is a sort of echelon structure. The top of a bank has a significant flat and broad surface, which at the margin descends abruptly to the deep sea floor.

The bed rocks are exposed on the steep slopes of the margin or in some parts of the flat surface, which are covered by gravel, sand and mud. The geological age of the bed rock of the majority of those banks is Tertiary as proved by the fossils contained in them. Judging from the bottom configuration and rock characters, these banks are tilted blocks which were isolated from the main island after deposition of the Tertiary rocks and then submerged by crustal movement or by eustatic rise of sea level.

Many banks are also found on the Pacific side of Japan, the characteristics of their shape and bottom are similar to those of the Japan Sea, but some of them show close relationship to the regional tectonic structure.

2). Volcanic banks. There are many submarine banks in the volcanic zone, but no special type or significant depth of them is established. The bed rock comprises lava, lapilli, pumice, commonly consolidated by recent organic remains. Sometimes coarse angular volcanic sand is distributed on and around the banks.

(b) Submarine valleys

Many submarine valleys exist on the continental shelf or slope surrounding the Japanese Islands. According to the record of echo sounding, traverse section of submarine valleys are V-shaped and closely resemble those of canyons on land. The course of the valley can be classified into a) Meander, and b) Straight. The depth of lower limit of valley can be traced a) down to more than 2,000 m and b) distinct about

800 m deep. The valley head reaches a) about 20 m and b) disappears at the flat plane of 140-160 m deep. Some submarine valleys are connected with the valleys on land. Dredging has proved that Tertiary rocks are exposed on the steep slope walls of the submarine valleys without exception and the gravels are distributed on the gentle wall of the valleys.

3. *Mineral resources in the sea floor around the Japanese Islands*

Today, the interest in the exploration of the underground mineral resources on the continental shelf, continental slope of Asiatic continent and its adjacent island area seems to be growing explosively.

The most fundamental requirement of exploring the submarine resources is to ascertain the existence of resources. The other geological, physical, and social factors are not less important and should be examined thoroughly at the time. The water depth, the distance from the shore, the state and its change of the sea, the facilities of the port, and the conditions of the available supplies are but few of them. In case of a continental shelf connecting two or more countries, there might be another type of problems which would restrict research activities in that area, as far as international law is concerned.

The exploration of mineral resources on the Japanese continental shelf has been increasing year by year. The kinds of minerals are coal, petroleum, natural gas phosphorite, magnetite, ilumenite, gold, sulfur, manganese, monazite and clay.

(a) Minerals found in unconsolidated marine sediments and in consolidated basement rocks.

Unconsolidated marine sediments can be classified into two groups: a) recent sediments on the sea floor, b) Diluvial sediments underlying recent sediments.

As those sediments are generally assumed to be of land origin, it is very important to examine coastal sediments in order to get better idea of the distribution of useful resources on the sea bottom. Therefore, countries separated by a strait should arrange for a better exchange of the necessary bathymetrical and sedimentary data. Besides these, the information about topography of the base rock, covered by the layers of sediments,

should be distributed through international means, for the base rock topography is closely related to the distribution patterns of mineral resources on the ocean floor.

1) Iron placer

The annual product of iron placer in the sediments of sea floor increases year after year. The record of annual product shows 523 tons in 1950, 2,387 tons in 1956 and 32,763 tons in 1959.

The location of iron placer producing area can be classified into three. 1) The sea floor around new volcanic district. 2) The sea floor along the Tertiary region where the rocks are of the volcanic origin. 3) Granite region.

In general, iron placer accumulates in tidal zone and also on the sea floor about five meters deep where waves break into surf. It also accumulates on the bottom at the depth of 20-30 m, this depth being the break zone of long waves or swells.

Iron placer is found in the unconsolidated sediments underlying the recent sediments. Often found is a rich ore in the buried coarse sand of the submarine valley.

2) Gold placer

Gold placer is reported from the sea floor of Esashi, Hokkaido and Omura bay in Kyushu but was never worked. In ancient times, Japan produced much gold placer, therefore it seems possible to produce gold placer.

3) Other minerals

Placer of monazite is known at the bottom of Kurushima strait in the Inland Sea and phosphorite deposit is found off coast of Ashizuri Peninsula, Shikoku. Manganese nodules are found in the sea floor of the Kashima bank near Cape Choshi. But those minerals are never exploited.

(b) Mineral resources in the basement rocks.

Many kinds of minerals are found in the basement rocks of the sea floor.

Fuel resources such as coal, natural gas and petroleum especially attract our attention today.

1) Petroleum and natural gas

Exploration for submarine oil and gas field has only recently begun. In 1958, a small quantity of petroleum was produced



Figure 1.

- Black . . . Distribution of Neogene Tertiary rocks
- Cross . . . Exposure of Neogene Tertiary rocks in the sea floor
- Line . . . Neogene water soluble gas field.

from Sarukawa submarine oil field and in 1964 five submarine oil fields produced 299,467 kl of petroleum and 765,999 m³ of natural gas.

The survey of submarine oil field is now going on the continental shelf around Japanese Islands and also on the banks

or continental slope. The result of the airborne and seaborne geophysical and geological survey shows that there are promising provinces for future submarine oil and gas field. The seaward edge of the continental shelf of the East China Sea appears to coincide with an extension of a tectonically folded zone of largely Neogene strata between North Kyushu and Taiwan where petroleum and gas are produced.

The sea floor and the coastal region of Northeast Honshu and Hokkaido along Japan Sea also belong to a tectonically folded zone of Neogene Tertiary strata where oil field is developed. The banks arranged outside of the continental shelf also belong to the extension of folded zone and there seems to be possibility of a new oil field.

2) Coal

The submarine coal field in Nagasaki region, Kyushu was explored about 100 years ago. Recently about 26 percent of annual product of coal of Japan was produced from submarine coal field. The water depth of the exploited coal field is 20-30 m. Galleries extend more than 7 km under the sea and reach depth of 940 m below sea level. Most of the submarine coal fields are situated off shore the coal fields on land.

The possibility of the further exploration of submarine coal field depends on the quality of coal and the geological data. There are large submarine coal fields under the sea floor of Ariake Bay, West Kyushu and also along the southeast coast of Hokkaido.

3) Phosphorite

The exploration of phosphorite in the Tertiary strata under the sea bed at Noto Island in Noto Peninsula took place about 60 years ago but the mineral is not being mined now. There is an exposure of low quality phosphorite deposit at the opening of Ashizuri Peninsula, Shikoku but it was never mined.

4) Manganese

Manganese nodules were dredged from the surface of the banks along the west side of Izu Island near Tokyo. The depth of the locations is 114-280 m.

The chemical analysis of the manganese nodules from 28 m deep is as follows;

6-NHCl soluble part		6-NHCl insoluble part	
Fe ₂ O ₃ , Al ₂ O ₃	2.88%	SiO ₂	0.34%
MnO ₂	58.54%	Al ₂ O ₃ + MgO etc.	0.34%
CaO	6.55		

A different type of manganese deposit was found off shore Aomori Prefecture. This deposit seems to belong to Tertiary marine deposit.

Those manganese deposits are not mined yet.

4. Conclusion

It is an eager desire of marine geologists that geological or geophysical data should be collected at every point of the sea. The supplementary materials collected by ordinary fishing boats, ocean liners and navy ships must be reported to the international data collecting agencies for this purpose.

A foundation may be effectively used to pay proper amount of money for confirmation of the report.

This foundation should be operated by an international organization, otherwise the narrow nationalism and territorial troubles might jeopardize its data gathering activities.

References

- NIINO, H., 1934. On the fossil locality at the sea bottom of Korea Strait. Jour, Geog. Soc. Tokyo, V, 9, no. 12, pp. 33-39.
- 1952. The bottom character of the banks and submarine valleys on and around the continental shelf of the Japanese Islands. Tokyo Univ. Fisheries Jour., V. 38, no. 3, pp. 191-403.
- 1955. On a manganese nodule and *Perolrochus* dredged from the banks near the Izu Island, Japan: Record of Oceanographic Works in Japan, Vol. 2, No. 2, pp. 1-5.
- 1958. On the bottom character of the submarine oil field in the continental shelf of Northeast Honsyu, Japan and a consideration on the relation between submarine oil field and insular shelf or fisheries bank: Tokyo Univ. Fisheries Jour V. 44, Nos. 1-2, pp. 131-144.

- NIINO H. and EMERY, K.O. 1961. Sediment of Shallow Portions of East China Sea and Bouth China Sea: Geol. Soc. Am. Bull. V. 72. p. 731-762.
- SHEPARD, F., NIINO, H., CHAMBERLAIN, R., 1964. Submarine canyons and Sagami Trough, East-Central Honshu, Japan: Geol. Soc. America, Bull. V. 75. pp. 117-1130.
- NIINO, H. and EMERY, K.O. 1966. Continental shelf off Northeastern Asia: Jour Sed. Petrology V. 36, No. 1. pp. 152-161.
- EMERY, K.O. and NIINO, H. 1967. Stratigraphy and petroleum prospects of Korea Strait and the East China Sea. Rep. Geophysical Exploration V. 1, No. 1, pp. 1-19.
- NIINO, H. 1968. A study of the marine geology around Danjo Island in the East China Sea and Mishima Island in the East part of the Korea Strait: Economic Commission for Asia and Far East. Mineral Resources in Asian Offshore Areas. Tech. Bull. Vol. 1, pp. 87-92.
- EMERY, K.O., HAYASHI, Y., HELDS, T., KOBAYASHI, K., KOO, JA MENG, C.Y., NIINO, H., OSTERHAGEN, J., REYNOLD, L., WAGEMAN, J., WANGE, YANG, S. 1969. Geological structure and some water characteristics of the East China Sea and the Yellow Sea: Economic Commission for Asia and the Far East, Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas. Tech. Bull. Vol. 2, pp. 3-43.

OIL AND NATURAL GAS; EVALUATION,
EXPLORATION AND EXPLOITATION
OF DEEP WATER PETROLEUM

BY

Dr. T.F. GASKELL

Scientific Adviser, The British Petroleum Co., Ltd., London

Formation of Oil

Oil is normally formed due to the decay of marine animals in shallow sea water conditions, the sort of conditions that exist in places like the Orinoco delta. Rivers bring down loads of silt and sand that are deposited in shallow water to form layers of sedimentary rocks. These sedimentary rocks trap with them the decayed marine animals, which, in the course of millions of years, change into the peculiar range of hydrocarbons from methane with one carbon atom and four hydrogens attached together at the one end of the scale, to heavy bitumens used for road making which may have a molecule with two or three hundred carbon atoms.

It is not just enough to have sedimentary rocks; the rocks must be porous to house the oil in a reservoir so that there is petroleum in sufficient concentration for economic production. Two kinds of sedimentary rock that are porous are limestones and sandstones. The petroleum is not contained in a vast underground cavern; it is held in very fine pores of this limestone or sandstone, pores that may be half a millimetre in diameter or less.

In addition to porous rock some form of trap is needed. The commonest type of trap is produced by a gentle folding of the porous layer of rock; petroleum, which is lighter than water, can then be trapped in the top of a fold with water sealing it and pushing it up from underneath. An impervious layer of rock, called "cap-rock", must rest on the reservoir rock to hold the petroleum in place.

With all these various conditions it is not surprising that commercially exploitable reservoirs of oil or gas are not continuous over a very large area, but are in fact the exception rather than the rule.

In a recent exploration area, the North Sea, which has an area of about 200,000 square miles, probably contains only a few hundred square miles' worth of porous reservoir gas-containing rock, which is only about 1/1000th of the area of the sedimentary basin.

Oceans and Continents

The continents, together with their shallow-water continental shelves, rise up from the deep ocean bed as if they were giant icebergs, with a great root of lighter material stretching down into the mantle rock. In the course of geological history, these continental blocks were subjected to tilting and warping, since they form part of only a comparatively thin skin on the earth, and are, therefore, affected by small readjustments in its body. A relatively slight tilting or warping of the European block could for example, change the North Sea to dry land again and flood the present-day land areas. All the continental blocks have frequently alternated between shallow water seas and dry land in the past.

Since the continental shelves are, from a geological standpoint, part of the continental block, and, therefore, subject to the continual reworking caused by erosion and re-deposition of sediments, it is not surprising that oil is found in these shallow water areas. In fact, the chances of finding oil offshore are as great, or small, as those on the neighbouring land areas. Economics plays a part in assessing the chance of finding an exploitable oil field. Since offshore drilling and production costs are far greater than similar operations on land, only large oil and gas fields are of value. The chance of an economic strike on continental shelves are, therefore, about 1 in 20 or 30 instead of 1 in 10 on land.

It is estimated that one quarter of the world's oil lies beneath the continental shelf areas. Since activity in offshore exploration and production is comparatively new in the oil industry,

there will be many discoveries of underwater oil and gas during the next few decades. These discoveries, however, do not mean that the whole of the oceans are covering vast quantities of petroleum. The continental shelves only account for a small fraction of the water covered area of the earth. A similar fraction in size is occupied by the continental slopes, while the greater part consists of the true ocean where the water is about 3 miles in depth, and which is studded with islands and sea-mounts and crossed by submerged mountain ranges.

The earth has an interesting structure. The 8,000 miles diameter globe consists of an inner half, 2,000 miles in radius, of probably liquid iron core. The outer wrapping or mantle, is solid rock which appears from earthquake measurements to be a basic type of material which may appear at the surface in the roots of the Alps or in the exposed Atlantic ridge at the St. Pauls rocks. The crust of the earth, the thin outer skin which controls man's destiny, is only 20 miles thick where there is land, and a mere 5 miles thick beneath the oceans. The discovery of these facts was made during the past 20-30 years and led to the interesting oil exploration which took place in the shallow continental shelves. Once it had been established that the crust was different under the ocean from that on land, there became first the possibility of oil on the shelves which are part of the continental structure, and at the same time there was less interest in the deep ocean because it could not be expected that they had beneath them the tons of thousands of feet of sediment that housed oil on land.

Geological Structure of the Sea Bed

There is considerable uniformity in the geological formation beneath the deep seas all over the world. The seabed itself consists of clay-like sediments which continue down for a few thousand feet. The lower part of the sediments are shown by seismic measurements to be some form of medium-hard rock, and they will be discussed in detail later under the somewhat amorphous, but generally accepted title of "Layer 2". The real hard rock of the primaeval ocean-floor lies beneath the sediment and Layer 2, and probably the most striking result

of all the seismic observations is the demonstration of the universal existence of this rock layer in which the sound velocity is 6.7 Km/sec. This same velocity is found in the Atlantic and Indian Oceans as well as in the Pacific, and well over a hundred measurements spread over the world are in close agreement with this figure. There seems little doubt that the rock layer consists of similar material in all the different places at places it has been recorded, and that it is a primary constituent of the earth's crust. If similar observations are made on land masses of the world it is found that there is also a change from sedimentary rocks to a hard rock basement layer. However, the depths of the basement rock is not the regular few thousand feet found in the oceans, but varies from tens of thousands of feet to zero where the basement rocks appear as outcrops at the surface. The sound velocity in the continental basement rocks is, moreover, much more variable than the fairly close limits that are found for the oceans. Both the soft sediment and the Layer 2 are of interest when considering the possibility of oil accumulations beneath the deep oceans.

The soft sediment layer is a few thousand feet thick and contains fine sediment from the land which has taken so long to settle that it has drifted away from the main deposition on the continental shelves. Another source of ocean sediment is material from outer space. The bulk of this material is in the form of meteoric dust, but occasionally large meteorites are collected by the Earth in its movement through the heavens, and these serve as more solid reminders of the constant accretion of matter that is taking place at the Earth's surface. There is also a contribution from volcanic eruptions which throw up a great shower of solid particles into the sky; gravitational attraction ensures that these gradually settle out of the atmosphere. Finally there is the rain of debris provided by the life in the sea — the shells and part of the organic remains of dead fauna and flora, all move inexorably downwards. In the deepest water many of the limestone skeletons and shells are dissolved before they reach the sea-bed, and therefore the red-clay of the deep oceans contains a preponderance of silica remains. In the shallower seas, the globigerina ooze is a graveyard for the more limy animals. Much can be deduced about the past history of the world by a careful examination of the sea-bed sediments.

Sometimes curious pebbles and even boulders are found, and care must be taken not to allow these 'erratics' to confuse the general picture. They have showered down from above after being carried from land by ice-bergs which have subsequently melted in deep water.

There is another type of horizontal movement which affects the distribution of sediment on the sea-floor. This is the downhill flow from the continental shelves towards the deep oceans, and it has the effect of increasing the thickness of the deep-sea carpet of mud, and at the same time smoothing out some of the local irregularities in the primaevial rock floor of the ocean. It is possible, by careful analysis of samples collected from the sea-bed, to determine what proportion of the material has originated in the continents and what is the result of the steady rain from above. It is to be expected that sediment layers will be thickest near land because here there will be the greatest contribution from sideways movement of material. This is in fact found to be so from seismic measurements. In the deep Pacific, for example, about 3,000 feet of sediment is found a few hundred miles east of Japan, whereas the average for the more remote deep ocean is only about 1,000 feet. Then again, a breakdown of the results into groups determined by the depth of water shows that those in shallow water have a thicker sediment cover than those at the greater depths; the shallow water measurements, on average, are closer to land than the deep-water ones. The thickness of these deep ocean sediments appears to be inadequate to be a source rock for an oilfield, although the marine life necessary as the starting point for petroleum formation does exist.

Layer 2

It is possible that Layer 2 in some parts of the Pacific ocean consists of a layer of limestone, and that it is sandwiched between the soft sea-bed sediment and a further layer of sediment beneath Layer 2. If this is so the limestone layer might form porous reservoir rock, which could possibly contain oil. This could have been formed say in the Cretaceous period some hundred million years ago, when enormous animal activity in

the seas laid down great thicknesses of chalk and limestone all over the world. If there was an excess of lime-loving marine life in the shallow seas where the thick continental rocks were deposited, there could equally well have been suitable conditions for strong marine growth in the deep oceans. There are many signs that the Cretaceous period was a critical one in the Earth's geological history, and it is quite likely that changes of climate accompanied other catastrophic changes that took place.

Suitable folds in the limestone, assuming that such a layer exists, will be a further requirement for an oil accumulation, and an impervious layer to contain the oil and gas. From what is known at present, the possibility of finding oil in the rock strata of the deep ocean floor is remote.

Continental Slopes

There has been optimism in some quarters that large oil accumulations may exist on the continental slopes or at the foot of the slopes, where continental type material has slumped down from the continental shelf, or has been carried by turbidity currents. These latter are formed by a suspension of mud in water, and this mixture, being heavier than the plain water, tends to sink. If the sea-bed is sloping, as it is on the continental shelf, the mud and water mixture starts to flow downhill, just like a river. The slopes are steep and long and the mud and water gradually gathers speed until it is moving as fast as an express train. Once started in this way, the very force of the current scours up fresh bottom material to augment its initial volume, and the torrent careers downwards until it comes to the flat plains of the deep ocean, where its momentum allows it to gorge out a river bed in the sediment that has already collected there.

It may seem strange that a stream of mud and water can move through water with the speed of an express train. In fact, when the turbidity current was first mooted it was greeted with scepticism by many geologists. It becomes a little easier to accept if it be compared with avalanches in snow fields. In some avalanches one body of snow slides comparatively slowly over rock or over more snow in the same way that snow slides

off a warm roof, but there are times when the snow and air form a turbulent mixture which races down the mountainside at speeds of the order of hundreds of miles an hour. Then again, there are the katabatic winds which flow at up to a hundred miles an hour down the mountainside in some parts of the world. These winds are merely the result of a cold, and therefore heavy, layer of air sliding in turbulent fashion below the normal warm air. It is easy to see that high speeds are possible if once it is admitted that the resistance to motion is small. A hundred and twenty feet of vertical fall are enough for a dropping body to reach a speed of sixty miles an hour. Sometimes a mixture of ash and hot gases from a volcano forms a layer that is heavier than the surrounding air; instead of sliding gently down the slopes of the mountain the mixture rushes down at great speed to catch its victims unawares, as in the suffocating holocaust of Mount Pele. Mathematical calculations show that water weighted with mud, provided it moves in a turbulent fashion, should flow in flat streams about ten feet thick with surprisingly little friction. This theoretical work is supported by model experiments which demonstrate the way in which turbidity currents maintain their entity even though they are flowing through water which would be expected at first sight to oppose and break up the forward movement. No one has actually seen a turbidity current, so that the fact that models and mathematics show them to be possible does not mean that they do play any part in the formation of the deep oceans. However, there are several pieces of experimental evidence which can be readily accounted for if turbidity currents are accepted.

Many cores taken from the flat deep sea-bed of the Atlantic show not just plain clay, but alternating bands of sand and silt, together with fossils similar to those found in shallow water deposits and clearly belonging to shallow water animals. It is possible that some movement from shallow to deep water could take place by slumping of great lumps of sediment down the continental slope, and such slumping undoubtedly does take place. It does not explain, however, the long distance of travel that is necessary to account for some sand and shallow water fossils way out in the almost flat part of the deep ocean. Furthermore, it does not explain the details of the bedding

and grading of sand grains which are observed in the deep-sea cores and which fit the turbidity current theory very nicely.

Although the laying of the Atlantic cable was one of the main reasons for starting the nineteenth-century study of the sea-bed, it was not until comparatively recent times that modern oceanographers and cable layers found that they had between them a fascinating set of experimental facts relating to turbidity currents. Cable breaks have long been associated with earthquakes, but it was always considered strange that, when several cables were broken by an earthquake, they did not break simultaneously. The times of failure were usually recorded accurately since the cables were in use; the results form a very well-recorded natural phenomenon for this reason. It is possible that the earthquake loosened a large mass of sediment which slumped on to the cables, but large masses of sediment do not travel very far — unless, that is, they form a turbidity current. Turbidity currents could travel down the continental slope, cutting all cables in their path. If the cable breaks are examined, with this possibility in mind, the pattern of times of breaking falls very well into line. They can be explained by a turbidity current, which always moves downhill, as one would expect, and which travels at a speed of about 50 miles per hour on the 1-in-10 slopes, and at a slower speed of about 12 miles per hour where the flatter part of the ocean-floor is reached. Thus not only can the cable breaks be accounted for in a reasonable way, but also the times and location of the breaks themselves provide a measure of the speed of travel of the currents.

There are mechanisms, then, for transporting considerable thicknesses of continental type sediments both to the continental slopes and to the deep ocean floor at the foot of the slopes. However, there has been no evidence, for example from sepages on the sea-bed, that this sedimentary material on the continental slopes or at the foot of the slopes, does contain hydrocarbon deposits. No oil company has yet considered it worthwhile to look for oil in this area, so that the lack of positive evidence could be due to the paucity of observations.

To sum up — oil fields of commercial value can be expected and have been found below the continental shelf areas of the sea; there may be an overspill of oil source rock sediments

onto the continental slopes, and even to the foot of these slopes, but there has not been any sign of an oil field in this zone; the sediments on the deep ocean floor are thin compared to known oil producing areas, and although it is not possible with present knowledge to assert that no oil will be found under the deep oceans, the chances of oil existing in this area are small.

Exploration

(a) Continental Shelves

On land, especially in places where there is sparse vegetation and little surface cover of soil, it is often possible to locate the rock folds which form underground oil reservoirs by visual examination supplemented by aerial photography. When the prospective territory is covered by opaque sea water, such examination is almost impossible (although some new tools have been devised to probe the water and the sea-floor mud, and some useful observations can be made by diving). Therefore, in order to locate underground structures that could be potential oil or gas reservoirs, geophysical methods must be employed.

Three main geophysical tools are used in the oil industry and all have been adapted for use in offshore prospecting. Measurements of the earth's magnetic field in different places give an empirical measure of the thickness of the sedimentary rocks. This is because magnetic field changes are caused by the intrusion of volcanic material into ancient basement rock, and these changes are blurred if the material is distant and covered by thick layers of sedimentary rock. Magnetic measurements can now be made rapidly from an aircraft, and in places like the North Sea or the Gulf of Thailand they have confirmed geological opinion that there is a sedimentary layer several miles thick.

Surveys of the earth's gravitational field, made to an accuracy of one part in a hundred million, have been most effective on land in pinpointing oil fields associated with salt-plugs. Salt behaves geologically as a fluid substance such as pitch, and thick layers of salt, when compressed by the weight of the overlying

rock, burst out into vertical moving plugs of salt. The upward pressure of the salt plug causes the overlying rock strata to bend into structures that form traps for oil or gas. As salt is less dense than the surrounding rock, the presence of these salt plugs can be located by an accurate gravity survey. At sea unfortunately the movement of the waves precludes any measurements of gravity to better than a few parts in a million and, therefore, gravity measurements only serve to assist in building up a picture of the regional geology rather than in locating specific structural traps.

The seismic reflection method is the one that points the way for the offshore driller. The seismic 'probe' uses sound waves from an explosion or a special noise source to plot the sub-surface profiles of the layers of rock. The sound echoes from discontinuities in the underground strata, and the travel time of the waves is less when reflected from a hump in the rock layer than when reflected from a valley. The technique is relatively easy to use — so much so that in spite of the inherent expense of any operation associated with ships, it is cheaper to survey a given sea area than a similar one on land. This is because on land the explosive charges must be put 50 to 100 feet below surface in order to give a strong wave in the ground. Furthermore, at each shot the instruments must be precisely laid out and moved again for the next. At sea, the instruments are trailed behind the ship with fixed relative positions, and the location of the recording is automatically plotted.

The speed of the method at sea has required rapid advances in automatic processing of the records, and today most recording is made on magnetic tape. In many cases, it is recorded in digital form so that it can be fed directly to a computer. This corrects for such factors as depth of the water, and it also allows many empirical calculations that would be too tedious to do in any other way.

There have been many attempts to devise a combination of geophysical and geochemical methods that would specifically select the structures actually containing economic quantities of petroleum from the others — approximately ten times as numerous — that are merely promising. However, none of these has yet been proved reliable, and the expensive method of drilling is still the only one that can eliminate those structures

indicated as promising by seismic reflection that in the event either contain water or consist of nonporous rock.

Seismic reflection techniques have proved adequate to perform the difficult task of determining the structure of the rock layers at depths of 10,000 to 15,000 feet below the sea floor on the continental shelves. The methods of collecting the results and of analysing them are both being improved as experience is gained by working in areas of increasing geological complication and greater depth of structure, and there is no doubt that the major oil resources of the continental shelf area of the world will be found in due course. It is estimated that one quarter of the world's oil reserves exist in these shallow water shelf areas.

In order to test whether the favourable geological structures located by geophysical methods contain oil (or whether they are "dry" meaning that they hold only water) it is necessary to probe the rock layers with the drill.

Drilling is by far the most expensive operation in looking for oil, and a 'wildcat' well at sea may cost as much as half a million pounds. The heavy drilling equipment must be held in position above the sea surface either by a platform supported on legs which rest on the sea floor, or as a floating structure. The most popular technique in the North Sea has been the use of the 'jack-up' type of platform, where an artificial island is erected by raising the drilling equipment above the sea surface well out of reach of the highest waves. In water depths of more than about 200 feet, ships' hulls, fitted with a drilling derrick, are anchored in position, but these are not suitable in very rough weather. The latest type of exploration drilling rig is the 'semi-submersible', which is a floating platform which takes its buoyancy from chambers 70 feet below the sea surface. This makes the platform stable even in bad weather, since the up and down water movement diminishes rapidly with depth.

Although offshore oil production is a comparatively new venture, knowledge and experience have been gained gradually over the past twenty years; offshore drilling rigs are now familiar sights not only in the Gulf of Mexico but also in the Middle East, Nigeria and Australia.

(b) *Continental Slopes*

The depth of water over the continental slopes ranges from about 600 feet to 15,000 feet. At the top end exploration techniques applicable to the shelf may be used. The problems of position fixing become more difficult in seismic reflection work, as the distance from navigational aid stations on shore increases. However, in the future accurate positioning will be possible with the help of the new navigational satellites.

The large semi-submersible drilling platforms are capable of operating in depths up to about 1,500 feet. Beyond this depth anchoring becomes difficult, but the method of 'dynamic positioning' is now well tried and will be commonplace even on the shallower shelf areas in a few years time. In place of anchors, the craft is maintained in position in face of wind and currents by means of auxiliary motors which are automatically switched on to oppose any drift.

(c) *Deep Ocean*

Geophysical methods of exploring the sea bed were in use in the 1930's by physicists who studied the sea-floor rock strata, and the adaptations of these techniques to find oilfields were made at a later date. The three methods, magnetic, gravity and seismic, have produced those results which have led to the modern ideas of continental drift, movement of the sea bed, formation of mid-ocean ridges, etc. There is no reason why these geophysical methods should not be used on the continental slopes and on the deep ocean floor to locate structures that could house oil. The information given earlier concerning sediments and Layer 2 has been obtained by seismic refraction experiments. In refraction, as opposed to reflection seismic work, the sound waves from an explosion are used to probe the underground rock layers, but instead of following the contour or a deep-seated rock layer by observing the time taken for the sound to echo back to the surface (as in the reflection method), the refraction technique follows that used by earthquake seismologists. The shock waves, from explosion or earthquake, are recorded at a series of distances from the source, and by a suitable analysis of the travel times of the waves that

have traversed the rock layers, it is possible to determine the depth of the interfaces between different rock layers, and to label the rock layers as being similar or different by means of the velocity with which the sound waves travel in the respective layers.

Although the refraction seismic experiments have shown the geological structure beneath the ocean floor, and therefore have made it possible to distinguish between the ocean regime and that pertaining to the continents, it is probable that the more detailed survey of the local irregularities in rock strata that may provide oil traps cannot be recognised by this method. Seismic reflection measurements have been made in deep water, but it is probable that they may not have the discrimination that is achieved on land or on continental shelves; the 20,000 feet cover of water will cause the detail of the geological picture to be blurred. However, the history of the international oil industry suggests that scientists and engineers working oil in exploration will overcome the problems and, if there are promising targets for oil in deep water, methods of finding them will be discovered.

At the present moment a project is being carried out to make a next step forward in our knowledge of the geological structure of the ocean floor. The National Science Foundation of the U.S.A. is producing the financial support for a Deep Sea Drilling Project which is being operated jointly by the major oceanographic research institutes of the U.S.A. This JOIDES* programme has already completed the four cruises planned for the Atlantic and is currently investigating the Pacific Ocean. It has been realised by marine geologists for some time that sea-going geophysical experiments are limited in the facts that can be gathered, while at the same time these ocean experiments are very costly. It is not so much more expensive to sample the sea floor to penetrations of the order of thousands of feet using the techniques developed by oil companies in their offshore continental shelf exploration.

The Deep Sea Drilling Project uses a Global Marine ship-mounted drilling derrick and maintains the station in any depth

* The reports of this work will be published as soon as they are available by the office of the Deep Drilling Project, Scripps Institution of Oceanography, Post Office Box 109, La Jolla, California 92037, U. S. A.

of water by dynamic positioning. The work in the Atlantic has demonstrated that the drilling equipment works very well in deep water, and in quite severe weather. The first test site was in the Caribbean, in the Sigsbee Abyssal Plain, and the rocks encountered during bottom penetration of the order of more than 2,000 feet were the expected ooze, but also limestone and evaporites more usually associated with shallow water marine deposits. In one boring on an elevation raised by a salt dome, oil and gas was found in a limestone rock. The depth of water at this site was over 11,000 feet, and it might be supposed that this finding demonstrates the possibility of the existence of oil reservoirs below the floor of the deep oceans. It is difficult to understand, however, in what manner salt and other evaporites have been formed in deep water, although some marine geologists believe this to have been the case. Most marine geologists subscribe to the theory of continents and ocean floors being both permanent and separate so that at first sight it must be accepted that the finding of salt and oil saturated limestone at a depth of two miles of water is an indication that a mechanism for both crystallisation and oil formation at great depth must exist. On the other hand the Caribbean, lying between the two large continental masses of North and South America and surrounded by long thin land connections or by lines of volcanic islands, is a part of the earth's surface where one would expect to find anomalous crustal structure. If one subscribes to the theory of continental drift, this is an area that has suffered terrific contortions in the past few hundred million years. It is possible that the movements and forces that have been brought into play could have pushed blocks of continent down two miles below the sea surface, or slid a surface slice to the side of the continent. On this premise, we would say that the Caribbean drilling results are exceptional and that, normally, continental type shallow water sedimentary rocks are not found at the bottom of the deep oceans. It is not right, however, to be dogmatic, and the further results of the Deep Sea Drilling Project in other deep oceans are awaited with great interest.

The whole picture of the sediments at the bottom of the deep oceans will be clarified by the deep sampling provided by the JOIDES project. In the first instance a better evalua-

tion of past geophysical results will be possible. The nature of the soft sediment layer, and of layer 2 will be determined. This will allow more accurate calculations of the thickness of the sedimentary column of the ocean floor rocks to be made. The extra knowledge obtained by examination of the fossils in the sediments will help to prove or disprove theories of continental drift and of progressive movement of the sea floor. A better understanding of geological history will make more reliable any forecasts of what minerals may lie beneath the sea floor. The Deep Sea Drilling Project is probably the most important line of scientific research that is being carried out today to determine the mineral resources of the deep ocean floors. Some of the borings that are planned are located on continental slopes, and again, the results will be most valuable as a pioneering lead for future commercial exploitation of these intermediate areas. In much the same way that academic curiosity started geophysical experiments at sea, which in turn led to oil industry realisation that the shallow shelf areas were geologically part of the continents, so the latest lines of research may one day lead oil companies to prospect in detail on the continental slopes. The oil companies will be occupied with the shallow water offshore prospects for some years, and it will form a reasonable development if marine geological research can provide evidence of new prospects for the future.

There is one shortcoming of the Deep Sea Drilling Project. The penetration of the sea bed is limited to that distance that can be drilled before the drilling bit wears out. If the bit has to be pulled out of the bore-hole to the surface in order to be renewed, it is impossible to guide the drill back into the same hole 2 or 3 miles below the sea surface. This re-entry problem is, of course, able to be overcome. The Mohole project, which was planned for several years and was only abandoned due to lack of financial support, had the aim of drilling 5 miles or more through the sea floor in order to sample rock of the earth's mantle, which forms the inside of the earth beneath the thin veneer of crustal rocks. The Mohole would call for many bit changes, and in order to re-enter the bore-hole a system was devised whereby a guide pipe, supported by special pressure resisting floats, would reach to within a few hundred feet of the sea surface. At this depth the pipe would be free

from damage by waves, yet within easy reach from the surface drilling craft. If oil exploration is to take place in deep water, some form of re-entry system will be needed. It is probable that the success of the Deep Sea Drilling Project in providing new facts about the sea floor geology will encourage financial support for the future, so that not only will the project be continued indefinitely, but it will develop into a deeper drilling project able to penetrate to the depths that can be reached by drilling engineers on land.

It is very expensive to drill at sea, even on the continental shelves, where an exploration well may cost one million dollars or more. There is no doubt that the logistical problems, together with the greater cost of a deep sea drilling vehicle, will make it even more costly to operate in the deep oceans, hundreds of miles from land. It will be necessary, at present day values of petroleum, to find very large reservoirs to make any discovery an economic one. A large amount of risk capital will be needed even to explore the deep ocean prospects, so that any hopes of a world organisation becoming rich in a short time are unrealistic. If the oil rights are reserved to such an organisation, there will be many years of putting in risk money for exploration, before there is any prospect of taking anything out. The world organisation could lease rights to established oil companies, but again due to the time it takes to find and develop an oilfield, any financial return will be well into the future.

Exploitation

(a) Drilling

If the re-entry problem of drilling in deep water is solved for exploration purposes, there will be no insuperable obstacle in drilling for production. The cost per well for production will be considerably less than for wildcat exploration wells, as is the case in continental shelf production. It is normal practice to drill several producing wells from one platform location, by deviating the boreholes so that they reach the underground reservoir at different places. In deep water a similar

procedure could be adopted, using one sea bed assembly and deviating the hole below the sea bed.

It will be many years before production in water depths of 10,000 to 20,000 feet will be called for, and it is possible that by the time it is required, a method of drilling from the sea bed itself may have been developed. It is not practicable at the present time to build fixed platforms standing on the sea bed in depths of water much greater than 200 feet. For greater depths than this on the shelf areas, floating and semi-submersible platforms are used, and valves and safety devices are placed on the sea floor. With bottom completion of production wells, the oil and gas can be collected by pipeline and brought to the shore without recourse to a platform. In some instances, the gas and oil are separated at the sea bed before being sent along the pipeline, or to a tanker loading point at the sea surface, or to an underwater storage tank.

Production drilling would probably be carried out from a large semi-submersible type platform operating from the sea surface. This type of craft will be well tested by the time it is required for this task. However, some inventive thought has been given to working from a chamber below the sea surface, out of reach of wave action, and anchored to the seabed. It is possible that this type of assembly may be better for production drilling, since it could subsequently house the production control gear and the tanker loading facilities.

(b) *Production*

The developments that are taking place in order to cope with production problems on the deeper parts of the continental shelves will lead the way to the ultimate problem of producing from the deep ocean floor, if such a problem ever presents itself. However, there will probably always exist one fundamental difference between work on the deeper parts of the continental shelves, say to depths of 1,000 to 1,500 feet, and operating at true ocean depths of 20,000 feet. This is because, although the working depth of divers has been increased very greatly during the past twenty years, it does not seem possible that the human frame will ever be able to go uncased to the greatest ocean depths. Diving is needed for inspection and for emer-

gency repair work. Although it is possible to perform the most complicated manoeuvres from the sea surface, the use of divers speeds up work and they are always used. Small submersible craft are, however, developed which will enable engineers to inspect while working under atmospheric pressure. Craft have already descended to the greatest depth of the ocean (the Challenger Deep in the Marianas Trench, first discovered in 1951 by the British survey ship HMS Challenger; the water depth is in excess of 35,600 feet), and therefore inspection of well head fittings etc. on the deep ocean floor would be feasible.

If any oil is discovered under the deep oceans, it can be assumed that it will be contained in a large reservoir, since the cost of production would rule out development of small oilfields. It will also be a fact that the oilfield will be several hundred miles from land. There will be two courses which the production scheme may follow. Pipelines could be run on the sea floor to take oil to a land terminal where normal gas/oil separation, storage and tanker loading installations exist. No one has yet laid pipelines in ocean depths, but a great deal of thought has been given to pipelines across the Mediterranean where the water depth of 9,000 feet is considerably greater than on the continental shelves, and there is no doubt that pipelines could be laid across the deep oceans if they were needed. Telegraph cables have been strung over the oceans for more than 100 years, and a wealth of experience exists in this type of operation. The only snag is that, as with drilling in 20,000 feet the costs of pipelaying will be several times the cost of doing a similar operation on land.

An alternative to long undersea pipelines and a land base is to load tankers at some form of artificial island base floating above the oilfield. This could take the form of a semi-submersible platform similar to those used for drilling, or as has been mentioned above, it could be floating out of reach of wave action a few hundred feet below the surface, held down by anchors and cables. It might even be an economic proposition to resuscitate the war-time Habbakuk project, which was to make a large mid-ocean airfield of ice. A large artificial island constructed on these lines might well be the cheapest form of structure for a production life of 20 to 30 years. The well heads on the sea bed would be connected by vertical pipe to the artifi-

cial island, or submerged platform. There are considerable problems associated with a 20,000 foot length of vertical pipe joining the well head to the surface. Steel is not strong enough to support such a length of pipe and the whole weight of pipe must be suspended from the surface floating installation. Fortunately the design work for the Mohole project covered the problem of re-entry of the drill bit into the bore hole by means of a vertical steel guide pipe. The support for the pipe was to be achieved by floats spaced at intervals along the length of the pipe. The floats at the lower end of the pipe must be able to withstand pressures of the order of 10,000 pounds per square inch. The material chosen was a plastic impregnated with minute thin walled glass spheres. Provided the spheres are small enough they will resist the high pressure and yet provide buoyancy in water.

The oil could be shipped from the production platform by normal tanker operation. Considerable experience has been gained recently of loading tankers from single point moorings, without any need for a jetty for the ship to come alongside. Some form of storage is necessary. This could be provided by tanks either on a floating platform or ice island, or a submerged production unit. It is possible that a sea floor tank might be used as storage. This would be filled from the sea floor well head when required for loading at the sea surface.

All the devices, such as underwater storage tanks, deep water pipelines, remote control system are being developed for work in the deeper parts of the continental shelves. There is plenty of information available for engineers to enable them to adapt their techniques to very deep water. However, when planning for the future, it must be remembered that large capital expenditure will be entailed and that the operating costs will be higher than in shallow water oil production. Not only will oilfields be in much deeper water, but they will also be a great deal further from land than presently produced offshore fields.

Conclusions

When considering the possibility of oil in the rock strata that lie beneath the deep oceans, it is necessary to realise that

the geology of the deep ocean floor is fundamentally different from that of the continents and their continental shelves. This can be used as an argument for and against the probability of discovery of large oil fields beneath the oceans. Since the geological regime is quite different from that on land, it could be hoped that some new type of oil deposit might be found in the sediments of the sea floor. However, one should not be very optimistic, since the deep sea sediments, which on any supposition are needed to provide sources of oil accumulation, are probably only a few thousand feet thick beneath the oceans. On the other hand, the history of oil discovery shows that unexpected discoveries do occur, and, therefore, there may be some rich fields beneath the ocean floor, and also on the continental slope. One thing is certain, it is stupid to attempt any extrapolation from the oil content of the shallow continental shelves to the vast area of the deep ocean floor. Anyone who does such extrapolation is either ill-informed or is ruthlessly trying to distort the geological picture.

The U.S. Deep Sea Drilling Project is providing that sensible long term examination of deep sea geology that is a natural extension of the marine geophysical work that has produced such interesting results over the past few decades. It is from these borings that we shall obtain information to confirm or deny some of our modern geological and geophysical theories of the past behaviour of the earth, and this pioneering work will demonstrate to the oil industry the need for more concentrated activity, if any interesting oil indications are found. Although the tools for exploration of the deep oceans are available, the work is very expensive, and an enormous oil reservoir (say 1,000 million tons or more) would be needed to make any production economic. There is plenty of work for oil company exploration on land and in the shallow water shelf area of the world, and it is unlikely that any deep water exploration will be economic until the resources of the continental shelves have been worked out in much greater detail.

INTERNATIONAL REGIME OF THE SEA-BED;
OIL AND NATURAL GAS
EXPLORATION AND EXPLOITATION
OF DEEP WATER PETROLEUM

BY

Eng. GIUSEPPE MUSCARELLA
Technical Service, AGIP, S.p.A., Milan

The continuous expansion of the human population of the world, the continuous improvement of its living standard, have already created the necessity of exploiting resources which only a few decades ago were considered unexploitable, if considered at all.

One of the major potential reservoirs of resources, mineral, biological, chemical and of various other nature, are the oceans, to which the attention of scientists and technicians has been particularly dedicated in the recent years in order to examine the practical possibilities of use offered by such resources, and to develop basic and applied research programs for their study and exploitation.

Based on the current status of this research, there is no question that in the near future the oceans will yield more and more of their wealth through the ever expanding achievements of science and technology.

In addition to the possibility of exploiting tangible resources of the types mentioned above, there are many services for which the oceans can be used, such as waste disposal, transportation, military bases etc.

In the continuous effort to extend the areas explored for new resources, the operations will be conducted in deeper and deeper waters, and technology is being developed to reach this objective.

Almost any nation in the world has jurisdiction over off-shore areas, whose boundaries have been defined by international

agreements; within their offshore boundaries, the coastal countries have the right to explore and exploit those natural resources that lie permanently upon the sea bed or are contained beneath it, outward from the coast edge of the continental shelf, (defined as the 200 meter water depth contour), and beyond that limit for so far as the depth of the superjacent water admits the exploitation of such natural resources.

Considering that the development of the offshore activities is expected to be effected in the areas toward and beyond the 200 meters (600 ft) water depth contour, it is obvious that the establishment of an international control regime for the activities of different nature that are going to be developed within and beyond the continental shelves, is of utmost importance for the countries and for the companies interested in such activities.

The present paper deals with offshore petroleum exploration and production, and gives a panoramic view of the state-of-the-art of today's deep-water activity and technological research; an illustration of the possible solutions of the problem of exploiting deep-water petroleum that may be feasible within the next decade; and some economical considerations relating to offshore activity.

This paper is therefore written from the technological and economical point of view and should furnish to the legal experts data upon which they can develop recommendations to the appropriate bodies, for the study and approval of international regulations governing the offshore operations.

The statistical data of any kind included in this paper are those available at the time of preparation of the text; variations may have occurred in the interim period.

Offshore exploration

Until a few years ago hydrocarbons exploration in sea waters was limited to a few regions in the world (Gulf of Mexico, Lake Maracaibo and the Caspian Sea) but it is now continuously expanding throughout the world, as the industry, due to the growing demand of fuel energy and to the fact that most of the inland favourable petroleum regions have been explored, is

looking to the continental shelves and adjoining deeper waters for obtaining the necessary future reserves.

Oil is found throughout the world in depressed areas or basins, which are filled with sedimentary rocks. The term "basin" is used in several different ways by petroleum geologists, but we may define sedimentary basins as downwarped areas that were usually submerged through long periods of geologic time and have been subject to intermittent sinkings, so that the sediments, deposited during such times of depression, increase in thickness from the edge to the center of the basin. Particular types of basins or *embayements* are the ones found along the continental margins, where the oceans in the geologic past have overlapped the continental borders, accompanied by a downwarping of the inundated areas with a resultant seaward thickening of deposited sediments. On the ground of the basic conceptions that large oil fields are usually found in sediments deposited in deep marine basins, that petroleum seems to have originated from organic matter of former marine life, and that the natural reservoirs which contain accumulation of oil are usually of porous rock, it becomes clear that under-sea basins have a fundamentally superior environment for the generations and accumulations of petroleum.

Exploration at sea has to be indirect as only inferred geological properties may sometimes be established through direct observations on nearby land. Thus all marine survey work is restricted to geophysical exploration, based on variations of physical properties such as the magnetic field, the gravity field and the acoustic properties of the soil. These are measured by various methods, and enable the interpreter to deduce the presence of geological phenomena that are favourable to the accumulation of hydrocarbons, such as sufficient thickness of sediments and trapping mechanisms.

Following the great advances that have been made in the last ten years in exploration, and particularly in geophysical techniques, an assessment of potential areas is now continuously being carried out not only by oil companies that are specifically involved in the exploration of acquired areas, but also by governmental agencies (although mostly on a scientific basis) and by private geophysical companies that rely upon the purchase of the results of such surveys by oil companies. Thus lately,

many reconnaissance magnetometric, gravimetric and seismic surveys have covered substantial offshore areas of the world. The most significant example of seismic reconnaissance survey is the world-wide ocean traverses carried out by U.S. geophysical companies for a total of more than 40,000 Kms around most of the continents and through the Atlantic, Indian and Pacific oceans. Oil and gas firms are paying ever more attention to oceanographic research. Oceanographic institutions, conducting what was considered at the time essentially as basic research, have found numerous offshore oil prospects.

These institutions are leading the way into ever deeper water, as for example indicated by current investigations of the Sigsbee Knoll in the center of the "Gulf of Mexico".

Also Gulf Oil Corporation's new oceanographic ship indicates that in the future numerous oil firms may seek more information on marine areas where still little is known about the surface section. New offshore sedimentary basins will be sought not only where adjoining mainlands give some hint at petroleum prospects (e.g., Norwegian Sea, Bering Sea) but where unknown sedimentary basins may be identified in large open ocean areas.

Many areas now are opening up, particularly in the Far East, Africa, South America and the Arctic, all of which should continue the trend to offshore and to deeper waters that was commenced in the oil business about ten years ago. The industry trend toward exploration in deeper waters has induced experts to make worldwide inventories of the extension of under sea basins and their hydrocarbon productive potential. Up to now estimates concerning submerged areas near the coast have been made only up to the depth of 1000 ft. Mr L.G. Weeks, an eminent American Geologist, trying to assess, in 1965, the potential hydrocarbon resources of sedimentary rocks of the continental shelves and beyond to the 1000 ft depth, has considered in his paper two basic factors: the areal and volumetric distribution of sedimentary rocks underlying the present seas, and the degree of favourability of the sediments in each area, by far the most important.

To do this the author has subdivided the world areas into four rating categories, A, B, C and D, in decreasing order of favourability for petroleum. In this analysis he has concluded

that the percentage of total shelf that is underlaid by appreciable sediments in which petroleum pools are possible, ranges from as low as 41 % in Europe to as high as 86 % in the Middle East, with North America 57.5 %, Africa 56.8 %, South America 65.4 % and the total world 57.3 % (6,170,000 sq. miles).

Measuring on the same basis, Weeks also specified that "the total basin area underlying lands of the world is about 18 to 18.5 million sq. miles, thus the world's offshore basins to 1,000 ft of water depth have a total area of about one third that of the basins on land".

Offshore exploration will thus venture into new areas around the globe and into ever deeper waters.

In addition to the problem of the development of techniques and equipment which will have to be solved in order to produce and convey economically oil and gas to shore, an important question that arises in connection with the expansion of exploration to deeper waters is the one concerning the legal position of these operations.

From the technical point of view, geophysical methods of very high sophistication have been developed, and exploratory wells have been drilled in water depths up to 1300 ft; the drilling techniques are far more advanced than the production techniques for deep water, as we shall see later, and therefore exploration can already be conducted in the water depths which are the next objective of offshore activities.

Exploitation

Once an oil gas field has been discovered and evaluated as a commercial field, the next step is to develop and exploit it.

Development wells will be drilled, a gathering system and treating equipment will be installed, and in the case of the offshore fields, the products will be transported by an underwater pipeline (sealine) to shore, where a storage and shipping terminal is located.

In today's offshore operations, with the deepest production area laying under some 340 feet of water (Gulf of Mexico),

the system almost universally used for exploitation of offshore fields consists of:

— a fixed platform, supported by the sea bottom by means of piles, from which the development wells are drilled through large diameter conductor pipes driven into the sea bottom, and on which the well heads, the gathering system and the treating equipment are installed;

— a sealine connecting the platform with the shore, in which oil is pumped from the platform, or gas flows by its own pressure or is compressed;

— the system, in the case of an oil field, may be completed by a second tanker-loading sealine, when it is necessary to ship the oil by tankers and the shore terminal is not equipped with jetties or pier facilities; the tankers would be anchored to mooring facilities to which the tanker-loading sea lines are connected.

With the system described above, the operations of drilling, gathering and transportation are conducted basically as inland, the fixed platform being the support for drilling rig, well head, pipeline connections.

A few differences exist insofar as the details of the operations are concerned, and the installation of the platform and of the sealine have required the use of special techniques and naval equipment, specially developed for these operations in the last years.

In any case, it is possible today to build and install fixed platforms and lay sealines in water depths ranging between 300 and 600 ft; the maximum water depth in which a platform and sealine are installed today is 340 ft, as mentioned above.

Operating offshore almost like inland is of course the easiest way; the fixed platform permits landing of helicopters and mooring of service vessels, provides for ample space for crew quarters and storage, as well as for stable support for the well heads and equipment.

But with the increase of the water depth the construction, transportation to site, installation, and, above all the cost of the platform increase tremendously, and there will be a water depth in which the conventional platform will be non-economical.

There is considerable dispute today about the limit of economical feasibility of a fixed platform compared with other systems being studied, but it is certain that with the outlook of ultra deep water operations for the offshore petroleum production, the fixed platform will have to be abandoned beyond certain water depths.

The elimination of this basic support creates a number of problems for the exploitation operations: drilling cannot be made from a fixed rig, wells cannot be completed at a point above the water, men cannot live offshore in conventional habitats, conventional transportation equipment cannot be used.

The increased water depth poses economical and severe technical problems also for the sealine, such as collapse of the pipe, necessity of modifications of laying methods, buoyancy control, emergency interruptions of laying, undersea connections and repairs, etc.

Increased water depth makes also impossible the work of man under water, at least with normal equipment which is today routinely used.

For the above reasons, the industry is studying several ways to solve the various problems outlined before, by means of integral systems capable of handling deep water productions operations.

Many ideas have been developed, many studies completed, many new techniques envisaged.

The areas of research may be grouped basically as follows:

- drilling
- underwater well completion
- non conventional platforms
- maintenance, service equipment, diving
- automation, telemetry and communications.

To mention only the main subjects, with the exclusion of the basic research programs being conducted on the environmental conditions, medical aspects of man-at-sea survival, corrosion of materials, nuclear energy sources, etc.

We shall briefly outline the present status of the various aspects of the applied research topics above indicated, in order to give a panoramic view of what can be expected in the near future for the deep water petroleum production.

A - *Drilling*

The alternative to drilling with the rig installed on a fixed structure is to drill from a floating support. Such drilling is already performed for exploratory wells, that is for the first wells being drilled in a particular area, to test it, and sometimes also for development wells.

The main types of floating units are the drilling vessels and the semisubmersible platforms. There is another important type of mobile unit, the jack-up platform, which can be towed while floating from one place to another, and then lowers its legs to the sea bottom in order to obtain support and raise its body from the water to a certain height over the surface. This type of unit is similar to the fixed platform from the point of view of drilling operations, and is not suitable for ultra deep waters, due to the limitation of the legs extension, unless it is associated with other special equipment.

The drilling vessel is a ship often specially built for drilling operations, self-propelled or not, depending on the principal area of operations, which is anchored on the spot and supports the drilling rig; the semi-submersible platform is a structure made of large columns ending at their bottom with caissons and connected together, and carrying on their top a deck on which the drilling rig, living quarters and equipment are installed; the platform is towed from one place to another while floating, and, on the spot the caissons are flooded to a certain level in order to sink partially the structure in the water, which gives more stability; mooring is accomplished by the same systems as for the vessels. This unit is normally more stable than the drilling vessel, and for this reason is being taken into consideration as a support for production facilities, as we shall see later.

Both drilling vessel and semi-submersible platform are theoretically not limited by water depth in which to operate; the only limiting factors are the mooring systems, the capability of reentering into the well, and the stability under the action of wind, tide and currents.

These two types of units will be the drilling support also for the future: a well has been drilled from a floating vessel in some 1300 ft of water (Santa Barbara Channel, California); a semi-submersible rig, the STAFLO (the name means *Stabile*

while Floating) belonging to a company of the Royal Dutch-Shell Group, has been capable of staying throughout the winter of 1967-68 in the North Sea, in waters 400 ft deep; from a drilling vessel research wells have been drilled in water depths up to 18,000 feet.

The studies relative to the floating drilling units are mainly dedicated to the improvement of their stability in rough open seas, to the versatility of use, to the capability of simple and reliable well reentry, to the new types of positioning equipment to substitute the traditional anchoring method.

Considerable success has been achieved in these directions. Stability and percentage of operating days over the year continue to increase. A new rig is being built, which is ship-shaped for movements from one place to another, and can be used on the spot as a jack-up rig or a semi-submersible. Reentry systems, with the use of electronic equipment instead of the usual mechanical connections, are being used specially for ultra deep water drilling. On some drilling vessels dynamic positioning systems, are currently installed. They consist of a number of propellers located on the sides of the ship, and individually driven by motors operated by electronic signals from the well head over which the vessel must remain; such system eliminates the anchors and cables, which would be not suitable for very deep water, and keeps the ship within a small area over the well.

As far as the drilling itself is concerned, the efficiency of conventional rotary rigs is being improved by better study and control of the various parameters which determine the cost of drilling; considering that 50 to 70 % of the rig-time is spent in actual drilling operations, the main object of the studies is the drilling speed, for which purpose process computers are being studied and experimented, to optimize each parameter having influence on the drilling speed.

Another field of study is the automation of the rigs or the use of different techniques such as turbodrills and others.

The rotary rig is for the time being the rig that will be used also for deep water drilling; the main effort must then be directed toward reducing the drilling costs.

New methods such as electron beam rock cutters and similar schemes, which may in some time change the situation and

allow the drilling of wells from under the oceans - are in the stage of laboratory research.

In any case, with the present development and foreseeable improvements, it is estimated that it will be possible within ten years to drill commercial wells at the depth of 4000-6000 ft.

B - *Underwater well completion*

We have seen that drilling methods and equipment are already capable of drilling wells in ultra deep water, and that commercial drilling is already being performed at the depth of some 1300 ft. The deepest production instead comes, as we have seen, from the depth of 340 ft (Shell Oil Co. - Gulf of Mexico). This limit is a consequence of the technical difficulties still encountered with the installation of production facilities in deeper waters, with the use of alternate development techniques more economical than the system using the fixed platform. The elimination of the fixed platform, for the economical reasons already mentioned, creates, among others, the problem of the location and support of the well head, which is the assembly of valves controlling the various ducts of the well, normally known as the "Christmas tree". The most immediate solution of this problem is to locate the well head, or to "complete" the well, over the sea bottom.

This requires special types of well head and well head equipment, capable of being remotely controlled, and allowing for well servicing and simple "work-over" operations (that is interventions inside the well with tools and equipment for special purposes) also from a remote location.

Several types of underwater well completions have been built and installed in water depths up to 300 ft. The major problems have been solved. Several wells are being operated with underwater completions, and continuous development work by manufacturers and users is aimed at obtaining secure and continuous service. The final result in this research area, obtainable in a very short time, should be an underwater well head, remotely controlled by acoustic signals and operated without the intervention of diver's labour. Remote control refinements, lower manufacturing costs and greater reliability are the main objectives of today's development for underwater well heads.

C - *Non-conventional platforms*

The solution of the problem of exploiting deep water petroleum depends largely on the solution adopted for the substitution of the fixed platform emerging from the sea level with a more economical and feasible unit.

For this reason the study of new types of platforms is the major topic in which operating and engineering companies are engaged in order to design an integral system.

Although numerous solutions have been proposed, the basic ideas are the following:

— Submerged platform, installed at water depth accessible to divers, on which well heads and production equipment can be installed; such platform would be connected with the sea bottom by legs through which wells could be drilled by a floating drilling vessel or by a Jack-up rig standing over the platform's upper deck; the upper portion of the unit is buoyant, and its shape is spherical or prismatic; flexible connecting hoses would transfer the extracted oil to the floating storage units; with systems of this type, divers' work could be used at depths at which divers cannot operate today.

— Sea-floor units incorporating the gathering and processing facilities, remote control and service equipment, with which underwater well heads would be connected; underwater storage units (which we shall describe later), of floating storage, would complete the system; maintenance would be performed by personnel transferred to the unit by special submarines, or from the submarine itself.

Inside the units, the atmospheric pressure would be maintained at a normal level in order to allow the workers to operate like on the surface.

— Modular units containing respectively well-head and associated controls, process equipment, storage, would be installed on the sea floor; operations would be completely automated and remote controlled; maintenance and repairs would be performed by substituting the modular units by means of submarine work boat, and by moving the unit to be serviced to the surface.

Following the three basic systems, which are only generally described above, a large variety of types of non-conventional

platforms and associated equipment for deep water operations is being designed. It is very likely that many systems will be finally adopted, according to their cost and feasibility in the different locations, water depths and general environmental conditions.

D - Offshore storage and loading facilities

A large oil field, lying under very deep water, for which well drilling and completion and gathering system have been successfully devised, may be economically doomed by excessive distance from shore involving long and expensive sea-lines, or by excessive water depth which could make it impossible to lay a pipeline. In addition, an oil field requires the installation of a certain number of storage tanks on site in order to allow a continuous production and fast loading of tankers.

Without the support of the emerging platform, underwater tanks have been designed and built experimentally; the first underwater reservoir for commercial use is being installed in the Persian Gulf.

Underwater tanks are normally semi-spherical or cylindrical shaped, with open bottom, and are normally filled with liquid (sea water or oil) in order to reduce pressure on the tank.

The operation is normally carried out on the water displacement principle: the oil produced is pumped to the top of the tank, displacing the sea water from the bottom; when a tanker is loaded, the sea water flows into the tank from the bottom, replacing the oil being pumped out from the top; control valves remotely operated allow for the performance of the various functions.

An alternative solution of the problem of storing oil offshore is the use of floating tankers which have been long used in shallow waters. The main problems to solve are those related to the mooring of the vessel and to the connection with the underwater well heads or manifolds.

Such connections should be flexible or capable of free movements in order to follow the movements of the storage tanker, which can be reduced to a minimum but not eliminated; the mooring systems do not present problems very different from those already solved and related to the mooring of drilling vessels,

with the exception that smaller movements should be allowed, due to the connection with flow lines from the wells.

E - *Maintenance, service equipment, diving*

Any piece of equipment installed in the field will require maintenance; this will be more difficult in an underwater environment, especially at depths where conventional diver work cannot be used.

Two main approaches have been pursued in developing operational systems:

- use of man power, with consequent study of equipment and techniques capable of bringing the man, and allowing him to work effectively, beyond the water depth limits in which divers can now operate;

- use of completely automated systems with the elimination of man's participation.

A variety of systems and equipment has been designed and built, such as:

- underwater, at subhydrostatic pressure, habitat units, mounted on top of the well heads and within which people can work in normal atmospheric conditions; people would reach the unit by a submarine, to be connected to the unit upon arrival, in order to allow the transfer of persons and equipment;

- submarine work boats equipped with manipulator arms operated from inside, which can perform a wide range of tasks under water;

- modular units which can be substituted over the well head when maintenance is required, and transported to surface for reconditioning and overhaul;

- submersible work chambers in which divers can be lowered to depths of about 1000 feet and from which they can dive and be assisted during their works.

Experimental tests will prove which system is more feasible, safe and economical.

Man will always be requested to perform certain tasks, and therefore the extensive research in deep diving techniques

and equipment is one of the crucial aspects of the technological development for deep water operations.

With the increase of operational water depths, however, the use of manpower, will be impossible or very expensive, and therefore fully automated equipment shall be developed, and intermediate-depth work stations shall be installed, where men can work for maintenance tasks.

F - *Automation, telemetry, communication*

Regardless of which aspect of deep water operations is considered and of which system will be used, it is obvious that automation, process computers, underwater television, radio communications and the like will be extensively used in any operational system for the exploitation of deep water resources.

Any improvement in these areas will largely contribute to the development of a feasible integral system.

Automation and telemetry may be the key point which will make it possible to reduce deep water operation costs to acceptable levels.

Reduction of human intervention, remote controlled operations, higher safety, and reliability in the performance of certain functions will be the major goals.

As in the aero-space technology, automation and computers will play a determinant role.

This research area, however, is not the most advanced insofar as offshore applications are concerned, and a considerable effort should be exerted for its development.

The systems of the future

We have outlined briefly the various areas of research which are being developed in order to extend the limit of depths at which petroleum can be produced.

It would be impossible in a paper of this kind to discuss completely in detail all the ideas and solutions that have been developed or that are under study.

The long range outlook is that a system capable of exploiting resources at the depths of 1500 feet will become operational

within 3-5 years, and that in ten years operations will be feasible at depths of 4000-6000 feet.

The system of the future, achieved through intermediate stages, will use underwater well completions with products flowing to underwater processing and storage units, controlled and serviced from remote points and with minimum human labor on site; offshore loading points will consent use of tankers of the largest possible size; where necessary, underwater habitats will accommodate men at maximum or intermediate water depths; submarine work boats will connect the shores with the underwater installations; the science fiction designs which today appear in specialized magazines will become a reality.

All this under one condition: economical feasibility, which shall be discussed next.

The future of deep water petroleum

There is considerable degree of consensus among experts on the forecast of a bright future for the exploitation of ocean's resources, with particular emphasis on petroleum.

The offshore exploration for oil and gas will foster its continuous growth for the following main reasons:

— rate of increase of world demand; today's rate of increase is one billion barrels per year; it is estimated that in 20 years the demand for oil and gas will be five times today's demand; to match this demand new reserves must be discovered.

— unexplored basins in the offshore areas: according to the already mentioned estimated of Mr. Lewis Weeks, there are about 6 million square miles of sedimentary basins, with potentially oil bearing sediments, in the offshore area comprised within the limit of 330 meters (or 1000 feet) depth; such area represents about one third of the world land basins, and today it has been explored only to a very limited extent.

— technical feasibility of deep water operations; it is a common assumption among oil companies that technology will make it possible to explore and exploit petroleum fields lying at the depths of several hundred feet in the next few years, using the systems outlined before.

Currently, 6 million barrels of oil, per day, or about 16 % of the total world daily production, are produced from offshore fields; offshore oil reserves are about 86 billion barrels, or 20 % of total world reserves.

It has been estimated that in 1969 the oil industry in the free world will spend about 8 billion dollars for exploration, drilling and production, of which two billion dollars, or 25 % of the total, will be spent for offshore operations.

In ten years offshore production is estimated to reach one third of total world production, and the total investments for offshore operations will reach more than four times the level of today's investments; this is primarily due to the higher costs for exploitation in deeper waters, which will be conducted with the above described new sophisticated and expensive methods and facilities being developed today.

However, such development forecast is subject to the limits of economical feasibility, more than to those of technological feasibility. In fact, in current offshore operations at the depths close to 400 ft, the level of profits has been drastically reduced, in comparison with onshore operations. In the United States, operations at the depths over 300 ft have resulted in profits ranging from 25 % of profits for comparable onshore operations, to *zero*.

A few figures will give an idea of the size of investments required to develop an oil field in changing water depths; a fixed platform for the depth of 200 ft costs 2 to 3 million dollars; the same platform for the depth of 400 ft would cost an estimated 8 to 9 million dollars; for 800 ft - about 18 million dollars.

Similar examples can be given for almost every activity and every piece of equipment used for the development of an offshore field.

Considering that, as it stands today, the selling price of the barrel of oil or of the cubic meter of gas depends on world and local market conditions and not on the place of origin of the product, it is clear that, although the world demand for petroleum will be more and more dependent on offshore resources, the profitability of offshore production is already questionable for development of fields lying beyond the depths of 300-400 ft.

The real problem is therefore not merely to devise ways which will make it possible to exploit deep-water petroleum

fields, but also to devise ways which will make it possible to exploit deep water fields with an attractive return on the investments of the operating Companies.

The future of the offshore exploration for petroleum depends thus on the capability of the industry to produce deep water petroleum more economically than other sources of energy.

If we consider that such other sources, based on today's standards, are not yet economical, and that the point of equilibrium between deep-water petroleum and other sources will be reached at a level of costs higher than the present, it is evident that the research of new methods and the establishment of new regulations and incentives for the exploitation of offshore petroleum are the basic conditions for the development of the undersea petroleum resources.

The cost of research, the importance of avoiding duplication of efforts, the opportunity of sharing the knowledge acquired suggest that joint efforts be made by the operating companies to devise practical, feasible and economical systems for the exploitation of deep water petroleum.

At the same time, international cooperation is required to establish laws and regulations which protect the interests of the coastal nations, and at the the same time, allow for the necessary incentives for the companies to undertake operations.

An attractive investment climate, including security of investments, is a prerequisite for offshore petroleum development, since petroleum, is, and will remain for many more years, the primary source of energy in our modern world.

MARIGENOUS MINERALS: WEALTH, REGIMES AND FACTORS OF DECISION

BY

Dr. FRANCIS T. CHRISTY, Jr.

*Senior Research Fellow, Resources for the Future, Inc.,
Washington, D.C.*

Introduction

As States proceed to decisions on the issues of the seabed, they will begin to identify and evaluate the factors they consider to be important. This essential process, however, is beset by obstacles and laden with traps. There are misperceptions as to the values that might be enhanced and the interests that might be damaged. Underlying assumptions, that may be the remnants of past policies, may remain tacit and not subjected to reappraisal. Communication and understanding are made difficult by differences in concepts and definitions and by an imprecision in the use of words and terms. The exigencies of pioneer exploitation or unilateral declarations may obscure long-run objectives. And the pleadings of special interests may tend to outweigh the more general interests of the State as a whole.

Such obstacles and traps, already evident in current debates, can never wholly be removed. Nevertheless, it is desirable to diminish their effect insofar as this is possible. It seems useful, therefore, to provide at least a partial list of the factors that may have an influence on the decisions of States with respect to the sea-bed issues. The list that follows in Part II is descriptive and is designed as a guide for analysis. It would be both presumptuous and fruitless to do more, since the evaluation of the relative importance of the different factors will have to lie with each individual State ¹.

1. The author recognizes that a certain amount of bias may be evident in the selection and description of the factors. That the reader may be forewarned,

The factors relating to the material wealth of the seabed and subsoil are the most important and immediate factors to be considered. The potential realization and distribution of this wealth are the primary causes of concern about the adequacy of the present regime for the sea-bed and they are the chief sources of future conflict. Because the sea-bed wealth is fundamental to the decisions on the major issues, the first part of this paper will be devoted to the nature and value of the wealth (although much of what can be said at this time is admittedly speculative).

The second part of the paper will attempt the identification and description of the individual factors of influence. Certain of these relate generally to both of the two major issues. Others relate only to the issue of the limit of coastal State jurisdiction and some only to the issue of the character of the regime beyond such limits.

PART I - THE WEALTH OF THE SEA-BED

The potential wealth of the sea-bed lies in the vast deposits of minerals that lie on it and in its subsoil. It is well known that there are extremely large quantities of these minerals in waters beyond the 200 meter isobath. Popular literature often points with wonder to the billions or even quadrillions of tons of minerals waiting to be plucked from the bed of the sea. And it is often calculated that this fabulous storehouse of materials can meet man's needs for centuries to come.

But such estimates of quantity are of little relevance to economic activity and to the decisions that must be made. The numbers, being so vast, are of little meaning to decision-makers.

the author admits to the two following prejudices: that decisions on the allocation of productive factors (including exclusive mining rights) are best made through a market mechanism and that the greater the degree of international cooperation, the greater the benefit to the long run interests of the world community. For fuller expression of these prejudices see: Christy and Scott, *The Common Wealth in Ocean Fisheries* (Baltimore: Johns Hopkins Press, 1965); Christy and Brooks, "Shared Resources of the World Community", *17th Report of the Commission to Study the Organization of Peace* (1966); Christy, "Alternative Regimes for Marine Resources Underlying the High Seas", *Natural Resources Lawyer*, Vol. I, No. 2; and Christy, "Economic Criteria for Rules Governing Exploitation of Deep Sea Minerals," *The International Lawyer*, Vol. II, No. 2 (RFF Reprint No. 72).

An estimate of a billion tons is just as impressive and overwhelming as an estimate of a quadrillion tons. It is sufficient simply to know that the quantities are large.

Furthermore, the estimates are extremely imprecise. Definite knowledge of the marigenous minerals lying on the sea-bed has been obtained for only a few hundred sites which together make up a very small percentage of the sea-bed underlying the oceans. Definite knowledge of oil can only be obtained by drilling; and few holes have been drilled in waters deeper than 200 meters. The estimates of the total quantities are based upon major assumptions about the presence of minerals between these few and scattered points of definite knowledge. Thus, the range of error may be very great.

But even if estimates of tonnage were completely accurate, they would be of little value in the resolution of the sea-bed issues. It is not the quantities that are important but the net values, as may be illustrated by the economics of gold in sea water. It has been estimated that there are about 5 million (5×10^6) tons of gold in the oceans. At current prices this comes to about \$ 5 trillion ($\$ 5 \times 10^{12}$) plus or minus a few billion. This is surely a fantastic amount — but no State is asserting claims to the waters of the sea in order to obtain this potential source of wealth — no companies are interested in exploitation of the gold — because the costs of exploitation are so much greater than the revenues that can be received. The fact that the sea contains extremely large quantities of minerals is, by itself, of little importance or interest to man.

The primary elements of man's interests are economic and based upon estimates of the costs of extracting, transporting, and processing the minerals and upon estimates of the prices and revenues that can be received from the product. If the costs are greater than the revenues, then there is little value in owning or claiming exclusive rights to the minerals.

There may, however, be secondary elements of man's interests that are non-economic in nature. For various reasons (national security, full employment, etc.) a State may choose to encourage and support an industry through subsidies. The domestic United States oil industry, for example, receives subsidies such as depletion allowances, pro-rationing, and import controls, that support oil exploitation in places where it would

ordinarily be uneconomical, such as the Santa Barbara Channel off California. Non-economic objectives may also be important in deterring or preventing exploitation, as well as supporting it. If, for example, oil companies in the U.S. were subject to total liability for damages from pollution, they might be unwilling to drill in places, such as the Santa Barbara Channel, where the risks of pollution are high.

In communist and socialist States, where markets are controlled, there are no automatic measures of costs and revenues. Nevertheless, the same factors are taken into consideration as in market economies. Decisions to exploit resources are not made unless it can be calculated that the returns (monetary and non-monetary) to the State are likely to be greater than costs associated with the exploitation. Although the values may be calculated in different terms, the decision is still based upon the interests of the State and not upon the quantities of minerals that may be available.

In both situations, the conditions of supply and demand are subject to change and as they do, certain mineral deposits may grow or decrease in their attraction. Technological innovations may reduce the costs of exploitation and processing. Growth in demand, from increased use per person, more people, or newer uses for the product, may increase the expected revenues. These, and many other factors, may change the situation sufficiently so that it may become desirable for a State (or private enterprise) to exploit a resource that was formerly uneconomical.

Such changes, which are occurring continually, have made the bed of the sea more attractive. In this day and age, the changes can be very rapid. Eleven years ago, at Geneva, there was little awareness that sea-bed minerals would be as important as they are considered to be today. Eleven years from now, they may be vastly more important. While it is extremely difficult to anticipate the degree and kind of changes that may occur, it is essential that States be aware that changes will occur. For decisions to be viable, the certainty of change cannot be ignored and the present situation cannot be assumed to be static.

The sea-bed and subsoil minerals in depths of 200 meters or more that have become attractive in response to changes in the conditions of demand and supply can be grouped into four

categories — petroleum, phosphorites, metallic brines, and manganese nodules. Other minerals that are known to exist in this region include barite nodules, clays, sulphur, siliceous and calcareous oozes, glauconite, and others. But there is little indication, at the moment, that these are likely to be of economic interest to man for many years to come.

A large number of other mineral resources is found on the continental shelves in waters less than 200 meters in depth². Many of these are now being mined, including gold, tin, diamonds sand and gravel, shell deposits, and certain metalliferous sands. Other minerals, such as titanium, tungsten, and zirconium, may be mined in the future. The extraction of these minerals is likely to be restricted to shallow coastal waters for at least the near future. For this reason, they are not dealt with in this paper; nor is petroleum, which is the subject of another presentation.

Phosphorites

Of the three deep water minerals other than petroleum that are attractive, the phosphorites are likely to be developed first. Demand for phosphorus for use as fertilizer is growing. Although land sources of phosphate rock are abundant, they occur within a very small number of countries. Thus transportation costs are relatively significant and may make it economically feasible for certain States to turn to marine sources.

Phosphorus has many other kinds of uses than fertilizer. But fertilizer is the most important, accounting for about 70 % of consumption throughout the world. As a plant food there is no substitute for phosphorus. The chief source is phosphate rock, although basic slag, guano, and bone meal can also be used for their phosphorous content.

2. See JOHN L. MERO, *The Mineral Resources of the Sea* (New York: Elsevier Publishing Company, 1965); Economic Associates, Inc., *The Economic Potential of the Mineral and Botanical Resources of the U.S. Continental Shelf and Slope* (Washington: U.S. Government Printing Office, Clearinghouse for Federal Scientific and Technical Information, 1968); and Commission on Marine Science, Engineering and Resources, *Marine Resources and Legal-Political Arrangements for Their Development*, Vol. 3 of the Panel Reports (Washington: U.S. Government Printing Office, 1969).

The highly limited occurrence of phosphate rock is indicated by the fact that over two-thirds of world production comes from four countries — the U.S. (Florida), Tunisia, Algeria, and Morocco³. Most of the remainder come from the Middle East, a few other States in Africa, two islands in the South Pacific, one in the Indian Ocean, Brazil, and the USSR. In several of these areas, the reserves of phosphate rock are abundant and the costs of producing P_2O_5 for fertilizer are very low. The price of phosphate rock (31-36 % P_2O_5) at Florida mines is about \$ 7 per short ton⁴.

Because production is restricted to a very small number of States, most of the world must depend upon imports for their supplies. Transportation costs thus become significant and may actually double the price at the mine. In Japan, for example, the price is about \$ 14 per ton for phosphate rock produced in Florida, while on the West Coast of the U.S., the price is between \$ 11 and \$ 12.50⁵. Under these conditions, the costs of mining marine sources may be considerably greater than land and still be profitable.

The marine phosphorites are found as nodules, in sands, muds, and semi-consolidated tertiary bedrock, but the nodules appear to have a higher content of P_2O_5 than the other sources. The nodules may be found anywhere from shallow waters down to depths of about 3500 meters. The most attractive sites are in the shallow waters and on the outer parts of the continental shelf, the upper regions of the slope, and the tops and sides of the submarine banks. The deposition of phosphorites most commonly occurs in areas of upwellings where deep cold waters rich in phosphates are brought up to shallow depths.

The region that has received the most thorough investigation is that of the coast of southern California, where it has been estimated that there are about a billion tons of nodules. The coast of Baja California is currently being surveyed for phosphorites. Other areas of possible interest include the west

3. United Nations Economic and Social Council, *Resources of the Sea, Part One: Mineral Resources of the Sea Beyond the Continental Shelf*, E/4449/Add. 1, 19 February 1968, p. 18.

4. Economic Associates, *op. cit.*, p. 324.

5. WALTER ISARD and CHARLES L. CHOGUILL, "The Economic Potential of Phosphorite Recovery from the Continental Shelf Area", (Preliminary Draft prepared for Environmental Science Services Administration.).

coasts of South America, Africa, and Australia. However, much more investigation is needed to determine the commercial possibilities of these and many other likely areas throughout the world.

While no commercial production of marigenous phosphorites is underway at the moment, there was one attempt in the early 1960's and there are a few areas now being studied for commercial ventures. In 1962-63, Collier Carbon and Chemical Company leased 30,000 acres from the U.S. Department of the Interior in the general area of Forty Mile Bank near San Clemente Island west of San Diego, California. The legal significance of this attempt is indicated by the following statement of Frank J. Barry, the (then) Solicitor of the U.S. Department of the Interior:

If the lease applicant had wanted a lease in deeper water the Department (of the Interior) may well have given him a lease, as the May 5, 1961, Opinion (M-36615) of Associate Solicitor Thomas Cavanaugh indicated. That Opinion represents the Department's view of the relation of the definition of the continental shelf in the Convention and that in the (Outer Continental Shelf Lands) Act. The Opinion was rendered upon the application of a company to lease outer continental shelf land in order to dredge for phosphorite nodules lying on the ocean floor forty miles off the coast of California, in an area known as the Forty-Mile Bank. The water depth in that area is from 240 to 4,000 feet. Most was at a depth of far greater than 600 feet. It is separated from the mainland by an ocean floor trench as much as 4,000 to 5,000 feet deep. The Opinion concluded that the Act permitted leasing in that area because the ratification of the Convention by the United States constituted an assertion of rights to the sea-bed and subsoil as far seaward as exploitation is possible. The Opinion was submitted to the Departments of State and Justice to determine whether they had objections and they registered none⁶.

The company, however, failed to produce the phosphorite nodules and abandoned the lease. Presumably, the criterion of exploitability was not met. It may, however, be met by other developments that are currently underway — depending upon their success and the depth of water. It is reported that a company, formed in 1966, has "obtained an exploration con-

6. FRANK J. BARRY, "The Administration of the Outer Continental Shelf Lands Act", *Natural Resources Lawyer*, Vol. I, No. 3, p. 46.

cession covering about 70,000 square kilometres of the sea floor along the entire west coast of Baja California and around its southern tip up to about La Paz on the eastern side of the peninsula”⁷. Commercial enterprises have also leased exploration concessions for vast areas of the Australian shelf⁸. And on the Chatham Rise, about 200 miles east of New Zealand in waters between 250 and 1000 meters deep, “an extensive sampling survey is now being carried out by a prospecting company”⁹.

The costs of marine production have been estimated to be considerably higher than for land. Marine phosphorites are of much lower grade, generally not above 29 % P_2O_5 and usually much lower. They must be upgraded to at least 31 % to be marketable (although direct application of certain phosphate muds of much lower grade may be advantageous in some areas). The costs of extraction can only be roughly estimated because of the absence of significant experience thus far.

Some speculative estimates of mining California phosphorite nodules have been made. One states that the “cost of a ton of phosphorite nodules, mined from a depth of 150 to 600 feet and beneficiated at a plant located onshore, comes to at least \$ 12 per ton”¹⁰. Another estimate has produced a figure of \$ 12.69 per ton, although it was indicated that a technique using a much larger dredge bucket might lead to costs as low as \$ 5-6 per ton¹¹. Both sources state that their estimates are highly speculative and subject to a wide range of error. Both, however, conclude that, at least for the west coast of the United States, the present expected costs are too high to justify commercial production. Nevertheless, the possibility of a commercially successful venture is sufficiently strong so that a few companies have actually invested in exploration. Their experience over the next few years will provide much clearer answers as to the economic feasibility of the mining of marigenous phosphorites.

7. UN ECOSOC, *op. cit.*, p. 27.

8. *ibid.*, p. 26.

9. C.P. Summerhayes, “Marine Environments of Economic Mineral Deposition Around New Zealand: A Review”, *Marine Technology Society Journal*, Vol. III, No. 2, p. 61.

10. Economic Associates, *op. cit.*, p. 324.

11. ISARD, *op. cit.*, p. 7.

Metalliferous Brines

Much less can be said about the economic potential of the metalliferous brines and oozes that occur in deep waters. The sites that have been most clearly identified and have attracted the greatest interest were originally discovered in the Red Sea in 1948. Four of these so-called hot spots have been discovered so far, lying in about 6-7000 feet of water and about 30-50 miles from both the eastern and western shores of the Red Sea¹². Little is known about the formation of these deposits but it appears that they are associated with hot springs and closed or stagnant basins. It is possible that they may be found in other areas of the world where such conditions exist.

The metallic content of one of the Red Sea sites, the Atlantis II Deep has been estimated as follows: copper, 0.9 %; zinc, 2.6 %; silver, 0.008 %; lead, 0.10 %; tin, 0.002 %; and gold, 0.0001 %¹³. These estimates are based on sparse data and have "order of magnitude significance only".

In spite the absence of data and deep-sea mining experience, several commercial companies have expressed considerable interest in obtaining rights to the "hot spots".

In February 1968, Crawford Marine Specialists, Inc., a San Francisco firm, applied to the United Nations for an exclusive mineral exploitation lease covering 38.5 square miles in the area, but were advised that the United Nations has no authority to grant such rights. About the same time International Geomarine Corporation, a Los Angeles firm, demonstrated to the government of Sudan that the mineralized belt lay within the area of Sudanese jurisdiction. They then applied, successfully, to the Sudanese Government for exclusive right of exploration. Later a third company, Red Sea Enterprise, Inc., an international consortium, with Seaonics Inc., of Los Angeles, made public claim through a London newspaper, to 270 square miles of the Red Sea floor, including that claimed by I.G.C. Still later, Saudi Arabia laid claim to the mineral resources of the Red Sea, including the same hot spots, and there the matter rests¹⁴.

12. "Marine Minerals Exploration and Speculative Leasing Continue World-Wide", *Under Sea Technology*, January 1969, p. 63.

13. VINCENT E. MCKELVEY, "Mineral Potential of the Submerged Parts of the U.S.," *Ocean Industry*, Vol. III, No. 9, p. 41.

14. *Under Sea Technology*, loc. cit.

Manganese Nodules

In recent years, particularly since the work of John Mero¹⁵, a great deal has been written about the presence of vast deposits of manganese nodules and crusts on the bed of the sea. The writings have excited the imagination of the world community and have stimulated the discussions on the governance of the seabed. Of the many words that have been published, however, very few are satisfactory from an economic point of view. The critical questions still remain — when will commercial development be economically feasible? how profitable will it be? what, if any, surplus revenues will be available for States or the world community?

At this time, the answers can only be speculative because the requirements of production are wholly new and there is no analogous experience that can serve as a guide. Nevertheless, it is important to raise the questions and begin to approximate the answers. It is necessary to eliminate extreme anticipations and to make perceptions as realistic as possible. This is critical, not only to the improved understanding of potential wealth, but also to the necessary task of characterizing international regimes.

While the total area of samplings of the sea-bed is extremely small in proportion to the total area of the oceans, the frequency with which these samplings turn up manganese nodules and crusts indicates the prevalence of the deposits. Nodules are found in shallow waters and even on the bottom of fresh-water lakes, but the major occurrence is at depths of 1500 meters and below. The density of the nodules on the floor appears to vary significantly. From photographs, grab samples, and cores, Mero has estimated that the density of nodules in the Pacific may range from 0.05 grams/cm² to 3.8 g/cm².¹⁶ From the available data, the average concentrations in the Eastern Pacific were only 0.78 g/cm² while those in the Central region were 1.45 g/cm².¹⁷ Questions can, of course, be raised about the adequacy of the measurements and the different used, but

15. MERO, *op. cit.*

16. *Ibid.*, p. 174.

17. *Ibid.*

the relevant point is that there is likely to be wide variability in density of nodules.

Similarly, it is important to point out that there is likely to be wide variability in the metallic content of the nodules. The elements within the nodules of potential economic interest are manganese, copper, nickel, and cobalt. On the basis of 54 samples from the Pacific and 4 samples from the Atlantic, weight percentages on a dry-weight basis varied as follows:

WEIGHT PERCENTAGES IN MANGANESE NODULES *

	PACIFIC			ATLANTIC		
	Maximum	Minimum	Average	Maximum	Minimum	Average
Manganese	41.1	8.2	24.2	21.5	12.0	16.3
Cobalt	2.3	0.014	0.35	0.68	0.06	0.31
Nickel	2.0	0.16	0.99	0.54	0.31	0.42
Copper	1.6	0.028	0.53	0.41	0.05	0.20

* MERO, *The Mineral Resources of the Sea*, p. 180.

In addition to the differences apparent between the Atlantic and Pacific Oceans, there are also differences within each ocean. Mero has identified four different "regions" of the Pacific and several sub-regions as well. One of the regions has nodules that are relatively high in iron content. In a second manganese is high; in a third, nickel and copper; and in the last, cobalt. ¹⁸

Variations may also be significant for other factors. As Brooks notes, "Sea floor manganese deposits vary greatly in grade, pounds of nodules per square meter, depth of overlying water, and bottom conditions. They also vary in distance from markets and supply ports, as well as in the number of days of good weather that can be expected at the surface... Certain nodules in certain localities will offer the best commercial opportunities, and competition will develop for these depo-

18. *Ibid.*, pp. 225-30.

sits".¹⁹ These variations are important for a number of reasons. As indicated by Brooks, the high-valued sites will attract the most competition for exclusive rights. It will, therefore, be necessary to find some system for assigning the rights among competitive claimants. Also, since the sites will differ in value, a uniform royalty payment based on tons of output will be unfairly high for the producers of low value sites and unfairly low for the producers of high value sites (unless there is a market for the rights that would take these differences into account). These elements of variability will be discussed later.

Resource Evaluation

Calculations of anticipated net economic revenues of manganese nodule mining ventures are similar in kind, though not degree, to those for any other mining operation. The costs that must be considered include those of exploration, extraction, transportation, and processing. Revenues will depend upon the demand for the products that are produced. In addition, there may be costs and benefits (e. g., pollution, technological spillovers) that are external to the mining enterprise but that are important for society. These, too, must be considered.

The determination of a particular site for mining depends upon the evaluation of the site. This requires satisfactory information on the various elements mentioned by Brooks above — density, content, depth, etc. Some of the information is common knowledge. Other kinds of information will have to be gained by more intensive surveys and samplings than have appeared thus far.

In certain respects, the evaluation of sites may be relatively inexpensive. The deposits are surficial and can be scanned by photographic and television cameras. Samples can be obtained by various techniques that simply pluck them from the bottom. These measures are far simpler and far more accurate than those required for evaluating subsoil resources

19. DAVID B. BROOKS, "Deep Sea Manganese Nodules: From Scientific Phenomenon to World Resource", in Alexander, ed., *The Law of the Sea: The Future of the Sea's Resources* (Kingston, R.I.: The Law of the Sea Institute, 1968), p. 36.

such as oil. However, in other respects, evaluation will be more costly — the requirement for precise positioning far out to sea and the great depths of water in which the nodules lie.

One observer has stated that “a number of promising localities of these (manganese nodule) deposits are already known to exist, and some have been fairly extensively investigated. There is no question as to the existence of such deposits, and the extent and quality of the minerals is fairly well understood. Additional information is obtainable by existing sampling techniques at relatively low cost. Indeed, it is far easier to estimate the extent and quality of these deposits, and with greater accuracy, than to make such estimates with respect to oil and gas, or alternative upland sources of the same minerals”.²⁰

Another observer has adopted a different point of view. “A particular problem in sampling these deposits is their great variability in composition and their irregularity of occurrence. Moreover, though they occur on the surface, the underlying terrain is uneven enough in relation to the limited thickness of deposition that overall quantities and specifications are very hard to determine”.²¹

As discussed later, the questions of costs and accuracy of interpretation are important for stipulating the rules that would govern deep sea mining, just as they have been for rules governing oil exploitation on the outer continental shelf of the United States. To what extent should the world community through its agent participate in the provision and dissemination of information? To what extent should exploration and exploitation rights be combined?

Dredging, Transportation and Processing Costs

There are several speculative estimates of the costs of dredging, transporting, and processing the nodules. Of these, the estimates by Sorensen and Mead are the most careful and

20. GEORGE MIRON, “The Management of the Mineral Resources of the Ocean Floor”, (Preprint of article to be published in the *Stanford Journal of International Studies*).

21. Economic Associates, *op. cit.*, p. 133.

thorough.²² To emphasize the speculative nature of their estimates, they state that "there are indeed, no final engineering designs for (manganese nodule) dredges, despite the profusion of fantasy models illustrated in various publications... (It) appears that deep-water dredge will require an order of creative engineering to date unknown in world mining".²³

They estimate ("believe it reasonable to conclude") that the capital cost of the dredge will be about \$ 150 million and that yearly operating costs of the dredge would run about \$ 06.5 million. For the transportation of the nodules to the processing plant, they estimate an investment of \$ 15 million and annual operating costs of about \$ 10.5 million. One of the assumptions underlying this estimate is that "the original mining sites are expected to lie in the South Pacific, some 4,000 nautical miles from the (expected) location of the processing plant (near Los Angeles)".²⁴

The processing of the nodules has been recognized by most experts as difficult and costly. Sorensen and Mead have adopted a "reductive roast-ammonium carbonate leach process" (studied by the U.S. Bureau of Mines Metallurgy Research Center) as probably the most effective. On this basis, they arrive at an estimate of \$ 50 million as the capital cost and \$ 25 per ton as the variable cost.²⁵

Net Revenues

Using the current prices for the constituent metals (which is unrealistic, but done for illustrative purposes), they arrive at net operating revenues of \$ 18 million per year. As is appropriate, they discount (at 6%) future net revenues to their present worth and accumulate to arrive at a present value of net operating revenues of \$ 99 million. This, of course, is considerably less than the capital cost (discounted to allow for a 5 year development period) of \$ 175 million.

22. PHILIP E. SORENSEN and WALTER J. MEAD; "A Cost-Benefit Analysis of Ocean Mineral Resource Development: The Case of Manganese Nodules", *American Journal of Agricultural Economics*, Vol. 50, No. 5 (December 1968), pp. 1611-20.

23. *Ibid.*, p. 1614.

24. *Ibid.*, p. 1616.

25. *Ibid.*, p. 1617.

Since the estimated amount of output is large with respect to the present annual consumption of most of the metals, it is to be expected that prices for the metals would decline. They estimate a decline of 3.13% for the price of manganese ore, 3.67% for nickel 27.43% for cobalt, and no effect on copper price. These estimates assume unitary elasticity of demand, although the elasticities, they believe, are likely to be lower than one. On the basis of the price effect, their estimate of capital loss is about \$ 122 million as against \$ 76 million with no price effect. In short, under the current conditions of demand and supply, they figure that deep sea mining for manganese nodules is a totally uneconomic proposition.

One can change some of their underlying assumptions, to make the picture more attractive. If mining took place off Baja California, British Columbia, or the Blake Plateau, fewer barges would be needed and the costs of transport would decline. But since these costs are relatively low compared to dredging costs, the totals would not be affected sufficiently to change the outlook.

More important changes might be made by assuming higher quality nodules than assumed by Sorensen and Mead. Their figures were based on Mero's estimates of the averages for the whole Pacific — 24.2% Mn, 14% Fe, 0.99% Ni, 0.35% Co, and 0.53% Cu. It is likely that the developer would seek out higher grade deposits than the average, particularly for nickel. For example, six closely spaced samples taken from an area about 200 miles off the tip of Baja California showed a range of nickel content from 1.19 to 1.46% and of copper from 0.60 to 0.77%²⁶ — about 25% higher in content than the average for the Pacific. Assuming that everything else remains equal, the capital loss might be reduced by \$ 20 million — still far removed from the range of economic feasibility.

Changes in other assumptions might improve the net revenues, but only one change is likely to have a significant effect on profitability — development and production costs for the dredge and associated equipment. Sorensen and Mead assume that these costs will be about \$ 150 million.

²⁶. MERO, *op. cit.*, p. 233

The Bureau of Mines Marine Mineral Technology Center has also produced an estimate of profitability of a "hypothetical deep sea manganese operation".²⁷ There are a number of differences between their approach and assumptions and those of Sorensen and Mead (indicative of speculative nature of all such estimates). The Bureau assumes a hot sulphuric acid leaching process; \$ 20 per ton for processing instead of \$ 25; four barges instead of 18; higher content of nickel and copper and much higher recovery rate of the latter; no price effect due to output; taxes, depletion allowance, and royalty payments which are not included by Sorensen and Mead; and other assumptions that are different. On the basis of their assumptions, they calculate a 9.8% return on initial investment (or a 5.2% return if the manganese is discarded). "For the amount of capital, even the better case is considered marginal".²⁸

But the fact that there is any profit at all is due to a totally different assumption about development capital; which is included in the calculations by Sorensen and Mead, and excluded by the Bureau of Mines, which states, "in allowing for development capital it is assumed that major development has been undertaken *under other auspices* for the floating platform, the support submersible, and the control habitat. Total development costs for these items would probably be near the \$ 50-100 million range, and if included in the return on investment, they would reduce it to a quite unrealistic figure".²⁹ Thus, under both calculations, if development costs are to be borne by the entrepreneur, a deep sea manganese mining venture cannot be considered economically profitable.

Non-economic Factors

This raises the question as to whether governments, for reasons other than economic, may wish to participate in a deep sea mining venture. One justification for government parti-

27. See Commission on Marine Science, Engineering and Resources, *op. cit.*, pp. VII-179-186.

28. *Ibid.*, p. VII-186. If the effect on the market is considered and Sorensen and Mead's price elasticities are adopted, the return on initial investment drops from 9.8 % to about 5 % for the calculation including manganese.

29. *Ibid.*, p. VII-185 (emphasis added).

cipation is that a development might produce benefits to other producers or the public at large but for which the developer receives no return. That is, the non-patentable equipment and the knowledge and experience of the pioneer developer might be used by second generation entrepreneurs to make their operations economically feasible. If this were the case and if there were likely to be other non-economic benefits to the public, then governments might find it desirable to subsidize the pioneer or undertake the initial developments on their own.

In addition to the technological spillover, Sorensen and Mead suggest two other possible benefits that would be external to the operations of the pioneer — “pure research benefits flowing from the enhanced knowledge of the ocean floor (and) national defense benefits connected with increased engineering capability in the underwater environment and improved knowledge of undersea geology”.³⁰ Since public treasuries are limited, and the alternatives for use of public funds are great, it is questionable whether governments will be willing to invest \$ 100 million in the undersea benefits.

External costs must also be considered in determining whether or not to invest in deep sea mining. Two of these — pollution and interference with other marine uses — might be anticipated, although it is impossible to determine the degree of severity at this time. A deep sea dredging operation is likely to raise a good deal of sand, silt, and other waste materials that will be sorted out on the receiving barge and dumped back into the water. In addition, if kerosene is used as a lift or if beneficiation takes place on a floating platform, other potentially damaging materials may be put into the sea.

Siltation may be damaging to sedentary organisms on the bed of the sea. Fish in the superjacent waters may be damaged by increased turbidity or by waste products from beneficiation. Siltation might also add to exploration costs by covering manganese deposits on adjacent tracts. Or there may be long-run and indirect damages resulting from the disturbance to the environment. Even though it may be difficult, perhaps impossible, to anticipate such damages, developers should be made aware that they will have to bear the costs.

30. SORENSEN and MEAD, *op. cit.*, p. 1618.

Aside from pollution, interference with most other uses of the seas is not likely to be significant. There could be instances of damage to undersea cables, but the costs of avoiding or repairing damage will probably be small relative to the total costs of the enterprise. Since a mining operation is not likely to take up much space, there will be little interference with shipping or fishing.

It is possible, however, that deep sea mining might interfere with the military interests of certain States. Widespread exploration of the sea-bed might lead to embarrassing discoveries of military devices fixed to the floor (be there such). But this cannot be considered as a cost that should be borne by the developer. It is the military that must take the risks.

Market Effects

Most of the comments, made above, refer to the pioneer developer — the initial mining venture. But as stated by Sorensen and Mead, “second-generation dredges, engineered in the light of experiences gained by the pioneering firm, may produce much higher recovery levels... So it will pay to wait, to be the second or third firm in the industry”.³¹ However, it should be pointed out that gains accruing to the second and third efforts from reduction in costs might be counter-balanced by losses from lower prices resulting from an excess of materials being thrown on the market.

Sorensen and Mead assumed unitary price elasticity — i.e., an increase in supply is accompanied by an equally proportionate decrease in price. Brooks, assuming higher output levels and greater effects on the market, estimated that the price of manganese might drop by 45% (instead of 3.13%); of nickel by 7% (instead of 3.67%); and of cobalt by 33-1/3% (instead of 27.43%).³² Whatever the case, the effect is considerable. Thus as the second, third, and other enterprises develop, the additional output brought in by each producer

31. SORENSEN and MEAD, *op. cit.*, p. 1619.

32. DAVID B. BROOKS, *Low-Grade and Nonconventional Sources of Manganese* (Baltimore: The Johns Hopkins Press for Resources for the Future, Inc., 1966), p. 105.

will *depress prices and net revenues for all*. This scale of production is quite different than most industries where the additional output brought to the market by a new producer is so small that there is no measurable effect on prices.

Other factors may tend to aggravate the effect. With high capital and low operating costs, producers are tempted to produce as much as they can as quickly as they can in order to cover their investments. Performance requirements, which may be imposed by an international regime to prevent speculation in the holding of rights, may also artificially stimulate output. Other factors leading to the same results might include competition for prestige among nations and the desire of companies to gain experiences and competitive advantages over other companies. As Brooks points out, "while it is not difficult to develop institutions to prevent a race to acquire claims on the ocean bottom, this does little to control over-capitalization of and over-production from the nature of the resource".³³

Eventually the market will adjust. New uses will be found for the constituent metals and new producers will be able to enter without significantly affecting revenues. But the adjustment will be slow in coming. The period of adjustment will be hard on the producers, who may experience losses or even go bankrupt. But with one kind of exception, it will not be particularly detrimental to society. Royalty incomes and rentals (assuming these are extracted) might be low but society will benefit by receiving greater quantities of materials at lower prices. The period of adjustment, however, will be hard on those states that receive a relatively high portion of their income from exports of the constituent metals. Perhaps if royalties or rentals are collected, these might be used temporarily to ease the process of adjustment.

Summary and Conclusions

Two conclusions (if such they can be called) emerge from this review of the wealth of the sea-bed. The first is that commercial development of deep sea minerals is not likely to be

33. BROOKS, "Deep Sea Mangense Nodules", *op. cit.*, p. 35.

significant for many years to come. And the second is that after development becomes significant, it will still be many years before royalty or rental payments will become large.

Although petroleum resources have been excluded from this discussion, there is some reason to believe that exploitation in waters beyond 200 meters depth will be more restrained than past experience would indicate. The deep water area of greatest interest to oil companies has been the Santa Barbara Channel off the coast of California, where one company has already drilled a hole in 1300 feet (plugged and abandoned). The recent oil leak in this area and the subsequent public pressures to make oil companies bear a large share of, if not total, liability for pollution damages may be one deterrent to further development of the area. Other factors making deep water exploitation less attractive include the disappointing results, obtained from the Santa Barbara area prior to the leak; the discovery of large quantities of oil on the North Slope of Alaska; and the possibility of an increase in oil imports into the United States.

While phosphorite nodules may be the first of the marigenous sea-bed minerals to be developed, development will be restricted to a few localities where demand is high and alternative sources of supply are far removed. The quantities produced are not likely to be large relative to total consumption. However, development may be significant with respect to the issues of the sea-bed because of the possibility of exploitation in waters deeper than 200 meters.

At the moment, the metalliferous brines appear to be a very special case that may have little relevance for the oceans but that may be important in setting precedents for decisions on small, enclosed seas.

The materials that are most important to the issues of the sea-bed are the manganese nodules. As indicated, commercial development of these does not appear to be economically feasible now, for the next several years. However, the timing of development is subject to changes in the characteristics of demand and supply. The growth in demand for the constituent metals is not particularly great and it can probably be met from conventional land sources of supply without large increases in price. The unknown is the technology of deep

sea dredging, which may (and eventually will) bring the costs of marine mining down to a level making production competitive with land. This development cannot be foreseen with accuracy.

Nor is it possible to gain access to the analyses and motivations underlying the activities of certain commercial enterprises. The most highly publicized of these is Deepsea Ventures, Inc., a subsidiary of Tenneco and offshoot of the earlier interests of Newport News Shipbuilding and Drydock Co. This company has committed a vessel to prospecting and the development of technology. The degree of commitment appears to be contingent upon the degree of early success. But the achievement of success may not be as important as the attempt. The simple fact that a venture is under way is enough to raise the issues of the sea-bed and to call for their early resolution.

The prediction that royalty or rental income will not be great for many years after the initial development takes place can be made with a greater degree of assurance than the prediction on timing. When commercial development becomes successful, it will attract additional efforts. The anticipation of the effect of greater output on prices may deter some potential exploiters but others, for various reasons mentioned above, will persist. The added output and lowered prices will decrease net revenues and, therefore, any share of these net revenues that might be made available to the world community. It is quite possible that there will be attempts to create cartels, commodity controls, or other forms of oligopoly. This possibility is stated by Brooks. "Oligopoly, if not monopoly, will be the rule, and the resulting concentration of economic power must raise anew all of the old questions about the balance between gains in the efficiency of production and losses in the force of competition".³⁴ But whatever pattern develops, it will still be many years before there will be surplus returns to resource rights that can be extracted for the benefit of the world community.

34. *Ibid.*, p. 36.

PART II - FACTORS OF DECISION

Introduction

In addition to the wealth of sea-bed minerals, there are many other factors that will have an influence on the decisions by States on the two major issues — the limits of jurisdiction and the character of the international regime. There are other resources than minerals to be considered, other uses of the sea, and other values than those of economic wealth. Some of these are discussed in the following pages, together with certain general concepts that might be applicable to both of the issues. The list is neither comprehensive nor fully descriptive, but perhaps it might provide a useful guide for more intensive analysis by individual States..

General Concepts

Urgency: In view of the rather dismal forecast about the development of minerals of the deep sea-bed, it may appear that there is little urgency to the decisions on the two issues. Indeed, it is frequently stated that it is premature to create an international regime; that the law must wait for developments to take place; or that there is too little knowledge for the making of decisions and the establishment of codes and regulations. These seemingly plausible statements, however, come most readily from those who have the most to gain from the absence of law. But more importantly the statements, in their generality, sweep away the essential issues.

The issues will not be resolved by one or two major decisions, nor will they ever be "ultimately" resolved. Instead, there is a wide range of decisions on a wide range of alternatives. And the process of decision-making, similar to that for domestic law, is one that will continue to evolve throughout time. It is both specious and dangerous to attempt to preclude *any* decisions because of the difficulty or inability to make *final* decisions. The impossibility of prescribing precise mining codes

does not, and should not, prevent the establishment of general principles.³⁵

The task is one of determining what decisions need to be made now, those that need to be made in the near future, and those that can be postponed into the distant future. In each case, it will be useful to determine the kinds of knowledge that will be helpful to the making of decisions. And in each case, it may be possible and desirable to provide for a degree of flexibility, so that decisions can be refined as knowledge increases and experience is gained.

These comments do not belie the sense of urgency that is widely felt with respect to certain kinds of decisions. The technological and economic capability of the oil industry to drill in deeper and deeper waters has considerable importance for decisions on the limits of State jurisdiction. The announced intentions of Deep Sea Ventures to prospect for manganese nodules; the suggestions within the U.S. Senate to occupy the Cobb Seamount,³⁶ the disposal of canisters of poison gas on the sea-bed; these and other activities add to the pressures for determining the character of the international regime beyond State jurisdiction.

Perhaps it will be useful to think in terms of three stages of decisions. The first, and most urgent, is that of reaching agreement on general principles — should there be a limit to the extent of State jurisdiction short of the mid-points of the oceans? should there be an international regime beyond these limits? should there be prohibitions against claims of State jurisdiction within the international regime? should the world community share, somehow or other, in the benefits of exploitation within the international area?

35. Christy, *op. cit.*, "Economic Criteria" p. 225.

36. Senator WARREN G. MAGNUSON, "Statement by Senator Warren G. Magnuson on Project Sea Use for Release to Afternoon Newspapers on Thursday, May 23, 1968". This statement contains the following paragraph. "Ownership and control of the ocean and its resources beyond the continental shelves is an unanswered question that is receiving increased attention. Until this question is answered, it seems to me that it would be a healthy precedent for the United States to occupy Cobb Seamount. Should it be occupied by another nation, it could be an important strategic loss for our country".

The Senator, however, did not state that the Cobb Seamount is actually closer to Canada than to the United States.

The questions are not, of course, simple. They are subject to different interpretations and to wide ramifications. Nevertheless, they are urgent and should be answered as quickly as possible. While the answers may have to be quite general, in order to be accepted, they will still be useful in setting the pattern for the next stages of decisions.

If it can be assumed that answers will be generally positive — that is, that State jurisdiction will be limited and that there will be some form of international regime beyond the limits — then the next set of decisions can be made with a somewhat lesser degree of urgency. Where should the limits be drawn? How should the limits be defined? And what should be the general character of the international regime? These questions are far more difficult since they require a greater degree of precision and have a greater effect on the distribution of the sea's wealth. The decisions may not be reached for several years. But there is, however, a high degree of urgency in undertaking the research, analysis, and discussion that will lead to the decisions. This paper is largely devoted to this set of questions.

The third set of decisions can be postponed until more knowledge is gained and the development of the sea-bed is underway. The distinction between the second and third stage, however, is not easy to make. Perhaps it can best be characterized by the difference between determining the character of the regime and determining the regime itself. Clearly, there is no fine line of demarcation between these two, but the distinction may, nevertheless, be useful in emphasizing the suggestion that certain decisions — such as mining codes and regulations — do not need to be made in the near future.

Economic Efficiency and Economic Wealth: The term "economic" is not always used with precision. In some uses, the term applies to the efficiency in the production of goods and services, irrespective of who is the producer and who the beneficiary. In other uses, the term applies to items and goods that have value and which man seeks to own or to acquire for his exclusive use. In the first sense, the term refers to how the wealth is used and in the second sense, to the wealth itself.

Efficiency is a goal that is common to all producers of goods and services, within all kinds of economies. It may be constrained by other interests and values, and by the imposition of regulations. And it may be calculated in non-monetary as well as in monetary measures. But the concept of producing the greatest *net* benefits, or difference between costs and revenues, is common to all cultures. The concept can, and should be applied to the utilization of the resources of the seabed. Both national and international regimes should be designed to permit the developers to operate with as great a degree of economic efficiency as is in keeping with other objectives and values. This will permit the maximization of net economic revenues.

The question of *distribution* of net revenues should be kept as an entirely separate issue from that of the *production* of net revenues. This is the question of exclusive rights to items of economic wealth. Unlike the problem of efficiency, there are non objective criteria for determining the best or most appropriate distribution of the wealth of the seas. Economists can analyze alternative regimes and their effects on the production of income. But the distribution of economic wealth — who gets what — can only be determined by negotiation or the exercise of power. If there is no international regime, economic wealth will go to those who acquire (and maintain) exclusive rights, either by the extension of jurisdiction or by the assertion and protection of claims. If there is an international that provides protection for exclusive rights, but that does not extract rents or royalties, the economic wealth will go to those who are first to claim the rights. However, an international regime that does extract rents will permit the world community to share in the wealth of the sea-bed. And in such a situation, the returns to the world community will be greatest if the regime permits the developers to operate with the greatest degree of economic efficiency. That is, the larger the net economic revenues, the larger the economic rent available for distribution.

The utilization of international fisheries is instructive as a model that fails to distinguish between economic efficiency and economic wealth, and that thereby fails to provide real benefits for either the world community or the fisher-

men.³⁷ It is also, by the way, a much more difficult and more significant problem for the world community than the minerals of the sea-bed. In the case of fisheries, the principle of the freedom of the seas precludes *de jure* acquisition of exclusive rights in international waters. In most cases, this means that open access prevails and that anyone who wants to, can enter the fishery. Under these conditions, economic efficiency cannot be achieved as long as the demand for the fish stock continues to grow. Virtually every developed fishery is marked by significant economic waste.

In a newly developing fishery, catches per vessel tend to be high and produce excess profits; i.e., net revenues greater than those sufficient to keep them fishing. These economic rents, however, are sharable by all fishermen. Thus, as the early fishermen return to port with large catches and revenues, other people are induced to enter the fishery. As they do, they share in the excess returns until all economic rent is dissipated. When this occurs, the total costs of fishing are equal to the total revenues and there is no net economic revenue accruing to the resource.³⁸

If exclusive rights were available, this economic rent need need not be wasted. The holder of the exclusive rights would be able to prevent the extra fishermen from entering the fishery, and could employ only as many vessels and men as would be required to produce the greatest difference between total costs and revenues or, if society chose, to produce the maximum sustainable catch.

The savings would be considerable. It has been estimated that the annual catch of North American Pacific salmon could

37. Christy, "The Distribution of the Sea's Wealth in Fisheries", in Alexander, ed., *The Law of the Sea: Offshore Boundaries and Zones* (Columbus: The Ohio State University Press, 1967). See also Christy and Scott, *The Common Wealth in Ocean Fisheries op. cit.*

38. The first modern exposition of the economic waste in fisheries was advanced by H. Scott Gordon, "The Economic Theory of a Common Property Resource: The Fishery", *Journal of Political Economy*, Vol. 62 (1954), pp. 124-42. See also Anthony Scott, "The Fishery: The Objectives of Sole Ownership", *Journal of Political Economy*, Vol. 63 (1955) pp. 116-124; James Crutchfield and Arnold Zellner, "Economic Aspects of the Pacific Halibut Fishery", *Fishery Industrial Research*, Vol. I, No. 1, (Washington: U.S. Government Printing Office, 1963); and Ralph Turvey and Jack Wiseman, *The Economics of Fisheries* (Rome: FAO, 1957).

be taken with \$ 50 million less capital and labor than are now employed.³⁹ It has been shown that 25 years ago, the catch of Alaska salmon was 50% greater than it is today, and was taken by *half as many fishermen*.⁴⁰ In the North Atlantic, the same, or even greater, amounts of cod and haddock could be taken with far fewer fishermen — at annual savings of between \$ 50-100 million.⁴¹ Indeed, all economic analyses of developed fisheries have reached the same conclusions — tremendous economic waste because of the inability to acquire exclusive rights or a satisfactory form of entry limitation.

If exclusive rights were available, economic efficiency would be possible and economic income to the resource could be produced, although it might not be. In the case of the Pacific salmon, for example, the U.S. and Canada have exclusive rights to the salmon because the Japanese have agreed by treaty to abstain and because other States have not yet chosen to enter the fishery. But even with these guarantees the United States fails completely to do anything to prevent the waste from occurring. That this completely to do anything to prevent the waste from occurring. That this need not be the case is evident in the way the Japanese, the Soviets, and a few other States manage their fisheries in those situations where they are the only fishermen. These States, through controls over the number of vessels they employ, are able to produce very large net returns.⁴²

But where fisheries are shared by a number of States, the condition of open access inevitably reduces the revenues to

39. JAMES CRUTCHFIELD and GIULIO PONTECORVO, *The Pacific Salmon Fisheries: A Study of Irrational Conservation*, (Baltimore: The Johns Hopkins Press for Resources for the Future, Inc., 1969).

40. Resources for the Future, Inc., *Annual Report 1968*, (Washington: RFF), p. 98 (derived from Crutchfield and Pontecorvo, op. cit.).

41. Report of the Working Group on Joint Biological and Economic Assessment of Conservation Actions, ICNAF Committee Document 67/19, Annual Meeting, June 1967, p. 4.

42. For example, the Japanese Fisheries Agency licences the distant-water tuna fishermen. The licenses are limited so that excess fishermen are prevented from entering the fishery. A market has developed for the tuna licenses. In 1967, the value of the license was \$ 500 per ton of vessel. That is, the owner of a 500 ton vessel was willing to pay \$ 250,000 for the privilege of entering the tuna fishery. See Kamenaga and Christy, Discussion, in Alexander, ed., *The Law of the Sea: The Future of the Sea's Resources*. (Kingston, Rhode Island: The Law of the Sea Institute, 1968), pp. 139-40.

each of the participants and leads to the dissipation of economic wealth. Thus the dilemma. Without exclusive rights, the economic rent is dissipated — no one gets it, neither the fishermen nor the world community. With exclusive rights, rent can be produced, but will go only to those who have the rights — unless the rules are changed.

The solution is theoretically simple. An international agency (by region, by stock, or global) could provide the exclusive rights that are necessary for the production of economic rent. And it could then extract the economic rent and distribute it so that those who are excluded would receive some of the benefits, and might, thereby, be inclined to abide by the rules. Unless such a system is adopted, economic efficiency in fisheries will not be possible and economic wealth will continue to be a source of conflict. It is to be hoped that the regime for the minerals of the sea-bed will not follow the model of the present regime for international fisheries.

Time Horizons: One of the problems in the debate of alternative regimes is that the participants may be operating from different, and tacit, assumptions about the future. Three different time horizons are often adopted — the pioneer, the short term, and the long term. And these may have a significant influence on views about alternative rules and arrangements.

The horizon of some observers is limited to that of the pioneer development. And since one small ship operating in the vast expanse of the oceans is unlikely to be, in itself, a source of difficulty, these observers see little need for changing the present regime of the seas.

Looking a little beyond that, and to the time when there may be several producers of manganese nodules, the problems may still not appear to be very great. "If expeditions from too many nations cluster too close to the honey pot, the resulting disputes, initially at least, are going to be settled by accommodation among the competing states, or by the evolution of adversary case law"⁴³.

For the long distant future (30 years ?) it is not difficult to foresee a multiplicity of uses of the sea and the sea-bed almost

43. ELY, "American Policy Options in the Development of Undersea Mineral Resources", *International Lawyer*, Vol. 2, No. 2 (1968), p. 222.

as great and diverse as that on land. They will at least be sufficiently complex and interrelated to require a refined system of law and government. Provisions will have to be made for the transfer of property (exclusive rights), control over external effects such as pollution, arbitration, resolution of conflicts among different uses of the marine environment, and a host of other rules of law similar to those on land.

The world community should be thinking in terms of this last time horizon. To be sure, the details cannot be forecast except in the most general of terms, but this is sufficient to question the validity of proposals designed to meet only the pioneer development or short run situation. For example, to rely only upon "accommodation among competing states" may be to establish a pattern that will preclude or greatly impede the reaching of a more satisfactory and mutually beneficial regime. It the reaching of a more satisfactory and mutually beneficial regime. It may lead the world community to the top of a molehill, rather than to the shoulder of a mountain. Such dangers may be reduced by keeping in mind the fact that the future uses of the sea will be diverse and manifold.

Factors Related to Limits

Interpretation of the Convention. There are wide differences of opinion as to how the Convention on the Continental Shelf should be interpreted. Some legal scholars delight in weighing the words of the participants in the Geneva Conference and in the prior meetings of the International Law Commission. From these evaluations they arrive at conclusions on the real intentions of the conferees. Others, less scholars than advocates, seek interpretations that support the interests of their clients.⁴⁴

44. National Petroleum Council, *Petroleum Resources Under the Ocean Floor* (Washington: National Petroleum Council, 1969), p. 13. This states that, "it is the firm and carefully considered conclusion of the National Petroleum Council ... that the United States, in common with other coastal nations, now has exclusive jurisdiction over the natural resources of the submerged continental mass seaward to where the submerged portion of that mass meets the abyssal ocean floor ..." But perhaps the conviction is not as strong as it seems, since the rest of the sentence states "that it (the United States) should declare its rights accordingly".

Neither approach is particularly trustworthy or useful in reaching decisions on appropriate and acceptable limits. In the first place, the conferee had such widely differing positions and opinions that no clear conclusions, short of rejection of certain extremes, can be reached. In the second place, decisions are not going to be made on jejune legal interpretations but on economic, military and other interests.

Several questions of interpretation are raised. One lies in the meaning of the word "adjacent" which is used in the definition of the continental shelf. To what extent does it imply that rights should be limited to areas relatively close to shore? Another question is whether or not the text of exploitability confines limits to the area being exploited or, like the lowering of the water in a bathtub, extends limits everywhere to the depth at which exploitation has taken place. And a third question lies in the definition of exploitability. Must it be commercially successful exploitation, and if so, in whose economic terms?

Proliferation of Rights. It is suggested by some, and feared by others, that rights to the resources of the sea-bed may tend to migrate upwards through the superjacent waters and to the surface of the sea. To the extent that this occurs, it might diminish the present freedoms of fishing, navigation, and scientific inquiry. Under the present law, coastal states have full jurisdiction over their territorial seas except that they cannot prevent innocent passage of foreign vessels. Several States, including the U.S., claim territorial seas of three miles. Others claim 12 miles; and some assert limits of 200 miles. In many States, there are separate and additional zones in which exclusive fishing rights are claimed. The U.S., for example, has claimed such rights out to nine miles from its territorial seas.

There is already evidence of interference between national use of the sea-bed and international use of the superjacent waters. In the waters of the Gulf of Mexico, for example, oil rigs have become so plentiful that it has been necessary to provide "fairlanes" for shipping. The oil companies bear the cost of reduced access to oil pools. And the shipping companies bear the costs of having to go greater distances to navigate through the fairlanes. If non-U.S. shipping (and fishing) interests had little to say in the determination of fairlanes, it is evidence that rights

do tend to migrate upwards and interfere with international freedoms. Thus, there appears some justification to the fear that extensive sea-bed rights may lead eventually to extensive territorial seas.

Values of Continental Margin Resources. Before deciding about limits, it is desirable to know as much as possible about the value of the resources on either side of the line. This, however, is of more theoretical than real importance, and the lack of knowledge should not be used as an argument for postponing decisions. Knowledge of the material lying on, or underneath, the continental slope and continental rise is extremely difficult to come by. And government budgets for developing such knowledge are minuscule.

But even if we knew much more than we do now about the raw materials, estimates of economic value would still be highly speculative. It is not the quantity of materials that is important, but the cost of extracting them and the prices that can be received. And since elements of supply and demand change over time, it is difficult to predict the potential value of raw materials.

This does not mean that we should not continue to expand our knowledge. It simply means that we should not be very sanguine about the chance of achieving significant increases in relevant information in the near future.

Furthermore, limits based on distance from shore have little relevance to the amount of economic wealth. One State, for example, may have greater wealth within 50 miles of its shores than occurs within 500 or 1000 miles of the shore of another State. Sudan and Saudi Arabia, perhaps, may acquire greater wealth by extending their limits to 40 or 50 miles than can Chile, Ecuador and Peru by extensions of 200 or more miles. The accidents of geography exist not only with respect to the length of shoreline and openness of ocean vista, but also with respect to the resources in adjacent waters and submerged lands. Thus, it is futile to hope for "equity" through the means of arbitrary limits of jurisdiction.

The Dependence of Mining Operations Upon Shore-Based Installations. Most present mining operations are highly dependent upon adjacent lands for certain services and functions.

Pipelines tie oil wells to shore-based refineries. Underwater conveyor belts or slurry pipelines may do the same for hard minerals. These, and other elements, make it economically desirable for the mining operators to have close ties with the coastal States adjacent to their operations. And at the same time, the ties give the coastal States a significant influence over the mining enterprises. Thus, even if the operation fell outside the jurisdiction of the adjacent State, it may still be subject to that State's demands.

But as distances extend further from shore, the ties will become weaker and technological advances will provide substitutes for proximity to land. At some point, the value of ties to land may become negligible and the operator will be freed from the influence of the coastal State. It is important to anticipate insofar as possible the point at which ties to land are no longer economically desirable.

Stability of Regimes. One of the more important questions of interest to mineral producers operating in foreign countries is the degree to which they can find stable regimes for their operations. Most of the large international oil companies have invested considerable time and effort in learning how to deal with foreign States. They have more confidence in their experience with individual States than they have in an unknown international agency or authority. They would, therefore, rather have extensive limits and large national jurisdiction than narrow limits and large international jurisdiction.

The confidence, however, may be misplaced. The recent Peruvian expropriation of a U.S. oil company's operations is only one instance of the growing difficulties that oil companies are experiencing with producing countries. The Organization of Petroleum Exporting Countries recently adopted a manifesto incorporating the "principle of changing circumstances", under which contracts can be opened for re-negotiation wherever changes in circumstances are deemed sufficient. In addition, the OPEC manifesto urged producing countries to undertake their own exploitation whenever possible.

Such instabilities in host countries *may* make the alternative of an international regime somewhat more attractive, particularly if that regime is developed so that it protects the *bona fide* interests of the companies. To the extent that this is

true, companies might be more willing than they appear to be now, to endorse narrow limits.

Security. For some States, the interests of security are in conflict with respect to the determination of desirable limits. Wide extensions of limits may impede the freedom of mobility through narrow straits, whereas narrow limits might permit foreign military activity close to shore. The solution of the dilemma depends upon the degree to which upward migration of sea-bed rights can be prevented and upon the value of the sea-bed as a site for military activity.

If wide limits are chosen and if rights tend to move upwards, then the maritime powers will lose a degree of mobility in foreign waters while, at the same time, gaining a greater degree of protection off their own coasts. The value of the sea-bed as a site for military activity is questionable. Monitoring devices fixed on the bed may help determine the presence of foreign submarines. But weapons of aggression are likely to have value only to the extent that they remain undiscovered and provide advantages not available to submarines.

Other elements may also have important influence on the military position. But information about these elements is not readily forthcoming.

The Problems of Islands and Small Seas. There are certain complicating elements that make it difficult to evaluate the effect of alternative limits. Should the limits, however they are defined, apply to all islands no matter how small (*viz.* Clipperton, Rockall, Ascension, Tristan da Cunha)? Or should they apply only to islands that are sovereign States, thereby giving large awards to Barbados (and perhaps Anguilla) and little to Bermuda and the Hawaiian Islands? If the limits are narrow, then the inequities and difficulties are not particularly great. But as limits become larger, the problems become more intransigent.

There are also difficulties in determining where limits should fall within small seas, such as the Gulf of Mexico, South China, Caribbean, and Mediterranean. The problem of the North Sea has been tentatively resolved by dividing the sea-bed among the adjacent coastal States. (The recent ruling of the International Court of Justice does not significantly affect the division.) But the North Sea is clearly continental shelf and

everywhere, except for a small trench off Norway, less than 200 meters in depth. But for the other seas, the question remains as to whether they should be divided up among the adjacent States or there should be narrower limits with an international or perhaps, regional regime in the middle.

Acceptability. There are more than two dozen nations that are landlocked. Another 50 or so face small seas, have little more than toeholds on the oceans, or have vistas broken by foreign islands off their coasts. Of the remaining 50, about half have small to moderate coastlines and the rest, extensive shores, on the open oceans. If there were extremely wide limits, only the last two dozen would receive great gains in jurisdiction. With moderately wide limits, the gains would go to the last 50. The rest would receive little, if anything, in enlarged jurisdictions.

It was noted above that economic wealth is not related to size of area. However, in the absence of knowledge about the resources of deep water areas, States are likely to perceive their gains or losses in terms of square miles or distance from shore. Thus, the wide variations in areal gains under different limits, raise questions of acceptability of limits.

States are not so much concerned about gains in their own area of jurisdiction as they are about how their gains measure up against the gains of all other States. The greater the appearance of inequity in gain, the lesser the likelihood of universal acceptance.

Relationship of Limits to the International Regime. One more factor of influence on decisions on limits should be mentioned. As limits are extended, the area under international jurisdiction becomes diminished. And if this area is subjected to a system for sharing of rents, then the rents are also likely to be diminished. A State's decisions on limits, therefore, cannot be considered without some knowledge about the character of the international regime that may exist beyond the limits. If principles can be established that will guide the international regime so that States will have confidence in it and benefit, from it, then perhaps this will serve as a restraint on wide extensions of exclusive rights.

Other Factors. Many other factors might be brought into the discussion. These would include the description of con-

tinental margins, the wide variability in them, the different kinds and degrees of exclusive rights, problems of overlapping jurisdictions, and others. Most of these, however, are treated in other papers at this conference.

Factors Related to the International Regime

Concepts of Property. One of the difficulties in discussing international regimes lies in the different terms that are used to describe property and in the different interpretations of these terms. There is, for example, a great deal of vocal opposition to proposals that the United Nations take "title" to the resources of the sea-bed. There is a good deal of lengthy discussion among lawyers as to whether the resources of the sea-bed are *res nullius* or *res communes*. Terms such as jurisdiction, sovereignty, ownership, private property, public property, common property, freedom of the seas, freedom of access, etc., are used with a great deal of freedom and imprecision (by the author as well as others).

While not denying the validity and usefulness of these terms, it can be pointed out that there are essentially only two elements in the discussions of sea-bed property and that the free use of the above terms is often confusing, frequently pejorative, and sometimes irrelevant. The two essential elements are first, the degree to which all States feel they have an interest in the sea-bed, and second, the necessity for providing some form of exclusive right to the users of the sea-bed resources.

In the first case, whether the sea-bed resources are *res communes* or *res nullius* is a question that is largely academic. There are a few people who maintain that the resources are "ours" because they are *res nullius* and only "we" (the United States) have the technological capacity to develop them. And these same people say that vesting authority over the resources within an international agency would constitute a great "give-away". This is a sadly imperialistic notion. But the proponents of this position are only within the United States and are not, it is to be hoped, of very great number. Most of the States appear to feel that they have an interest in the sea-bed and that their interest is held in common. This is certainly

true of international fisheries, as reflected in the treaties and conventions that carry an obligation to conserve fish stocks and protect the general interests of the world community.

How strong the interest is, remains to be seen. It might only be strong enough to prohibit sovereign claims in the international areas. Or it might be so strong that non-mining States may insist upon receiving a share of the rents that are produced. But in either case, the decisions are not likely to be greatly influenced by arguments over the meaning of ownership.

Arguments over exclusive rights are similarly confused by the mis-use of terms. The necessity for providing some form of exclusive rights to miners (discussed below) appears to be generally accepted. The rights, of course, can be limited in time, area, and with respect to specific uses. But if there are such rights, some agency must provide them and ensure their protection. This is the function that must be fulfilled. Whether the agency that fulfill this function has "title", "sovereignty", "jurisdiction," or "registering authority" is irrelevant and the terms, themselves, are misleading.

Degrees of Authority. There are similar difficulties with respect to the terms that are used to describe the agency and its functions. A committee of the American Branch of the International Law Association, for example, recently stated its opposition to a "supra-national authority" with the "power to grant or deny concessions".⁴⁵ These terms, which were used pejoratively, were contradictory to the substance of the committee's recommendations, which called for an international agency with the authority to resolve conflict among competing claimants. The use of such terms as supranational does little to advance international discussion.

The form and degree of authority will follow the functions that must be fulfilled. If the miner requires exclusive rights, if there is to be a means for the non-arbitrary allocation of exclusive rights, if royalties or rent are to be extracted, then the international agency (regional agency, "supranational authority," or whatever) must have sufficient authority to fulfill these tasks. The following items in the paper refer to some of the

45. Committee on Deep Sea Mineral Resources of the American Branch of the International Law Association "Interim Report", July 19, 1968.

functions that are, or may become, important for the international regime.

Exclusive Rights for Miners. It has been assumed above that miners of the deep sea-bed would require exclusive rights to their mining area. This assumption might be challenged. The answer would depend upon the degree to which there are significant differences in value between different resource sites and upon the degree to which the operations require equipment fixed to the bed of the sea. If differences in value are not great and fixed equipment is not necessary, then there will be little competition or conflict over location. The exploiters would not need to exclude others because there would be plenty of equally valuable sites elsewhere.

But the value of resource sites is not likely to be uniform. The differentiating characteristics include the density of the manganese nodules on the floor, their metallic content, the depth at which they occur, their proximity to land, the topography of the area, the amount of storm hazard, etc. Variations in these characteristics are likely to be such that the value of sites will range as widely as they do for mineral bodies on land.

For the pioneer efforts, exclusive rights may not appear to be necessary but over the short run (and definitely the long run) they will become vital. A State or a State's entrepreneur is not likely to invest in exploration and exploitation if there is a chance that others will be able to move in and mine the same area. In setting up the regime, therefore, provision must be made for rules that will permit the miner to gain and hold exclusive rights to a sufficiently large area for a sufficient length of time to produce a satisfactory return.

Allocation of Exclusive Rights. If exclusive rights are necessary then how can they best be acquired or allocated? There are several possibilities. One is by the exercise of force or power. While most people would abjure this means, the indirect applications of power are common to many international negotiations. The more arbitrary the means for allocation, the more chances that power will be exercised. A second technique is on the basis of some concept of public interest (*viz.* the allocation of the radio spectrum in the U.S.). And a third is by accommodation among competing claimants. These last two leave the decisions essentially in the hands of diplomats that are only

indirectly concerned about the efficiency of production and they permit arbitrary decisions that may be damaging to both the entrepreneurs and the world community.

Two other techniques remain. One is allocation on the basis of first come-first served. And the other is allocation by initial market or, more specifically, by auction or sale by the international agency. In each case allocation can be associated with a variety of rules designed to reduce detrimental consequences and meet the interests of the producers and the world community. A first-come-first-served system might encourage a race to claim areas of the sea-bed, for example. But if the right can be maintained only by meeting a requirement performance, the temptation to claim rights might be reduced. A performance requirement could, however, stimulate an excessively rapid rate of production which could have a detrimental effect on the market for the metals. In short it is difficult to anticipate and trace out the net effects of the different systems and the rules that might be required.

However, the essential differences between the two systems can be determined and evaluated. The first come-first served technique provides no means for choosing among claimants to the same or overlapping areas. It does little to encourage an orderly allocation of rights and production of resources. And it provides no means for extracting the economic rent that might accrue to the exclusive right.

The main difficulty with the auction mechanism is that it requires that the international agency have a significant degree of authority. Many of the problems that bedevil the U.S. Federal Government in its auction of leases to the outer continental shelf would also apply to the international agency — the frequency of markets, the size of leases, the determination of areas, etc. It would, however, provide the most orderly and efficient means for allocating rights and determining the amount of revenue to be extracted.

Royalties and Rents. The extraction of revenues (which is assumed above) is subject to question. The question hinges upon the desirability of equity in the enjoyment of the resources owned by the world community or, in other terms, upon the necessity for providing a stable regime by obtaining the acceptance of those States in a position to break the regime. This,

as noted above in the discussion of limits, is a question of wealth distribution and not subject to objective economic criteria.

If the question is expressed in terms of equity, then someone has to determine the amount that is fair. If in terms of acceptability, then it is conceivable that nothing need be paid by the exploiters or that they can negotiate the smallest payment that is acceptable.

There are those who argue that the benefits to the world community occur through the greater production of natural resources at lower prices. And they also argue that any payment would operate as an impediment to investment. They therefore oppose such payments. But it is questionable whether these blandishments are likely to succeed in view of the widespread attention given to the sea-bed and the degree of interest that nations perceive that they have in common.

In view of this, the question remains as to how the payment should be determined. It has been suggested that a tax be negotiated between the exploiters and the international agency. If, as further suggested, this be a fixed yield tax (e.g. dollars per ton of ore raised) then it does not permit efficient allocation of production between sites of different value. An alternative — a tax on net income — would be difficult to determine in view of the differences among national economies that might be involved. In either case, it would also be difficult to determine that tax would be fair to both the entrepreneurs and the world community.

For these reasons, it would appear that an auction of exclusive rights would be preferable. The amount that is bid would reflect the value of the right. For pioneer exploiters, the bid is likely to be negligible in view of the high risks involved, and it would not, therefore, act as an impediment to investment. As experience increases and uncertainty is reduced, the bids would provide an accurate reflection of the value of the rights. To be sure, the market is likely to be less than perfect, but even so, the flexibility of this system would appear to provide a better means for determining a fair return to the owners of the resource than would an arbitrarily decided tax.

One further question remains, and that is the method for disbursing the revenues that are received. It has been suggested that the revenues might provide a source of independent

income to the United Nations. This, however, is likely to be unacceptable to those who oppose independent income for the UN on the grounds that it might be used for a peace-keeping force. Thus, most of those who urge the collection of revenues suggest that the funds be devoted to some generally acceptable humanitarian purpose such as the reduction of protein malnutrition or the stimulus of economic growth in the less developed countries. Acceptance would depend upon how the non-exploiting States would perceive of this as meeting their interests in the bed of the sea.

Other Factors. The international regime for the sea-bed will also have to deal with a large number of other factors. Most of these can only be described in speculative terms at present. They need both more factual knowledge and more thorough analysis than is now available. For example, it is not yet clear whether or not it would be desirable to have resource surveys and or resource evaluation done by an international agency or left up to the prospective miners. This would affect not only the authority and management activities of the agency but also rules as to the provision of exploration as well as exploitation rights.

The magnitude of production is another important factor. If output of manganese is so great that it has a deleterious effect on some of the manganese exporting countries, this may require some measures to alleviate the hardship. The possibility of cartelization or commodity agreements may have to be taken into consideration. Or if the agency is responsible for leasing mining rights, there will be questions as to the rate at which leases are to be provided.

Other kinds of production controls may also be important — to ensure efficient sweeping of the nodules, rather than haphazard harvest of the mineral bottoms. It may be desirable to provide for controls over pollution or for other kinds of conflicts in the use of ocean space — military, cables, fishing, shippings, etc. There may also be problems in inspection, enforcement, and adjudication.

For most of these factors, the critical need is not for immediate decisions, but for immediate research and discussion.

Summary

The objective of this paper has been to set forth some of the more important factors that should be considered in the evolution of a new international regime for the bed of the sea. It has been written with the hope that the participants in the international debate will be able to shape the evolutionary process, rather than leaving the process to the whims of chance and pressures of vested interests. There is, of course, a modicum of truth in the often quoted dictum that the law follows the facts. But in the case of the oceans, the world community has an opportunity to influence the facts. And this can best be done by having clear and realistic perceptions of problems and opportunities and by developing goals that will facilitate efficient, orderly, and equitable enjoyment of the sea's resources.

SOME CONSIDERATIONS OF LIVING RESOURCES ASSOCIATED WITH THE DEEP SEA-BED

BY

Dr. MILNER B. SCHAEFER

*Professor of Oceanography; Director, Institute of Marine
Resources, University of California, La Jolla, Calif.*

Introduction

Adequate consideration of the living resources is a vital aspect of regimes for the management and the utilization of the resources of the sea-bed, whether national or international. This is so, both because the sea-bed has living on it, or in it, or in close association with it, certain living organisms that are important food-resources for man, and because the use of the seabed for other purposes, such as production of gas and oil or production of minerals, can have adverse effects upon these living resources. There can, in some cases, even be important adverse effects on pelagic species, that is species of the high seas not associated in their adult stages with the sea-bed, although such cases are largely confined to the shallower waters.

This Symposium deals with the *international* regime of the sea-bed. Under the 1958 Geneva Conventions, including the Convention on the Continental Shelf, and under any proposed revisions thereof with which I am familiar, the sea-bed within the territorial sea, and the sea-bed beyond it to a depth of at least 200 meters, is under the sovereign jurisdiction of the adjacent coastal State for the purpose of exploring and exploiting its natural resources. Therefore, I shall be largely concerned here with the living organisms associated with the sea-bed at depths beyond 100 meters. It is the purpose of this paper to summarize and review knowledge of the distribution and abun-

dance of such organisms, with a view to some evaluation of their commercial potential, and to discuss the implications thereof to regimes for this portion of the sea-bed.

1. *Categories of living organisms associated with the sea-bed*

The living resources associated with the sea-bed are commonly divided into two categories: (1) benthonic, or sedentary, organisms, consisting of those that live attached to the sea-bed, or burrow within it, or crawl about on it, and (2) demersal organisms, consisting of creatures of the superjacent waters that have a close association with the sea-bed either because they subsist on benthonic organisms, or because they use the sea-bed for shelter. The demersal organisms, such as the flatfishes, or the shrimp, often burrow shallowly into the sea-bed to evade their enemies, and so might be considered temporarily benthonic. Conversely, many of the species which are sedentary in their adult stages, such as oysters, mussels, barnacles, and some gastropods, often have eggs and larval stages that drift about, or swim freely, in the water above the sea-bed, although they settle down and become sedentary as adults. The division between these categories is thus not precise. Further, only some of the species are harvested by man.

The Convention on the Continental Shelf provides in Article 2, paragraph 1 that "The coastal State exercises over the continental shelf sovereign rights of the purpose of exploring it and exploiting its natural resources". In order to provide a precise definition of the organisms to be included in such natural resources the following definition was adopted in Article 2, paragraph 4: "The natural resources referred to in these articles consist of the mineral and other non-living resources of the sea-bed and subsoil together with living organisms belonging to sedentary species, that is to say, organisms which, at the harvestable stage either are immobile on or under the sea-bed or are unable to move except in constant physical contact with the sea-bed or the subsoil". Thus, there are included in the resources of the sea-bed under national jurisdiction only those organisms that at their harvestable states *never* get off the bottom and "swim" in the overlying waters. Organisms that are

capable of swimming in the overlying waters at their harvestable stage, are *not* resources of the sea-bed, even though they may spend some share of their time on or in the sea-bed.

In my discussions of the benthonic organisms of the deep sea floor, I shall not, except where specifically indicated, be employing the legal definition of the Convention, but rather the looser criteria employed by marine biologists dealing with the fauna of this part of the ocean. Biologists studying this fauna ordinarily collect their material using deep-sea grabs, or dredges, and include in the benthos all of the organisms that are taken by such gear. This equipment captures both those organisms that are entirely sedentary and some that also may spend part of their time in the overlying waters and part on or in the sea floor; this is particularly true of some shrimps and other crustacea.

In addition to the benthonic and demersal organisms intimately associated with the sea-bed, some species that as adults are pelagic creatures of the open sea, not dependent on the seabottom, have young stages that are associated with the sea-bed. For example, the herring of both the North Atlantic and North Pacific deposit their eggs in shallow water on the seabottom, as do some species of squid, and some species of sharks and rays. To the best of my knowledge, however, all commercially important species with this type of reproductive behaviour do so only in waters shallower than 200 meters. Thus, the relation of such species to the sea-bed is primarily a problem of national regimes and not of the international regime of the sea-bed. It is, of course, in some instances, an important element in the international regime concerning the living resources of the high seas.

2. *Benthonic organisms*

1. *Benthonic plants*

Benthonic organisms include both plants and animals. For our purposes here, we may dispose of the former category rather quickly, however, because plants living attached to the sea floor are confined to depths considerably less than 200 meters,

due to lack of adequate sunlight at greater depths. In order to survive, any plant requires sufficient light so that it can produce by photosynthesis at least as much organic material as required by its own metabolic needs. In the case of the giant kelp of California, *Macrocystis*, for example, the illumination required is the equivalent of 15 foot-candles of white light. In the clearest water along the California coast, the depth where the light is no longer adequate is something less than 50 meters. (Institute of Marine Resources, 1964). Similarly, according to Harvey (1955) the depth of the photosynthetic zone in the English Channel in summer is about 45 meters (based on two species of diatoms, which are tiny planktonic plants). Even in the very clearest ocean water the photosynthetic zone, where photosynthesis exceeds respiration, either for attached plants or for open-sea phytoplankton, does not reach deeper than about 100 meters. Consequently, the benthonic plant resources along the margins of continents and islands are within the limits of the continental shelf under the jurisdiction of the adjacent coastal State, according to even the most restrictive current legal interpretation. Only on the tops of shallow seamounts, remote from the continents, will there occur benthonic plants currently subject to an international regime. Thus, the sedentary plants need be of little or no concern relative to possible international regimes of the sea-bed.

2. *Benthonic animals*

On the contrary, benthonic animals occur on the deep sea floor into the greatest depths of the ocean. However, until quite recently knowledge of the quantitative distribution of benthonic organisms beyond the continental shelf has been lacking. During the last two decades our knowledge, although still sparse, has been greatly increased due to the work of deep-sea expeditions supported by a number of nations. Vinogradova (1962) has reviewed and summarized much of the available information. Much of it has been produced by vessels of the Soviet Union using a standardized bottom-grab, "Ocean", as well as dredges. Vinogradova has converted the samples of all different investigations in different parts of the world ocean

to estimates of biomass per square meter of seabottom. From this summarization, and from the review of individual papers by Vinogradova, a number of important generalizations are evident:

— Biomass decreases from the continental shelves down the continental slopes and out onto the deep sea floor in all oceans.

— Even in the abyssal part of the ocean, the sparse biomass tends to decrease with distance from the continents.

— There is a general decrease in biomass of the deep sea floor from the temperate regions towards the tropical regions.

— In equivalent latitudes and depths, the benthonic biomass tends to be higher in those oceanic regions where there is high primary productivity in the near-surface waters.

Vinogradova has summarized, and explained, the observations as follows :

...the quantitative distribution of the bottom fauna has a pronounced zonal character, and is subordinated to the general scheme of geographical zonality in the ocean. Among the many factors of the environment, that influence the distribution of life on the floor of the ocean, such as temperature, gaseous regime, currents, type of sediments, bottom configuration and food supply, the latter is doubtless the most important and decisive.

Detritus is the basic source of food of the bottom animals; it is brought to the depths from the coastal shallows and sinks to the sea floor in the form of dying off plankton. The bacterial flora of the sediments in near bottom water layers must also be taken into account.

Toward the central open parts of the ocean the influence of the coastal shallows as a source of food gradually fades away. Further decrease in the abundance of bottom fauna from north to south is determined by the latitudinal zonality and the distribution of plankton, far more abundant in the water masses of the temperate zone as compared with the tropics.

The food resources of the floor of the open ocean are scanty; they diminish progressively from higher to lower latitudes, in relation to the impoverishment of plankton and the gradual decrease of nutrient matter brought from inshore shallow depths ...

Vinogradova also presents a table prepared by Zenkevitch, Barsanova, and Belyaev (1960) in which the quantity of bottom fauna in the World Ocean has been roughly estimated by depth

zones. This is reproduced here as Table 1. Even though this tabulation must necessarily be very crude and approximate, because of sparsity of data, it is evident that the larger part of the benthonic biomass in the World Ocean occurs on the continental shelves in depths of less than 200 meters, and that substantially the entire biomass occurs on the bottom within the continental margins. The latter is located at an approximate average depth of 2500 meters, according to a recent estimate by Dr. W. Pecora of the U.S. Geological Survey. Prof. A. J. Guilcher's paper for this symposium indicates that the continental margin extends approximately to 3000 meters.

Table 1

QUANTITY OF BENTHONIC FAUNA IN THE WORLD OCEAN, AFTER ZENKEVITCH, BARSANOVA AND BELYAEV (1960), FROM VINOGRADOVA (1962).

DEPTH (meters)	AREA 10 ⁶ km ²	%	MEAN BIOMASS g/m ²	TOTAL BIOMASS 10 ⁶ tons	%
0- 200	27.5	7.6	200	5,500	82.6
200-3000	55.2	15.3	20	1,104	16.6
3000 and more	278.3	77.1	0.2	56	0.8
Whole Ocean	361	100	18.5	6,660	100

It further appears that there is a striking decrease in the biomass of benthonic organisms in the vicinity of 1000 to 1500 meters, according to some of the papers reviewed by Vinogradova. Her review indicates, for example, that in the north-west Pacific the biomass on the continental shelf reaches generally several hundred grams per square meter but that further down, in depths ranging from 1000-3000 meters, the biomass decreases to 10-20 g/m² in the Bering and Okhotsk Seas. She observes that in the northeast part of the Pacific Ocean, "Owing to a narrow continental shelf and very steep slopes the biomass of benthos begins to decrease at some 100-200 miles offshore; from some scores of grams per 1 m² in depths ranging from 400-1200 meters it drops to 1.4 g/m² beyond 2000 meters". Again for the Indian sector of the Antarctic Ocean

the following estimates of biomass are provided for various depth zones:

Depth (meters)	Average biomas g/m ²
100 - 200	1347
200 - 500	239
500 - 1000	43
1000 - 3200	13

Sanders, Hesseler and Hampson (1956) have recently reported on a detailed study of the bathymetric distribution of benthonic organisms along a transect from Massachusetts, U.S.A., to Bermuda in the north Atlantic Ocean, employing a new "anchor-dredge" which digs a strip of constant depth at the surface of the sea floor. Their results are given in number of organisms per square meter, and show rather greater faunal densities than those reported from some previous studies, probably resulting from the smaller screen-aperature used in their dredge. From the standpoint of our considerations, the important aspect of their results is that each region of their transect was found to support a characteristic number of animals per square meter, with a general trend of decreasing density with increasing depth and distance from the continent, these being: outer continental shelf (less than 100 meters) 6,000-13,000; upper continental slope (200 to 487 meters) 6,000-23,000; lower continental slope (823 to 2086 meters) 1,500-3,000; abyssal rise (2500 to 3752 meters) 500-1,200; abyss under the Gulf Stream (4436 to 4520 meters) 150-270; abyss in the Sargasso Sea (4667 to 5001 meters) 31-130; lower Bermuda slope (1500 to 2500 meters) 140-300; upper Bermuda slope (1000 meters) 500-850. The sharp drop in numbers of organisms on the lower slope is clearly evident. This shows even more markedly in figures presented by these authors for individual groups of organisms, such as Polychaeta and Crustacea.

Sanders, et. al. have also summarized some information gathered by other authors in other parts of the World Ocean. They note that in the eastern Mediterranean Sea Chukhchin (1963) found that five samples collected from the depth interval of 100-200 meters gave values of 16 to 764 animals/m², with a mean number of 290; ten samples from the 200-1000 meter

interval ranged from 0 to 104 animals/m², with a mean of slightly less than 21/m²; and nine samples from the 1000-3000 meter interval yielded only 0 to 4 animals/m² with a mean of less than 2 organisms/m². They also present results obtained by Kuznetsov (1963) on the shelf and slope in the southern Kamchatka and northern Kurile Islands, where it was found that the average numbers of benthic organisms obtained at different intervals, for a very large number of samples, were 102/m² for the 0-50 meter depth range; 94 for the 50-100 meter interval; 111 for the 100-200 meter range; 245 for the 200-500 meter interval; 284 for the depth of 500-1000 meters; and 26 for the 1000-2000 meter depth range. The sharp decrease in the vicinity of 1000 meters is again evident.

The significance of variations in abundance of benthonic organisms, at depths beyond 200 meters, along the continental slope and the deep sea floor is in relation to the potential food supply for demersal species that may be harvested by man. The truly sedentary species do not support commercial fisheries anywhere at such depths. Harvesting of sedentary benthonic species, such as clams, oysters, etc., is entirely on the shallower portions of the continental shelf. As we will see in the next section, a variety of shrimps and other crustacea are taken at depths considerably greater than 200 meters, but most of them are forms that have a demersal existence, being capable of swimming about above the bottom. A few kinds of crustacea, occurring below 200 meters, that are existing or potential commercial resources, such as the king crab (*Paralithodes*) walk about on the sea-bed, and may not be able to swim, so that whether they are sedentary in the terms of the Convention on the Continental Shelf may be a matter of technical argument. However, such species are not captured by the kinds of sampling gear employed in the scientific surveys of benthonic animals discussed above.

3. *Demersal species of existing or potential commercial importance*

Scientific sampling, employing trawls, on deep-sea expeditions has demonstrated the occurrence of demersal animals

in all depths of the sea. Demersal species were also observed in the deepest portions of the ocean, in the Mariannas Trench, in the dives of the bathyscaphe "Trieste". More recent descents by manned submersibles to depths of as much as 4000 meters have also permitted direct observation of the occurrence of demersal fishes and crustacea in these great depths. In order to be of existing or potential commercial importance, however, such organisms must be sufficiently abundant, and sufficiently valuable in the market, to enable fishermen profitably to exploit them. Since as one goes deeper, the expense of harvesting increases, it is only those species which fetch rather high prices, such as shrimp, lobsters, crabs, and a few varieties of fish, that presently support fisheries much deeper than 200 meters. Exploratory fishing surveys that have been conducted in some locations enable us to make some estimate of where additional, potentially commercially exploitable, populations of crustacea and fish may exist. It is the purpose of this section to review some examples of the present commercial fisheries for deep-demersal species, as well as some exploratory fishing results, as a basis of considering what portions of the deep sea-bed, beyond 200 meters, are likely to be of future commercial importance from the viewpoint of the possible harvesting of living resources.

1. *Crustacea*

Shrimps, prawns, lobsters, and crabs are highly regarded in many parts of the world by consumers who are willing to pay relatively high prices for them. They are also easily shipped frozen from most parts of the world to markets in North America and Europe. In consequence, the fisheries for these kinds of Crustacea have grown very rapidly in recent years. By the same token, it is possible to fish profitably at considerable depths, because small catches, of the order of only several hundred pounds per day, can frequently prove commercially profitable. This not only has resulted in commercial fisheries for such forms to many hundred meters of depth, but also has stimulated a considerable amount of exploratory fishing activity in the search for potential additional resources.

(a) *Shrimps and prawns**

A notable example of a region that can support economically quite deep fishing is the Mediterranean, where fresh fish and crustacean species are highly valued, and the fauna of the near-surface waters is not very rich. It is a characteristic feature of Mediterranean trawling that boats of modest size, of say 18 meters with engines of only 150-200 h.p., commonly fish, at depths of 550-700 meters (Kristjonsson, 1968). Trawling for shrimp in this region is not a separate fishery, but shrimp constitute a financially important part of the catch in the trawl fisheries of the region, and make up a sizeable part of the total catch by volume in deeper waters. Several species of prawns and shrimps help support commercially significant fisheries in depths beyond 200 meters in the central and western Mediterranean, and the same or similar species are also fished in deep water along the Atlantic Coast of North Africa, and offer additional potential in this region and elsewhere. According to papers by Kristjonsson (1968), Massuti (1968), and Longhurst (M.S.), the gamba blanca, *Parapenaeus longirostris* is taken commercially in the central and western Mediterranean in depths from 200-400 meters, and also in depths of 100-300 meters in the Gulf of Cadiz and off Northwest Africa, and off Angola in depths of 250-260 meters. The first two authors indicate that between 400 and 700 meters in the Mediterranean there is characteristically taken commercially another shrimp *Aristaemorpha foliacea*, gamba roja, and a third species, *Aristeus antennatus*, gamba rosada, is also taken in 400-700 meters. Massuti (1968) states that this last species is taken off Morocco at 250 meters. According to Longhurst a related species *Aristeus varidens* is taken commercially from 540-600 meters in the Atlantic off Angola. This deep-water fishery for prawns off Angola was started only in 1966 by a single Spanish trawler, which was so successful that by 1968 a fleet of some forty small

(*) For the purposes of this paper crustacean resources are generally categorized as follows, after Longhurst, in an as yet unpublished manuscript (1) Shrimps and Prawns, including the high latitude pandalids, and the low-latitude penaeid prawns; (2) Lobsters and similar forms, including the genera *Homarus* and *Nephrops*; (3) Crabs of several forms, including king crabs (*Paralithodes*), tanner crabs (*Chionoecetes*), and Galatheid crabs (*Pleuroncodes*, etc.).

trawlers from Spanish ports had congregated in the Angola region. In addition to the species just mentioned, called listado in Spanish, they take at the same depth the carabinero *Plesiopanaeus edwardsianus* and, in shallower waters, at about 250 to 260 meters, *Parapenaus longirostris*. According to Kristjonsson (1968), off Nigeria another prawn *Plesionika sp.* occurs in potentially important quantities in depths of 400-600 meters.

Maurin (1965) provides also information on the bathymetric distribution in the Atlantic off Spain and Morocco of several of these species, based on exploratory cruises of the research ship "President Théodore Tissier", with some notes on their commercial utilization. *P. longirostris* occurs in 50-550 meters, and at high density in 150-300 meters. *P. edwardsianus* occurs in 600-900 meters, and has been captured at night up to 200 meters; *A. foliacea* is at similar depths. *Plesionika edwardsii* is taken in 350-500 meters; another species of this genus, *P. martia*, is quite abundant between 350 and 700 meters, optimally at about 500 meters.

The carabinero, *P. edwardsianus*, also occurs on the western side of the Atlantic, having been found in possibly commercially important quantities in the Gulf of Mexico below 550 meters (Bullis, 1956) and in 340-730 meters off the northeast coast of south America (Bullis and Thompson, 1959). There occur also in the Gulf of Mexico, (Bullis, 1956) in depths of some 300-400 meters potentially commercial quantities of *Plesionika longiceps*.

Of perhaps the greatest commercial potential in the deep waters off the subtropical and tropical coasts of the Americas on the Atlantic is the royal-red shrimp, *Hymenopenaeus robustus*, that has been an object of extensive exploratory surveys (Bullis, 1956; Bullis and Thompson, 1959; Kristjonsson, 1968; Bullis and Cummins, 1962). This species occurs in depths from about 275-900 meters all along the upper continental slope in the western Atlantic from Cape Hatteras to Brazil. In several locations it appears to be particularly abundant, and capable of supporting commercial fisheries. These locations include the Gulf of Mexico, especially off the mouth of the Mississippi River in depths of some 320-600 meters, and near the Dry Tortugas in similar depths: off the east coast of Florida in depths

of 255-475 meters and perhaps off the northeast coast of South America in waters below 375 meters. Some commercial fishing is now being conducted along the east coast of Florida (Roe, 1968) and there are a few commercial landings from the Mississippi River area (Bureau of Commercial Fisheries, 1968).

Bullis (1956) also recorded occasional sizeable catches of a smaller pink-colored shrimp *Penaeopsis megalops* in 350-400 meters off the Mississippi Delta. According to a more recent unpublished manuscript by Thompson, Roe and Carpenter, of the Exploratory Fishing and Gear Research Base at Pascagoula, Mississippi, kindly provided to me by M. R. Bullis, additional exploratory fishing cruises have revealed possibly commercial concentrations on the grounds off the Mississippi Delta and off the Tortugas in depths of 350-410 meters. This manuscript also indicates that *P. edwardsianus* occurs in the Gulf of Mexico and Caribbean Sea in depths of 365-2100 meters in sizeable but unquantified numbers.

In the northern Atlantic, the deep-sea prawn *Pandalus borealis* is widely distributed and fished commercially in a number of places. According to Kristjonsson (1968) it is fished off Norway from 55 to 500 meters and occurs to 910 meters. Squires (1968) indicates its occurrence between 200 and 365 meters off Newfoundland, while Longhurst (M. S.) indicates that it is fished in the North Atlantic between 60 and 600 meters, and extends to depths of over 1000 meters. Jensen (1965) indicates it is an important component of the trawl fishery for mixed species near Hanstholm in the Skagerrak in 200-300 meters. Smidt (1965) writes that it is widely distributed off west Greenland and the southern part of east Greenland, mainly in depths of 200-500 meters on muddy bottom with positive water temperatures; in bottom layers with sub-zero temperatures this species is sparse and is replaced to a greater or lesser extent by two other species, *Spirontocaris machilenta* and *Nectocrangon lar*.

In the north Pacific occur other species of the genus *Pandalus*. According to Kristjonsson (1968), these are fished in depths of 100 to 300 meters in the Bering Sea. Various species of the genus *Pandalus* are taken throughout the Gulf of Alaska and as far south as California (Alverson, 1968; Dalhstrom, 1965). Alverson, on the basis of extensive exploratory fishing

trials, indicates that *Pandalus* species form large accumulations which can support major commercial fisheries, but he does not indicate their bathymetric distributions. He does note that many of the species commonly rise well off the sea-bed, and have been reported taken in pelagic trawls. According to Dahlstrom (1965) *P. jordani* is taken commercially off California in depths ranging from 70-220 meters.

(b) *Lobsters and similar forms*

The north Atlantic lobster *Homarus americanus* is characteristically taken by traps in shallow water on the continental shelf. However, both exploratory and commercial trawling show that it occurs also in deeper waters. Black (1969), for example, indicates that the exploratory vessel Albatross IV of the U.S. Bureau of Commercial Fisheries has encountered it commonly in depths of 90 to 275 meters, and the Bureau is conducting a tagging program to determine whether these deep-water animals also migrate into the shallower near-shore zone. He indicates that lobsters have been produced in trial drags in depths of 900 meters.

The genus *Nephrops* is a lobster-like animal that is predominantly Indo-Pacific in distribution (Berry, 1969), but it also occurs in the Atlantic and in the north Pacific. In South Africa it is called the king prawn or langoustine, and in the north Atlantic the Norway lobster.

According to Berry *N. andamanicus* is widely distributed, inhabiting Australian, Indonesian, Indian and southeast African waters. It has been taken off the Natal coast in 185-840 meters. In Berry's own investigations off southeast Africa, he encountered it in depths of 295-550 meters, most commonly between 400 and 430 meters.

The Norway lobster, *N. norvegicus*, occurs on deep muddy bottoms, and has been taken in both the north Atlantic and the northeast Pacific. In the Atlantic it occurs in many areas from Iceland to the Mediterranean, typically in water deeper than 120 meters, but it also occurs commercially in shallower waters, especially in sheltered areas, such as fjords. It is the basis of significant commercial fishing in a number of locations in the north Atlantic, as documented in several papers at a recent

symposium (I.C.E.S., 1965). According to Massuti (1968) *Nephrops* is characteristic in depths of 200-400 meters in the region of the Balearic Islands. According to Sigurdsson (1965) the species has been taken near Iceland in commercially important quantities since 1958, but the fishery is permitted only in waters deeper than 110 meters; how much of the catch is taken below 200 meters is not indicated.

(c) *Crabs*

Several different groups of organisms which may generally be classified as crabs are taken in deep water in various parts of the world.

The king crab *Paralithodes camtschatica*, which is the object of an extensive commercial fishery in the north Pacific in the Bering Sea and the Gulf of Alaska, is taken primarily in waters less than 200 meters deep, but some are taken commercially deeper than this, and according to Alverson (1968) the species occurs well below 365 meters. A related species occurs, and is fished commercially in shallow waters during the summer off southern Chile; how deep it goes is not known.

An abundant species, somewhat smaller than the north Pacific king crab, *Chionoecetes tanneri*, and two related species, *C. opilio* and *C. bairdi*, occur in potentially commercial abundance well beyond 200 meters (Alverson, 1968). These tanner crabs occur at depths to 730 meters off the coasts of Washington and Oregon, and in the Gulf of Alaska they are most abundant on the outer continental shelf and upper slope at depths between 90 and 275 meters, but occur to at least 460 meters.

In the Gulf of Mexico a small, hard-shell crab *Geryon quinquedens* is reported by Bullis (1956) to occur in possibly commercial quantities in 365-730 meters. This species is also known to occur to depths of about 300 meters in the northeast Pacific.

Two species of galatheid crabs, *Pleuroncodes monodon* and *Cervimunida johni*, known locally as langostino, support a productive commercial fishery off Chile, and commercially important quantities probably extend northward to off Peru. These crustacea are taken with trawls, the largest concentrations appearing to occur within the depth range 125-200 meters, although

they go somewhat deeper (Longhurst, 1968). In the same depth-range the abundant shrimp appear to be *Heterocarpus reedi* although below about 150 meters the galatheids overlap the range of the deep shrimp *Hymenopenaeus dionedae*, according to this author, who also notes that the galatheid species extend into the zone of very low oxygen water. It appears that they must be capable of supporting mass populations in water with dissolved oxygen values as low as 0.1 ml/l.

Another very interesting related galatheid species is *Pleuroncodes planipes* that lives off the west coast of Mexico, particularly off Baja California. This species occurs both in a pelagic phase, when it constitutes an important source of food for the tunas, and in a benthonic phase (Boyd, 1967; Longhurst, 1968). In the benthonic phase it occurs at depths of about 360 meters. Although somewhat smaller than the related species off Chile, it is very abundant and may, therefore, have commercial potential.

2. Fish

The demersal fish species that constitute existing or potential commercial resources associated with the sea-bed deeper than 200 meters are almost entirely those that also occur in shallower waters (just as in the case of the Crustacea). In some cases, the deep sea-bed is part of the year-around habitat; in others, the fish migrate to deeper water for spawning. Our knowledge of the deep-water distribution of exploitable demersal fishes comes both from existing commercial fisheries and from exploratory fishing.

As already noted above, some fish catches are made along with the production of crustacea by trawls. These fish catches may be an important part of a mixed-species fishery, may be incidental to the fishery for crustacea, but retained for sale, or may be discarded if not of sufficient commercial value. One example of a mixed-species fishery, with prawns, is that by the deeptrawlers in the Mediterranean already referred to (Kristjónsson, 1968). Another is the Danish fishery in 200-300 meters near Hanstholm on the Skagerrak. Jensen (1965) indicates that here *Pandalus* constitutes 20-35% of the catch. *Nephrops* may be 2-5%, roundfish (mostly saithe and pollack, used

for human consumption) 10-40%, and miscellaneous fish used for fishmeal 25-60%. In the fishery for *Pandalus* near Greenland in 200-500 meters, already mentioned (Smidt, 1965), several fish species are incidentally taken, the most numerous being Greenland halibut (*Reinhardtius hippoglossoides*), redfish (*Sebastes marinus*) and different species of *Lycodes*. All of these are also common in shallower water. The Greenland halibut and redfish are retained by the fisherman, and are sold for local consumption or export. Sigurdsson (1965) shows the quantity, by species, of fish landed together with *Nephrops* off Iceland for three years. The total weight of these, which are adults of commercial fish species that also occur in shallower waters, is in each year greater than that of *Nephrops*.

The distribution of some demersal species characteristically extends rather far down the continental slope. A notable example is the redfish, *Sebastes marinus*, and related species of this genus, that occur in commercially important quantities in deep water in the north Atlantic and in the north Pacific where these fish are also known as rockfish. A great deal of information on this group was compiled at a symposium of the International Council for the Exploration of the Sea together with the Atlantic Fisheries Commission in 1959 (I.C.E.S., 1961). Martin (1961), reviewing the results of commercial fishing off southern Canada (Atlantic) shows that commercial catches are taken all along the 100 fathom (182 m.) isobath from Nova Scotia and Newfoundland to off Laborador, and observes that as one proceeds northerly the depth of fishing increases. On banks off Newfoundland and Nova Scotia most fishing is from 180 to 320 meters, and recently has gone to 400 meters near Hamilton Inlet Bank. Off the southern Canadian mainland, redfish occur most abundantly below 200 meters, according to the results of an exploratory survey (primarily aimed at cod and haddock, however) reported by Jean and McCracken (1961). Further north, off Baffin Island, Northern Laborador, and Ungava Bay, exploration by Templeman (1961) indicated redfish to be scarce, but especially in the northern part of the region, greatest catches were taken at the 550 meter level.

Along the Pacific coast of the U.S. and Canada, the distribution of *Sebastes alutus* and related species of *Sebastes* has

been studied, on the basis of both exploratory fishing and commercial fishing, by Alverson and Westrheim (1961), who state that these species are found in waters from a few fathoms deep to depths exceeding 900 fathoms (1640 meters), and that they are commonly found along the outer continental shelf and upper slope at 145-460 meters. At the time their paper was written, commercial trawling was being done to 550 meters, but the bulk of the catch was taken between 145 and 370 meters. Exploratory fishing results (Alverson, Pruter and Ronholt, 1964; Alverson, 1968) show that these latter depths also correspond generally to the greatest abundances of *Sebastes*. However, another genus of rockfish, *Sebastolopus*, of commercial importance is most abundant below 370 meters.

Sebastes, like the hake, *Merluccius sp.*, is apparently only partially associated with the sea-bed, occurring, and feeding, during the night, pelagically well above the bottom. Templeman and Pitt (1961) note that redfish migrate upward at night, and also that most female redfish disappear from the fishery for several months before spawning, and presumably move either pelagically or deeper than the usual fishing depths. Travin (1961) writes, "The main and favorite food of adult redfish is fish (herring, capelin, gadoid fry make up to 65% of the stomach contents; krill make up to 21%; followed by large plankton organisms...). Bottom animals are only rarely found in the stomachs and seem to be a rather accidental food".

One of the best studied regions, with respect to the potential for demersal fish, is the northwest Pacific Ocean off Washington, Oregon British Columbia and Alaska, due to the extensive studies by D. L. Alverson and his colleagues, based on the commercial trawl fisheries and very extensive exploratory fishing. Their results are reported in Alverson, Pruter and Ronholt (1964) and in Alverson (1968). From several thousand hauls from exploratory fishing vessels, using otter trawls and shrimp trawls, in this region, there were identified 55 species and 2 genera (skates, and grenadiers or rat-tails) as being commonly caught. A list of these (by common names; the scientific names can be found in Alverson et al., 1964) taken from Alverson (1968), showing their bathymetric distributions to 600 fathoms (1100 meters) is reproduced in Table 2.

Table 2

OCCURRENCE OF DEMERSAL FISHES BY DEPTH INTERVALS
(ALVERSON, 1968)

SPECIES	DEPTH IN FATHOMS							
	1-49	50-99	100-149	150-199	200-299	300-399	400-499	500-599
FLATFISH								
Bering flounder	×							
Longhead dab	×							
Arctic flounder	×							
Yellowfin sole	×	×						
Starry flounder	×	×						
Sand sole	×	×						
Pacific sanddab	×	×	×					
Rock sole	×	×	×					
Alaska plaice	×	×	×					
Butter sole	×	×	×	×				
Slender sole		×	×	×				
Petrale sole	×	×	×	×	×			
Flathead sole	×	×	×	×	×			
Pacific halibut	×	×	×	×	×			
English sole	×	×	×	×	×			
Rex sole	×	×	×	×	×	×		
Arrowtooth flounder	×	×	×	×	×	×	×	
Deepsea sole							×	×
Dover sole	×	×	×	×	×	×	×	×
ROCKFISH								
China rockfish	×							
Quilback rockfish	×	×						
Dusky rockfish			×					
Chilipepper			×					
Vermilion rockfish			×					
Pygmy rockfish	×	×	×					
Silvergray rockfish	×	×	×	×				
Greenstriped rockfish		×	×	×				
Widow rockfish		×	×	×				
Rosethorn rockfish		×	×	×				
Black rockfish		×	×	×				
Bocaccio		×	×	×				

(Table 2 cont'd).

SPECIES	DEPTH IN FATHOMS							
	1-49	50-99	100-149	150-199	200-299	300-399	400-499	500-599
Canary rockfish	×	×	×	×				
Redstripe rockfish		×	×	×				
Sharpchin rockfish			×	×				
Pacific ocean perch	×	×	×	×	×			
Aurora rockfish				×	×			
Blackmouth rockfish		×	×	×	×			
Splitnose rockfish		×	×	×	×			
Yellowtail rockfish	×	×	×	×	×			
Blue rockfish	×	×	×	×	×			
Rosy rockfish		×	×	×	×			
Rasphead rockfish		×	×	×	×			
Flag rockfish		×	×	×	×			
Striptail rockfish		×	×	×	×			
Blackthroat rockfish		×	×	×	×	×		
Channel rockfish	×	×	×	×	×	×	×	×
ROUNDFISH								
Arctic cod	×							
Saffron cod	×							
Lingcod	×	×	×	×				
Pacific cod	×	×	×	×	×			
Walleye pollock	×	×	×	×	×			
Pacific hake	×	×	×	×	×	×		
Longfin cod					×	×	×	×
Sablefish	×	×	×	×	×	×	×	×
ELASMOBRANCHS								
Spiny dogfish	×	×	×	×	×	×		
Ratfish	×	×	×	×	×	×	×	
Skate	×	×	×	×	×	×	×	×

It may be seen that, with the exception of one species of flatfish, the longfin cod, and 5 species of rockfish, all the species taken below 200 meters (ca. 100 fathoms) were also taken in shallower waters. The abundance of the major groups of demersal fish at different depths, as revealed by catch-rates of exploratory trawling, to 600 fathoms (1100 meters) off

Oregon and Washington and to 200 fathoms (360 meters) off British Columbia is exhibited in Figure 1, from Alverson, et al. (1964).

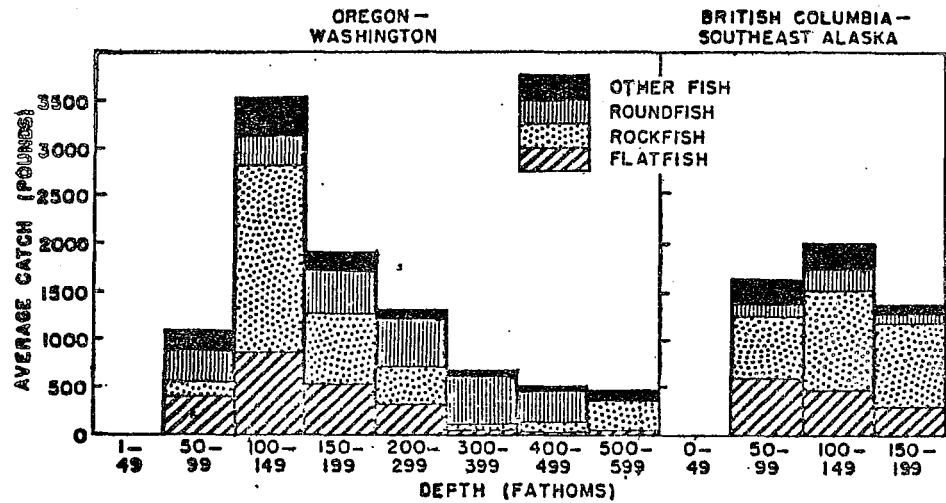


Figure 1. — Average catch per hour trawling (Transitional area) for demersal fishes taken during surveys in the Northeastern Pacific (after Alverson, et al. 1964).

Table 3

ESTIMATED WEIGHTS OF STANDING CROPS (ALL DEMERSAL SPECIES COMBINED) IN MILLIONS OF POUNDS BY DEPTH INTERVALS AND REGIONS (Alverson, et al., 1964)

REGION	DEPTH INTERVAL IN FATHOMS			TOTAL
	1-49	50-99	100-299	
Oregon-Washington	224 ⁽¹⁾	225	359	808
British Columbia - southeastern Alaska	909 ⁽¹⁾	1,005	916	2,830
Gulf of Alaska	448	1,081	683	2,212
Alaska Peninsula	458	361	438	1,257
Eastern Bering Sea	9,197	2,208 ⁽²⁾	386 ⁽²⁾	11,791
TOTAL	11,236	4,880	2,782	18,898

(1) Assumes density equal to the more adequately sampled 50-99 fathom interval.

(2) Assumes density equal to the 1-49 fathom interval.

It appears that peak abundance is near 180 - 270 meters, and that abundance becomes quite low beyond about 750 meters. Alverson, et al. (1964) have also calculated the total standing stock of demersal fish by regions and depth intervals to 300 fathoms (550 meters), their tabulation being reproduced here as Table 3.

It may be seen that there is substantial potential below 100 fathoms (180 meters), but that, because of the much larger area of seabed at shallower depths, it is not a large percentage increase. This is probably typical of the demersal resources in general, since the area of sea floor in the World Ocean between 200 and 1000 meters is only about 59 percent of that above 200 meters (Menard and Smith, 1966).

As mentioned above, demersal species frequently migrate seasonally between deeper and shallower water. Such migrations of some species have been studied in the northeast Pacific by Alverson (1960) who shows the seasonal vertical distribution patterns diagrammatically. A figure from his paper is reproduced in Figure 2.

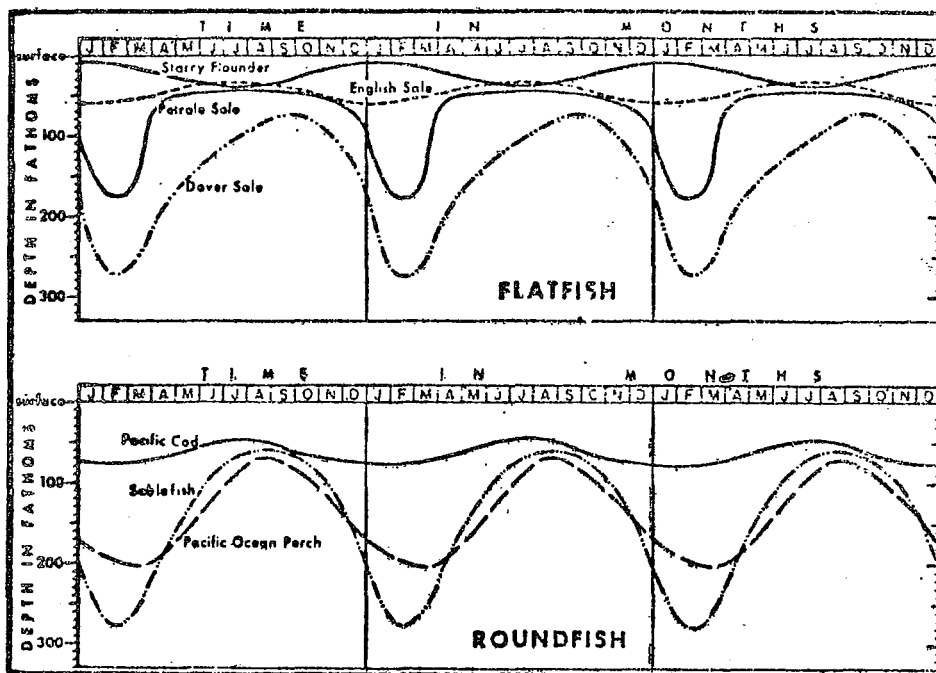


Figure 2. — Seasonal vertical distribution patterns for flatfish and roundfish (Alverson, 1960).

He summarizes his observations as follows:

(1) A bathymetric movement of small vertical amplitude for those species generally endemic to the continental shelf. The movement is to shallow water during the summer and to greater depths during the winter, e.g. English sole and true cod.

(2) A possible inshore movement during the winter months for several of the shallow-water pleuronectids, e.g. starry flounder and rock sole.

(3) A rapid movement into deep water during the winter to spawn and subsequent return to the shelf area following spawning, e.g. petrale sole.

(4) A bathymetric migration of relatively large vertical amplitude for species indigenous to the outer continental shelf and slope, e.g. Pacific Ocean perch (rockfish, redfish), Dover sole and sablefish. The movement is from shallow to deep water with the onset of fall and winter. With these species, the inshore summer movement to the continental shelf may be considered an intrusion from deep water, as through the greater part of the year the maximum species density occurs on the continental slope.

In the region of the northeast Pacific the commercial fisheries are already technically capable of fishing for the demersal species at all depths to which they occur in important quantities. According to Alverson (1960), the trawlers based in the State of Washington were already in 1957 fishing as deep as 350 fathoms (640 meters), and from his graphs it appears that about a third of the fishing effort was applied in depths below 200 meters, mostly between 200 and 400 meters. Thus, as elsewhere in the world, the technological capability exists, or is rapidly developing, to trawl at all depths on the continental slope where there are reasonably attractive commercial prospects.

4. Economic importance and potential of the living resources of the deep sea-bed

From the foregoing considerations we may, I believe, draw some general conclusions concerning the commercial potential of the living resources of the deep sea-bed.

Because of the small standing stocks of benthonic organisms, on which the demersal species depend in large part for food, it is not expected that either the benthonic or demersal species will occur in sufficient abundance to present any economic potential on the continental slope beyond about 1500 meters depth. Thus, the living resources of the sea-bed are essentially confined to well within the limits of the continental margin except, perhaps, for some seamounts further offshore. The total area of such seamounts is negligible in relation to the area of the continental shelves. Exploratory fishing, and the development of commercial fisheries in deep water for both crustacea and fish, confirm this expectation, the living resources apparently being of sufficient abundance to be of commercial interest only to a depth of, at most, about 1500 meters.

At the greater depths along the continental slope, the abundance of demersal species tends to decrease, and the cost of harvesting increases with depth. Thus, only the more highly esteemed, and therefore more valuable, species of crustacea and fish can be economically harvested.

Since the area of the continental margin beyond 200 meters to a depth of 1500 meters is no greater than the area of the shelf to the depth of 200 meters, and since the resource potential per unit area is smaller at these greater depths, it is not to be expected that the fuller harvesting of the unused living resources of the deep sea-bed will provide any very large addition to the existing fisheries for demersal species.

Although a few species of commercial importance are confined to the deeper parts of the continental slope, most of the organisms harvested below 200 meters are members of stocks also inhabiting the adjacent continental shelf. Thus, their rational exploitation and conservation-management is largely only an extension of such activities in the region of the continental shelf and its superjacent waters.

5. Problems concerning living resources in regimes for the deep sea-bed

Since beyond the continental margin the living resources associated with the deep sea-bed present no foreseeable economic potential, a regime for the exploration and exploitation

of the non-living resources of the floor of the deep sea beyond the continental margin need not be concerned with possible damage to benthonic or demersal species. However, there do occur in the open sea, in mid-ocean, important living pelagic resources in the near-surface waters. Consequently, we need to be concerned with possible damage to the pelagic organisms. Such damage can arise through pollution of the upper layers of the sea by floatable materials, such as petroleum, or by sediments brought into the surface layers in the course of mining operations. A regime for the use of the resources of the deep sea-bed needs, therefore, to include necessary measures for prevention and control of such pollution.

On the continental slope, above about 1500 meters, as we have seen, there occur living resources of economic importance directly associated with the sea-bed, at least many of which are members of populations also inhabiting the shallower waters of the adjacent continental shelf. In consequence, any regime for the exploration and exploitation of the resources of the sea floor in this region must be concerned with the whole set of problems that also exist on and over the continental shelf.

With respect to sedentary species of the types that are regarded as being included in the natural resources of the sea-bed in accordance with the Convention on the Continental Shelf, there are few or none in depths beyond 200 meters, with the possible exception of certain species of crustacea (such as king crabs and tanner crabs) concerning which there is apparently some difference of opinion as to whether, at their harvestable stages, they move otherwise than "in constant physical contact with the seabed or subsoil". However, between 200 meters and about 1500 meters there do occur sedentary species of importance as food for the demersal crustacea and fish that are harvested there. These demersal species also consume a variety of nonsedentary benthonic and pelagic organisms. Although the demersal species beyond the territorial sea or exclusive fishing zones are legally regarded as creatures of the high seas, they are closely associated with the sea-bed so that any regime for the deep sea-bed needs to take account of them. Two categories of problems are of concern: (1) The proper management of the fisheries for the living resources themselves. (2) The effects on the living resource, and on the harvesting of

them, of the exploration and exploitation of the non-living resources of the sea-bed.

The conservation-management of demersal fisheries has long been of international concern. Indeed, the need for international cooperation for this purpose in the North Sea and other parts of the north Atlantic, and in the north Pacific, stimulated the development early in this century of regional international arrangements for fisheries conservation-management, that provided precedence and pattern for similar arrangements for pelagic fisheries also. The experience with such arrangements constituted, in large part, the basis the International Convention on Fishing and Conservation of the Living Resources of the High Seas, negotiated at Geneva in 1958, that codifies the principles for handling, on an international basis, problems of conservation-management of fisheries. Such conservation-management requires the usual fisheries-management research, whether national or international, including the determination of the unit stocks and their migrations, the estimation of the optimum sustainable harvest from each of them, and development of means efficiently to obtain such harvest, without overfishing. A large number of multi-lateral and bi-lateral international arrangements are in effect for these purposes for particular species-populations or for particular regions. Although such arrangements, and the Convention referred to above, provide good bases for determining the optimum harvest, and for preventing overfishing, the remaining problem of how the harvest is to be divided among the nations participating in the fishery has been solved only in a few specific instances. There is no general agreement on principles for the division of the harvest.

With respect of fisheries-management of the living resources associated with the deep sea-bed, it is readily apparent that the problems are in no way different from those of other international fisheries and indeed are already covered, in part, by some regional fisheries-conservation arrangements, and by the International Convention on Fishing and Conservation of the Living Resources of the High Seas. Further progressive developments are, I believe, more the concern of regimes for the high seas fisheries than of regimes for the deep sea-bed.

The second category of problems, that is the effects on the living resources, and on the fisheries for them, of exploration and exploitation of the non-living resources of the sea bed, is of direct concern to any regime for the utilization of the non-living resources of the sea-floor on the continental margin beyond national jurisdiction if, indeed, such area exists. Some experts, such as the Committee on Deep Sea Mineral Resources of the American Branch of the International Law Association (1968) insist that, under the present Convention on the Continental Shelf, the exclusive jurisdiction of the adjacent coastal State over the exploration and exploitation of the natural resources of the sea-bed extends generally to the outer edge of the continental margin. Effects on the living resources and their harvesting, however, need to be taken account of by any regime, whether national or international. Such effects include the following:

(1) Killing of living resources, or their food, by explosives employed in seismic explorations. This can be minimized and controlled by (a) the employment of non-explosive energy sources, and (b) proper monitoring of the employment of explosives, when they are used, to prevent their detonation in or near to large concentrations of important living organisms.

(2) The direct destruction of sedentary organisms during the removal of minerals from the sea-bed or their destruction by the deposit on the sea-bed of spoil from mining operations. This will require proper zoning, and control of mining practices, to minimize such effects.

(3) The destruction of sedentary, demersal, and pelagic organisms by pollution associated with the use of the non-living resources of the sea-bed. Exploration for, and production of, petroleum seems to present a particularly important hazard, because this floatable material can cause widespread pollution in near-surface waters as well as on and near the sea floor. Recent experience indicates that control of "blowouts" of petroleum wells on the deep sea floor presents special difficulties. There is an urgent need for development of better methods of accident prevention, of better means of dealing with petroleum pollution when it occurs, and of improved procedures to enforce the employment of proper practices. Pollution of the overlying

waters is also a potential effect of deep-sea mining for such things as ferro-manganese nodules, phosphorite nodules, and placer deposits of heavy minerals. Such mining will probably involve bringing to the sea surface the raw material, and conducting a certain amount of processing or beneficiation aboard ship. The sediments, chemical residues, and other materials put overboard from such operations can pollute the near surface waters, as well as waters near the sea-bed. In the absence of knowledge of just what processing methods will be employed, the means of amelioration of such pollution is difficult to predict, but there certainly needs to be adequate authority for its control by whatever regime.

(4) Installations on the sea-bed can present hazards to trawls, or other fishing gear. Such problems can be dealt with in the deep sea, just as in shallower water by (a) burying installations, such as pipelines, (b) location of installations in an orderly manner to minimize hazards, (c) adequate devices, such as surface buoys or near-bottom sonar transponders, to enable fishermen to locate and avoid installations.

(5) Installations at the sea-surface can present hazards to navigation of fishing vessels. Again, this requires adequate systems of warning devices, such as lights, radio beacons, sound sources, etc.

Literature cited

- ALVERSON, D.L. 1960. A study of annual and seasonal bathymetric catch patterns of commercially important groundfishes of the Pacific north-west coast of North America. Pac. Mar. Fish. Comm., Bull. No. 4.
- ALVERSON, D.L. 1968. Fishery resources in the northeastern Pacific Ocean. U. of Wash. Publ. in Fish., N.S., Vol. 4, pp. 86-101.
- ALVERSON, D.L. and S.J. WESTRHEIM 1961. A review of the taxonomy and biology of the Pacific Ocean perch and its fishery. Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 150, pp. 12-27.
- ALVERSON, D.L., A.T. PRUTER and L.L. RONHOLT 1964. A study of demersal fishes and fisheries of the northeastern Pacific Ocean. Institute of Fisheries, U. of British Columbia, Vancouver, B.C. 1966, 190 p.

- BERRY, P.F. 1969. The biology of *Nephrops andamanicus* Wood-Mason (Decapoda, Reptantia). South African Assoc. Adv. Mar. Biol. Res., Oceanog. Res. Inst., Inv. Rept. No. 22, 55 p.
- BLACK, T. 1969. Tags show offshore lobsters like to travel. National Fisherman, March 1969, p. 14-B.
- BOYD, CARL M., 1967. The benthic and pelagic habitats of the red crab, *Pleuroncodes planipes*. Pac. Science, Vol. 21, No. 3, pp. 394-403.
- BULLIS, H.R., 1956. Preliminary results of deep-water exploration for shrimp in the Gulf of Mexico by the M/V OREGON (1950-1956). Commercial Fish. Rev. (U.S. Bur. Comm. Fish.), Vol. 18, No. 12, pp. 1-12.
- BULLIS, H.R. and R. CUMMINS., 1962. Another look at the royal red shrimp resource. Proc. Gulf and Caribbean Fish. Inst., 15th Ann. Session, No. 1962, pp. 9-13.
- BULLIS, H.R. and J.R. THOMPSON, 1959. Shrimp exploration by the M/V OREGON along the northeast coast of South America. Commercial Fish. Rev. (U.S. Bur. Comm. Fish.), Vol. 21, No. 11, pp. 1-9.
- BUREAU OF COMMERCIAL FISHERIES, 1968. Gulf Coast shrimp data. U.S. Bur. Comm. Fish., C.F.S. No. 4863, 16 p.
- CHUKHCHIN, V.D., 1963. Quantitative distribution of benthos in the eastern part of the Mediterranean Sea. (In Russian). Trudy Sevostopol Biol. Sta., Vol. 16, pp. 128-131.
- COMMITTEE ON DEEP SEA RESOURCES OF THE AMERICAN BRANCH OF THE INTERNATIONAL LAW ASSOCIATION, 1968. Interim Report, July 19, 1968. Washington, D.C., 1968, 29 p.
- DAHLSTROM, W.A., 1965. The California ocean shrimp fishery. Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 156, pp. 112-115.
- HARVEY, W.W., 1955. The chemistry and fertility of sea waters. Cambridge University press, Cambridge, England, 1955, 224 p.
- I.C.E.S., 1961. ICES/ICNAF redfish symposium. Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 150, 311 p.
- I.C.E.S., 1961.. Special meeting (1962) to consider problems in the exploitation and regulation of fisheries for Crustacea. Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 156, 217 p.
- INSTITUTE OF MARINE RESOURCES, U. OF CALIFORNIA, 1964. An investigation of the effects of discharged wastes on kelp. Final report to State Water Quality Control Board. California State Water Quality Control Board, Publ. No. 26, 124 p.

- JEAN, Y. and F.D. McCracken, 1961. Incidental catches of redfish in cod and haddock surveys off the southern Canadian mainland during the years 1957 to 1959. Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 150, pp. 142-145.
- JENSEN, A.J.C., 1965. *Pandalus borealis* in the Skagerrak (length, growth and changes in the stock and fishery yield). Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 156, pp. 109-111.
- KUSNETSOV, A.P., 1963. Benthic invertebrate fauna of the Kamchatka waters of the Pacific Ocean and the northern Kurile Island. (In Russian; English summary). Akad. Nauk, SSSR, Inst. Okeanol., pp. 1-271.
- KRISTJONSSON, HILMAR, 1968. Techniques of finding and catching shrimp in commercial fishing. F.A.O. Fish. Repts., No. 57, Vol. 2, pp. 125-192.
- LONGHURST, A.M., 1968. The biology of mass occurrences of Galatheid crustaceans and their utilization as a fishery resource. F.A.O. Fish. Repts, No. 57, Vol. 2, pp. 95-110.
- MARTIN, W.R., 1961. The distribution of redfish catches landed on the southern Canadian mainland, 1949-1958. Cons. Perm. Int. Explor. Mer., Rapp. et Proc., Verb., Vol. 150, pp. 148-153.
- MASSUTI, M., 1968. Los gambas de interes commercial en España. F.A.O. Fish. Repts., No. 57, Vol. 2, pp. 303-307.
- MAURIN, C., 1965. Les crevattes profondes de la région Atlantique Ibéro-Marocaine: Répartition bathymétrique et géographique, importance économique. Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 156, pp. 116-119.
- MENARD, H.W. and S.M. SMITH, 1966. Hypsometry of ocean basin provinces. Jour. Geophysical Res., Vol. 71, No. 18, pp. 4305-4325.
- ROE, R.B., 1968. The royal-red shrimp potential. Fishboat, June 1968, p. 43.
- SANDERS, H.L., R.R. HESSLER and G.R. HAMPSON, 1965. An introduction to the study of deep-sea benthic faunal assemblages along the Gay Head-Bermuda transect. Deep-Sea Research, Vol. 12, pp. 845-867.
- SIGURDSSON, A., 1965. A preliminary report on the Norway lobster (*Nephrops norvegicus*) in Icelandic waters. Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 156, pp. 142-146.
- SQUIRES, H.J., 1968. Relation of temperature to growth and self-propagation of *Pandalus borealis* in Newfoundland. F.A.O. Fish. Repts., No. 57, Vol. 2, pp. 243-250.

- SMIDT, ERIK, 1965. Deep-sea prawns and the prawn fishery in Greenland waters. Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 156, pp. 100-104.
- TEMPLEMAN, W., 1961. Redfish distribution off Baffin Island, Northern Laborador and in Ungava Bay in August-September 1959. Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 150, pp. 157-162.
- TEMPLEMAN, W. and T.K. PITT, 1961. Vertebral numbers of redfish, *Sebastes marinus* (L.), in the north-west Atlantic, 1947-1954. Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 150, pp. 56-89.
- TRAVIN, V.I., 1961. A brief survey of Soviet investigations in redfish (genus *Sebastes*). Cons. Perm. Int. Explor. Mer., Rapp. et Proc. Verb., Vol. 150, pp. 90-93.
- VINOGRADOVA, N.G., 1962. Some problems of the study of deep-sea bottom fauna. Jour. Oceanog. Soc. Japan, 20th Anniv. Vol., pp. 724-741.
- ZENKEVITCH, L.A., N.G. BARSANOVA and G.M. BELYAEV, 1960. Quantitative distribution of bottom fauna in the abyssal area of the World Ocean. (In Russian). Dokl., Akad. Nauk, Vol. 130, No. 1.

THE LIVING RESOURCES OF THE SEA-BED

BY

Dr. SIDNEY J. HOLT

*FAO Marine Science and Fishery Coordinator with UNESCO,
FAO, Rome **

I. *Introduction*

The present symposium is devoted to study of "activities which are taking place, or may take place in the future, on the ocean floor and in the sub-soil thereof, beyond the limit of present national jurisdiction". The United Nations has recognised that there does indeed exist an area of the ocean floor beyond national jurisdiction, notwithstanding the "open" definition of the continental shelf, in Article 1 of the U.N. Convention on the Continental Shelf (1958) as "the sea-bed and subsoil to a depth of 200m or beyond that to where the depth of the superjacent waters admits of the exploitation of the natural resources". This note is concerned with living organisms related to the sea-bed in depths beyond 200m or beyond the edge of the continental shelf, as geographically defined; that is to say the continental slope, the continental rise and the abyssal plain¹.

As photosynthesis is halted for lack of light at depths ranging from about 30 to 100m — depending on turbidity of the upper layers of the sea — fixed algae (sea weeds) do not grow, nor would live phytoplankton be found in quantity, on or near

(*) Views expressed in this paper are those of the author and do not necessarily reflect the policy of FAO.

1. I adopt the definitions used in the UK "Report on Marine Science and Technology", Cmnd 3992, April 1969.

Continental margin: comprises

Continental Shelf 0 to 130-200m (exceptionally 50-500m) gradient 0.1°

Continental slope 200 to 1,500m gradient 3 to 6°

Continental rise 1,500 to 4,000-5,000 gradient 0.1-1.0°

Abyssal plain: > 4,000-5,000m gradient < 0.1

the sea-bed beyond the continental shelf. Furthermore, although certain animals (starfish, worms) have been observed living on the abyssal plain, and others, such as specialized fishes, in the deep water over it, there are no known aggregations of such type and abundance that they might be considered as economic resources. Our impression of the relative rarity of such animals may in part be due to the inadequacy of present means of observing and sampling them. However, it seems unlikely that they could constitute a substantial biological resource since they are living well outside the zones of primary production and thus are dependent for their nutrition on, and are limited by, the "rain" of organic detritus from the surface layers and the products of microbial (anaerobic) metabolism. The species involved are thus scavengers, and predators on them.

We are therefore concerned here essentially with the animals living on or over the continental slope and perhaps the shallower areas of the continental rise. Most of these, too, are essentially dependent upon the influx of organic matter, either directly, or indirectly through preying on smaller detritus feeders, although some fishes, such as hake, may subsist on the oceanic pelagic system by swimming upwards at night to feed. Although the dynamics of the pelagic food web has been studied in some detail in certain areas, very much less is known about the pathways and flow of energy and material in the benthic system; the methodological problems are great, and there is not yet a satisfactory technique for measuring the flux of the dead organic matter, its relation with the animals and plant sources in the waters above or the feeding rates and efficiencies of the detritus feeders on the bottom.

The parts of the continental slopes lying under upwelling areas, or other areas of particularly high primary productivity, will tend to have relatively high demersal production. Large quantities of organic matter may reach the sea-bed in such areas, accounting for the presence of diatomaceous oozes in the Antarctic and under divergencies in both Northern and Southern hemispheres (around 40° latitude), and of phosphatic deposits off upwelling areas. In regions such as that of the Peru current, where high primary production occurs out to a distance of hundreds of miles, the amounts reaching the slope and even the upper continental rise may be considerable. On the other

hand, in the open ocean, where there is a steady primary production cycle of low intensity, organic matter does not enter the bottom sediments in quantity because it is consumed while sinking.

The living resources of the continental shelf, are defined by the 1958 Convention as "sedentary species, that is to say organisms which, at the harvestable stage, either are immobile on or under the sea-bed or are unable to move except in constant physical contact with the sea-bed or subsoil". The first part of this definition, referring to immobility, is practically unambiguous in its application to organisms such as oysters and mussels; the second part can give — and indeed has given — rise to controversy as to whether or not individuals of a given species are always in physical contact with the bottom when in motion. In the future there may well arise also the problem of deciding at what age and size the "harvestable stage" begins. It should further be noted that most fishing gears used on the sea-bed catch both "sedentary" and "mobile demersal," animals simultaneously, although with different degrees of efficiency. Even if a gear catches mainly one type it will naturally affect the other — for example trawling for demersal fish over shellfish beds. For these scientific, and perhaps for other, reasons it may not be assumed that the same type of definition would be adopted for a future regime concerning the living resources of the sea-bed beyond present national jurisdiction, nor, for that matter, retained in the Continental Shelf convention if that convention were to be amended, as has been suggested, in order better to define the outer limit of the shelf, and hence the extent of its resources. In the debates in the U.N. concerning the sea-bed and ocean-floor beyond national jurisdiction there has so far been virtually no reference to the living resources, except in relation to pollution that may result from exploration for, and exploitation of, minerals. Furthermore, the documentation on the "Food resources of the sea beyond the Continental Shelf, excluding fish", submitted by the U.N. Secretariat in implementation of ECOSOC Resolution 1112 (XL) of 1966 (Document E/4449 and Add. 1-2) deals virtually exclusively with the pelagic resources of the superficial waters; the true fishes were explicitly excluded from the scope of the resolution, and the other main benthic resources, the shellfish (crustaceans),

were excluded by subsequent decision of the UN Secretariat. It seems therefore appropriate and timely to consider the immobile animals living on the continental slope, and the mobile ones which live all or part of their lives on or near it and have therefore a definite biological relationship with it.

2. *Types of resources of the continental slope and their exploitation*

It should first be said that aggregations of economically useful animals do exist on or near the sea-bed at depths considerably exceeding 220m, and many of these are being exploited at the present time, in several ocean areas. There are no "immobile" species, such as clams, among these, but deep-sea trawling for demersal fish is, for example, now quite common down to 500m or a little beyond; successful trials have been conducted down to nearly 2,000m but 1,500m seems about the limit of abundant animals².

Trawling in deeper and deeper water is stimulated by declines in catch-rates (catch per unit fishing effort) in the shallower waters as fishing intensifies there. Deep trawling operations are, initially at least, more costly than shallower

2. The fact that the state of fishing technology now permits exploitation of sedentary living resources at depths greater than 200m, and indeed at depths considerably greater than it is feasible to exploit mineral resources at the present time, raises an interesting question of interpretation of the 1958 Continental Shelf Convention. It seems that either the "exploitability" criterion would have to be applied so as to give a separate legal definition of the outer limit of the shelf for each type of resource, or ability to exploit one type of resource in deep water must give a coastal state exclusive rights for exploration or exploitation with respect to the other types of resources in depths greater than 200m, which neither it (nor perhaps any other state) has yet the technology to exploit. Does ability to exploit one type of sedentary resource give rights with respect to another; or does the ability to exploit any sedentary living resource give rights with respect to mineral resources? If so, present technology seems to lead, under the 1958 Convention, to a "legal" limit of the shelf corresponding with the maximum feasible trawling depths. However, against this it must be recognised that in practice *exploration* is being treated by many, perhaps most, signatories to the 1958 Convention as if it were *exploitation*; so oil found down to 1,500m but exploited at present only on the shelf, would theoretically be "exploitable" to about the same depth as the living demersal resources. An approach to resolution of this question might be through considering separately the regimes of the sea-bed and of the so-called subsoil.

ones, but clearly not prohibitively so. Of course, catch-rates in the deeper waters will become reduced as fishing intensifies there too, so that the repartition of trawling effort between shallower and deeper waters may tend to a dynamic equilibrium. The way that such a tendency becomes manifest will be determined in each situation by the relative concentrations of the stocks in the offshore and nearer-shore waters, and the degree and rapidity of mixing between them.

Although bottom trawling is by far the most important method of harvesting the demersal species in deep water, other methods are feasible. These include bottom-set tangle and gill-nets³, lines and traps.

We must consider the smaller animals which form the diets of these stocks also as living resources of the continental slope. They are of varied types but are mainly small bivalves, worms, and the benthic euphausiids. Some of these are carnivorous; others live on dead organic matter, and all of course, depend ultimately on the plant production in the surface waters.

Lastly it should be mentioned that it is thought that the cephalopods (squids, cuttlefishes, octopus) form one of the greatest living resources of the open ocean. They are difficult to study and rather little is as yet known about their lives; they are predatory and most are pelagic, but some also hunt on or near the sea-bed.

We know neither the quantity nor the value, even to an order of magnitude, of the living resources of the slope. Evaluation of these will be a part of the International Decade of Ocean Exploration recently launched by the United Nations. However, judging from the results of exploration in a few areas the stocks of shrimps are likely to be important; and these have a high unit value in world markets. They include species that are also found closer to shore, and also species found so far only in the deeper water.

The resources of the continental slope are not, in general, biologically separate from those of the shelf, and neither there-

3. An interesting aspect of use of these gears, now usually constructed from synthetic materials, is that they may continue to catch fish even long after a fisherman has lost them, and this has raised questions as to their effects on fish stocks. Another operational feature of these types of gears is that they require *intermittent* servicing from the surface craft, as opposed to the continuous presence of the trawler.

fore can they rationally be treated independently for resource management purposes. The stocks of many demersal (and some sedentary) resources of the shelf extend into deeper water, and vice-versa. There is, moreover, probably a movement of individual animals throughout the continental margin, in both directions. The younger animals of many species, for example, live closer inshore than the older ones. The extent to which the younger stages are exploited may determine the potential yields of older animals offshore. Conversely, the number of young recruiting into a stock depends on the numbers of adult spawners.

Most sedentary and mobile demersal species have pelagic juvenile stages living sometimes in water over very great depths. The drift of these, by surface currents, is counterbalanced by a spawning migration of adults so that the stock may survive, in a given area, from one generation to another. Conversely a few pelagic species lay eggs that attach to the sea bottom (for example the Pacific herring) but this occurs mainly in shallow water, not on the deep sea-bed as far as we know.

Management of the harvesting of deep water resources so as to sustain high yields from them will involve consideration of their continuity or their relation with resources of shallower waters, and of the superjacent waters, as must be obvious from the biological facts mentioned above. These relations will in most cases need to be understood not only in qualitative but also in quantitative terms. Quantitative information is at present very sparse. Management of high seas fisheries takes the form of application, through international agreement, of regulations covering one or more of the following factors: the total permissible annual or seasonal catch; the numbers and types of fishing gear, particularly the size of trawl meshes or other structural features which determine the size of fish caught; the sizes and conditions of fish which may be caught and retained; the seasons and areas of capture. Such measures are applied to particular species stocks, or simultaneously to small groups of stocks of similar species. To be useful they must be worked out in relation to each whole stock, and applied to all those who exploit it. This implies, as far as the sea-bed resources are concerned, either that one legal regime would need to apply to the whole continental margin or that it is necessary to know in

some detail the distributions and abundances of animals over the different parts of the margin, the variations of these in time, and specifically the rates of "mixing" between the parts. Techniques exist for investigating these parameters but a rather considerable specialised research program would be required in each case. Then on the basis of such knowledge it would be necessary to develop closely coordinated regulations for the different parts of the margin ⁴.

A feature of modern fisheries is an increasing tendency to exploit less selectively — to catch many more different species, to take the smaller species as well as the larger ones and at times to take the young as well as the adults. This result is achieved mainly by the deployment of a number of different vessel and gear types (which may each also tend to become increasingly specialized) in the same general area, either simultaneously or successively through the seasons. This trend results from developments in processing, particularly fish meal and oil manufacture, but also from freezing and hence opening up of wider and more varied markets. As this trend develops, and exploitation intensifies generally, a new situation with respect to management may develop. Instead of regulating catches from particular stocks, man may be concerned to regulate the total harvest of the many interacting carnivorous species in an area. The impact of human activities on these may be such that much more account will have to be taken than heretofore of the characteristics of the food-resources which sustain the animal populations man uses ⁵. This would appear to make it increasingly difficult and unrealistic to treat the seabed, from the point of view of management of living

4. Similar problems already exist, of course, with respect to management of high seas stocks which live also partly in territorial waters of adjacent states. One solution is the national application of the same, or other appropriate, regulations in the territorial waters as are applied by international agreement outside them. However, in many cases the stock lives mainly in high sea areas, and specialised fishing, often by numerous small boats, inshore and within narrow territorial limits, can be virtually ignored for practical management purposes.

5. A plan recently drawn up by a group of scientists sponsored by the ACMRR of FAO, SCOR and WMO, for the scientific content of an Expanded Program of Oceanographic Research and an International Decade of Ocean Exploration stresses the need for biological research on a considerable scale, with this eventuality in mind.

resources, separately from the superjacent waters, including the near-bottom, mid-water and near-surface layers.

We have considered above management by regulation of fishing. Increasing attention is now being paid to the possibilities of great expansion of the coastal culture of bivalves, shrimps etc., and the extension of cultural practices to marine fishes in open water. While the application of culture techniques to waters deeper than 200m is something for the more distant future, it is clear that for successful fish culture on the high seas a great deal of ecological research will be necessary as well as largescale practical trials. Such trials on adequate scale are unlikely, and investment in commercial culture even less likely, in the absence of an effective international management regime which can ensure to each investor that the rewards will not be reaped by others. It seems to me possible that a growing point in this respect will be a further development of the resources of migratory salmonids.

Thus the salmonids graze the production of the open ocean and bring accumulated biomass back to man's doorstep. If agreement can be reached (perhaps along the lines of the Pacific Fur Seal treaty) on the rational harvesting of these stocks by the most efficient gears and at the most appropriate times and places, and an equitable distribution of benefits among nations, then it will be practicable to move forward with improvements by breeding, transplantation and so on to the true husbanding of ranging species.

3. *Effects on Living Resources and their Exploitation of Human Activities on the Sea-Bed*

One may expect that mining, drilling, and even trawling itself on the continental slope would have effects there, and on the superjacent waters, essentially similar to the effects of such operations on and over the continental shelf.

I) The sea-bed might become locally "polluted" with solid spoil, changing the nature of the substrate, and hence the quantity and quality of sea-bed life, and thus indirectly affecting the life of the demersal resources that subsist on benthic animals.

No generalizations can be made about such effects however; experience shows that in some cases solid spoil has little effect - or even possibly a "beneficial" rather than a "harmful" effect.

II) Pollution of sea-bed origin, such as oil spillage, can affect the resources, and their food supplies, not only on the sea-bed but also in the superjacent waters. The same may be said of the effects of underwater explosions during, for example, seismic survey.

III) Pollution at the sea-surface can be transferred to the sea-bed (and affect life there) by natural processes or as result of its treatment - e.g. the sinking of oil masses.

IV) Fishing operations may affect, by physical disturbance, the whole sea-bed life. Very little is known about this, however, even with respect to shallow waters.

V) Trawling can seriously interfere with the operation of submarine cables and pipe-lines. (Abandoned and subsequently uncharted cables also interfere with trawling, as do any large submerged objects). New telephone cables are armoured in shallow water, and hence protected from trawls, but the parts in deeper waters are not, and they are therefore vulnerable to trawling operations on the continental slope.

VI) Actions in surface waters for protection of sea-bed installations can affect demersal fishing operations by interfering with the movement of surface vessels.

It must be emphasised that forecasting, particularly in a quantitative sense, of most of the above examples of interactions would be very complex and difficult if not impossible in the present state of knowledge. The continental slopes are not charted in detail; the water movements close to them are not well understood; we have barely begun the systematic exploration of the living resources on them, and our knowledge of the structure and dynamics of the ecosystem associated with them is fragmentary.

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(A bibliography on the subject of this paper is given in the paper on the same subject by M.B. Schaefer in the present volume).

RADIOACTIVE SOLID WASTE DISPOSAL INTO THE OCEANS: IMPLICATIONS AND PERSPECTIVES

BY

Dr. CARLO POLVANI

*Director, Division of Radiation Protection, National Committee
for Nuclear Energy, Rome*

1. *Disposal of solid radioactive wastes*

The disposal of contaminated solid (or solidified) wastes has become a problem since the preparation and use on a large scale of radioactive isotopes for the use in medicine and in industry, and since stringent permissible levels in the human body for many of these radioisotopes were recommended by the International Commission for Radiological Protection and by national Commissions having the same interests.

The problem became more and more important along with the development of nuclear power programmes in various countries and with the increasing use of isotopes in nuclear medicine, in research, and in industry. Undoubtedly, much can be done during the design stage and during the operation of a programme involving the use of radioactive material to minimize the volume and the activity of solid wastes. Particularly, handling operations should be chosen to produce the minimum of spray and of dust. But even when precautions of all nature are carefully taken, laboratories, factories, and particularly some plants in nuclear centers produce large amounts, both in volume and activity, of solid wastes.

The property of radioactivity being a nuclear phenomenon, it is impossible to destroy it by any chemical or physical means. Only the natural decay taking place in different times for the various isotopes, is able to alleviate the problem. But since many isotopes have long half-lives (the time required to reduce to one half the initial activity), this is of limited help. For

instance, two very important products of nuclear fission in the core of reactors are Strontium 90 and Cesium 137 which require about 30 years to halve their activity. The half-life of Plutonium 239, a material which is becoming more and more important in nuclear technology, is 24,000 years.

It follows that a more or less permanent storage is required for solid wastes having a high activity level, and particularly for long-lived isotopes. This is especially true for wastes having a high activity per kilogram. When the activity per kilogram is not high (that is to say in the case of the so-called low level radioactive solid wastes) it is possible to make recourse to less strict means of storage or even to a dispersion into the environment, provided that the risk for man of being contaminated by these wastes is actually low.

The disposal of radioactive material into the ground is satisfactory for low level solid wastes when it is carried out in a controlled way. The waste can be buried as unprotected or protected material. A particular kind of burial is the disposal of wastes in disused mine shafts.

In this context the sea bottom has been taken into consideration for a long time and by many groups, as a possible site for the disposal of solid materials having low, or sometimes intermediate, activity.

2. *Sea dumping*

Sea dumping, however, is a final act and should be used only for materials for which no future is foreseeable. Furthermore, if the sea dumping has been carried on under conditions or to an extent that later appear to have been ill-advised or dangerous, there is no practical way of correcting the situation.

These considerations obviously lead to limitations of the possibility of dumping solid wastes into the sea. First of all, it should be made clear that not all solid wastes can be taken into consideration for such a solution. There has never been any actual suggestion of using the sea for the really high level wastes, such as those arising directly from the chemical processing of spent nuclear fuel. Such wastes can be liquid or solidified. Liquid wastes are out of question; they would contaminate

the water and fishing products. Solidified wastes are excluded too, because, among other things, the radioactivity concentration is such as to heat them and this heat production would cause considerable problems, could damage the disposal material, would facilitate convective motions; shortly speaking, would compromise all guarantees regarding the restraint of contamination.

While speaking on the limitation of a possibility to use sea dumping for low and intermediate level wastes (that is to say to those wastes containing only a fraction of one mCi of long-lived isotopes per liter), some specifications must be made on the containment of the material dumped into the sea bottom. This material can be — obviously — packaged or unpackaged: the present trend is to take into consideration almost exclusively the packaged material. We shall see, later on, that packaging does not always mean a containment for long periods of time, but it should be able to secure waste conditioning at dumping and also an increased time for the release of radioactive material.

Another relevant limitation concerning the sea dumping is based on the dumping areas of the sea. It is quite apparent, in fact, that not all the areas are suitable to such operations. The coastal estuaries, the bays and the regions immediately seaward of these areas have been first of all excluded as disposal sites for all kind of solid waste. In fact, shoreward transport along the bottom in these regions would tend to intensify the rate of return of a contaminant to man. The bottoms of the continental shelf and the bottoms of the deep sea are therefore left to our consideration.

3. *Dumping on the continental shelf*

The water depth on continental shelves rarely exceeds 200 meters and various experts considered it quite safe to dispose very low and low level solid wastes in these areas, particularly if they are not trawled.

But some opinions are against this. Fishing is almost ubiquitous on continental shelves; moreover, in the last years the shelf is increasingly used in search of hydrocarbons, petroleum, and other geological resources. Aquaculture is expected

to grow considerably in many regions in coming years. It should be assumed that the exploitation of the shelf is becoming more and more diffused as time goes on, and many groups deem it awkward to limit its use for health protection requirements. On the other hand, when small amounts, in volume and activity, are involved; when Plutonium having a very long decay time is avoided; when the dumping area is controlled - sea sumping on the shelf cannot strictly be prevented on the ground of the health protection criteria.

In particular, those advocating such type of dumping report that there are areas around the coasts of most countries, which are charted disposal sites for the dumping of waste materials such as unstable ammunition. These areas, called "explosive dumping areas" or "dumping ground by permit only", have been used in the past — for instance, in the U.S.A. — also for certain toxic chemical wastes. These areas are rather large: about $15 \times 15 = 225$ square kilometers.

No doubt that — whatever the opinion on the continuation of such procedure of disposal on the shelf even to-day — it seems right to say that, in order to avoid the multiplication of sites which would result in a reduced availability of shelf areas, it would be advisable to use the areas already involved. In this sense a working group of the Committee on Oceanography of the United States National Academy of Sciences and of the National Research Council concluded its work (1959), presenting a selection of sites suitable for dumping along the Atlantic coasts of the United States.

The United Kingdom also used — during past years and for a long time — a site off the Channel Isles having a depth of about 180 meters. No fishing takes place in this locality and limitations in tons per year and in Curies of alpha and betagamma activity of the wastes were set. The limits adopted can be shown to be very safe.

4. *Dumping on deep basins*

Waste materials with any significant associated radioactivity should be disposed of in ocean basins deeper than 2500 meters.

Generally speaking, it is obviously safer to use deep basins; in fact, the materials dumped there will be well below trawling

depths and will be farther from the land, so that there will be almost no chance for any activity to come back to man. When packaged materials have reached the sea bottom, the rate of diffusion of released activity (if any) is low. However, some doubts have been expressed recently about the previous opinions that there is little interchange of water in the deep ocean basins with the water nearer the surface. Some considerations suggest that the turnover can be quite rapid and emphasize the need for further studies before using the deep ocean basins as disposal areas for large amounts of intermediate level wastes.

It seems advisable, from now, to avoid some particular deep basins. Some ridges and trenches should be excluded because of their seismicity, which can lead to rapid ruptures of the packaged materials and subsequent mixing causing contaminated water to come to the surface. Areas clear of shipping lanes, of fishing and of submarine cables should be preferably selected.

As far as fishing is concerned, little is known about the distribution of organisms living deep in the oceans. It has been thought that deep sea fishes are rare and of no commercial value, but this is partly incorrect. It has also been assumed that no important organisms or groups of organisms inhabit bottoms deeper than 2500 meters (that is to say the disposal area) at least during a part of their life cycles.

Also in the case of deep basins it would be advisable to avoid an indiscriminate multiplication of the used sites. In the United States it has long been adopted that radioactive wastes are packaged in concrete containers designed to prevent the immediate release, and dumped in basins deeper than 1500-1800 meters. Bulk disposal — in which radioactive wastes are discharged directly into the sea in unpackaged form — was also admitted in principle in the United States ten years ago, but this trend is being now more and more abandoned. Six dumping areas have been identified (1957): three in the Atlantic Ocean and three in the Pacific Ocean. In the Pacific Ocean two of these areas were used during 1962, one off San Francisco and the other in the Santa Cruz Basin, both shallower (or partly shallower) than the 1800 meter depth assumed for deep sea dumping.

In the United Kingdom dumpings are carried out in deep basins beyond the continental shelf: the water depth was not less than 2500 meters, and more recently - 3600 meters. The material disposed of in this manner in the Atlantic Ocean is of higher activity than that dumped in the areas, nearer to the shore, and includes objects which might be considered valuable to encourage their rescue if they could float. Consequently, the containers should not be easily damaged or broken and should reach the bottom without appreciable loss of content.

A particular problem is connected with the deep basins of the enclosed seas. It is important to draw the attention to the disadvantages which may, under certain conditions, ensue, if the attitudes and policies governing open seas in general are applied to enclosed seas. These disadvantages mainly concern the possibility of pollution of the enclosed sea. The effects resulting from activity releases in enclosed and in open seas are different and therefore the same approach cannot be used in the two cases.

This is the reason why, in the absence of oceanographic studies which could give a greater knowledge on the subject, the deep basins of the Mediterranean Sea have not yet been used for dumping. About 1960 France took the Channel of Corsica into consideration but every operation was suspended owing to the unfavourable reaction of the public opinion and of a part of the scientific opinion as well.

5. The fate of packaged materials dumped in the sea

The disposal of radioactive waste by dumping in the sea began in 1946 in the United States and since then it has been practiced in different ways and sites. Therefore it is impossible to describe a unique technical system of containment and dumping. However, the containment by steel drums used either alone or with an inner concrete shell represents the most frequent way. We will now briefly describe this technique to see its relationships with the sea bottom and limitations of its use.

First of all, it is to be said that the 200 liter drum is the most used container. The disposal of solid wastes consists in the dumping of hundreds and hundreds of such steel drums

which are filled with a given amount of concrete or bitumen and of wastes. These are often in solid form: small pieces of fuel, ashes, sludges, compressed wastes deriving from laboratories, very active but small sources. Sometimes the waste is liquid; this is contained in bottles of plastic or of other material. The American practice (not the British one) has favoured converting liquid wastes to solid ones.

As we already said, the drums must be able to reach the sea bottom without appreciable loss of their content. Considering the high pressures in the deep waters, it is necessary that the content is free of voids or that the drum is supplied with an equilibrium valve. A minimum density of 1.2 kilograms per liter and a sufficient shielding for a safe shipment and a safe handling is required.

During the descent, some drums may be damaged by the turbulence and by possible collisions, or by the pressure acting on those drums the equilibrium systems of which are not efficient. The drums, however, are constructed in such a way that they do not allow wide breaks in the concrete to occur, and cracks or fissures in the concrete, caused by collapse, do not allow the loss of a portion of the content. Water can flow into the drums, but in principle cannot come out.

The velocity of impact of the drums on the sea bottom is relatively low; areas with sediment-covered bottoms are recommended for disposal. Drums partly penetrate in the softest bottoms. The possibility of striking other drums already on the bottom exists, but calculations indicate that only a small percentage will probably be damaged in this way. The combined effect of the damage during the descent and at the moment of impact is such that we must assume that a small percentage of the drums are not intact at their landing on the bottom. This is especially true when the dumping is made into deep basins with consequent very high pressures. We must therefore consider that radioactivity immediately begins to escape from an unknown but possibly significant proportion of the drums.

When the drums are on the bottom several processes may be of importance. As far as the corrosion action by sea water is concerned, the drums or canisters used at present have an expected life of approximately ten years. If this period of time could be accepted for the dumped activity as a whole, a safety

factor should be introduced for many nuclides having a half-life of many months or some years. In any case the hazardousness of Strontium 90, Cesium 137, and especially of Plutonium 239 would not be significantly reduced in the period of expected life of the containers.

Some experts have also pointed out that other phenomena are possible during the residence time on the bottom. Bacterial decay takes place in organic wastes; this leads to the production of gases, possibly of acidity and of reducing conditions. Consequently, some components of the iron or of the concrete may undergo an accelerated destruction which results in an increase of porosity of the drums.

We may, therefore, assume an early loss of radioactivity coming from drums which reached the bottom intact and underwent some processes inside. But we cannot be sure of the occurrence of such a corrosion process, accompanied by a consequent dispersion of activity. We could even assume that these processes might not always occur and that even after tens of years the concrete in the drums is still able to contain the radioactive waste. This is the reason why an involuntary rescue of the drums by fishermen or other persons might involve a certain risk. This undue risk is practically negligible in the deep basins of the oceans, while it would be remarkable on the shelf, even if the selected areas are forbidden to or neglected by commercial fishing.

To express an opinion on the future availability of the sea bottom it would be extremely useful to know for sure the evolution of the dumped material in time, either in the case when it is dispersed in the surrounding water or bottom sediments, or in the case when it is kept in the initial container for long periods of time. But we must recognize that our present knowledge does not permit us to express exact opinions on the subject. Several assumptions and some actual facts may lead us to think that the role of pressure before, of corrosion afterwards, could result in a progressive dispersion of the radioactive material contained in the dumped drums. After a century the greatest part of the initial activity not yet decayed will be probably removed from the dumping site on the sea bottom.

We may refer to the opinion of experts on the subject, assembled by the European Nuclear Energy Agency (ENEA)

(1966), and summarize the accepted hypotheses. One per cent of the drums are immediately broken at their landing on the bottom; 99 % are broken approximately after 10 years from the dumping. If all this has occurred in deep basins it is reasonable to assume that the diffusion and transport from the bottom to the surface takes 10 years, which means that about 20 years are required for the return of the mass of the dumped material to the surface of the sea.

On the other hand, it must also be taken into consideration, especially for the drums dumped at not very great depths, that living sessile organisms will attach to the drums. Some of these may be boring or drilling organisms. Some grazing invertebrates leaving cleaned trails, where the metal is exposed to corrosion, might also be important. An effect of such attachment will be the development of a differing bottom community in the disposal area. Some experts object that even if hundreds of thousands of drums are dumped in a same area of — say — 15 kilometers in diameter, the density of drums on the bottom is still sufficiently low and does not radically change the local ecological conditions.

Considering the interaction between the materials escaping from the drums and the local living community, we can say — from a general point of view — that soluble elements may pass through the resident organisms, and will diffuse out of the region, or will be diluted and carried out by the water and its stable elements passing through; insoluble elements will largely be retained by the sediments and by resident organisms. It is therefore possible to assume that fish or other organisms having direct access to the disposal area may contain higher concentrations of radioisotopes than other organisms in the surrounding area.

Fortunately enough, the marine environment is not included in the most dangerous environments from an ecological standpoint, as far as the accumulation of radioisotopes by the organisms used for human consumption is concerned. This is due to the fact that sea water is a solution rich in salts of several elements: consequently a remarkable isotopic dilution of radioisotopes immersed in sea water is possible. The result of such richness in salts is that for some elements, among them strontium and cesium, concentration factors (ratio between the concentration

in the fish and the concentration in the water) are not very high. This does not apply to some metals as cobalt, zinc, iron, copper. The radioactive isotopes of these elements do not have, however, very long half-lives.

Relatively favourable ecological conditions of the marine environment are more evident when we take into consideration the different conditions of lakes and rivers: that is to say of fresh water environments. In these waters the salts in solution are found in small concentrations. Isotopic dilution does not occur and radioactive isotopes pass into the body of fishes, thus contributing to very high concentration factors.

Anyhow, the concentration of radionuclides in marine organisms used for human consumption should not be neglected. In fact the permissible levels of radioactive concentration in foodstuffs and also in edible fishes, shellfishes, crabs and shrimps are very small; the concentrations in sea water must therefore be kept very low as well. To express this concept in a quantitative form we can say that for various radioisotopes, maximum permitted concentrations are of the order from less than 1 to 1000 microcuries (1 microcurie is one millionth of a Curie) for one cubic meter of sea water.

Just to give an example of the receptivity of the sea, let us imagine a selected sea water area; each year a given amount of wastes is dumped in it until equilibrium conditions between what is dumped and what is released are reached. A disposal rate of 200 to 300 Curies of Strontium 90 per year will surely keep the situation at the disposal area boundary below the permissible level of concentration. This is true for dilution conditions selected with very conservative criteria (among them the height of mixing water, fixed at 30 meters).

These are the health considerations which actually limit — at present — the disposal into the sea, apart from the considerations on the future availability of the sea bottom. In fact, up to now these latter considerations have not been given so much attention as the considerations of food contamination.

6. *The evolution of the use of dumping*

Since 1946 the Atomic Energy Commission of United States has disposed amounts of solid, packaged waste material at designed locations, partly on the continental shelf in the Atlantic and Pacific Oceans. From 1946 through 1963 the United States disposed in the Atlantic about 30,000 drums of all types, with an estimated activity of 46,000 Curies at the time of disposal. In the same period about 60,000 containers for 15,000 Curies were dumped in the Pacific Ocean. During the past five years a sharp reduction in U.S. sea disposal activities took place. Since no disposals were made during 1968 one might consider that this kind of operation has essentially ceased in that country. The sea disposal operations have become practically extinct primarily for economic reasons. There are no indications that this situation will change in the next years.

It is, however, interesting to note that a study made by the National Academy of Sciences-National Research Council in 1959 for the Atlantic coast showed that Curies of Strontium 90 (or an equivalent amount) can be dumped in adequately chosen sites of the shelf, for each area and for each year, with a wide cautelative margin. This study pointed out 28 sites which could be used for this purpose; they would permit a safe annual disposal on the shelf of 7,000 Curies of Strontium equivalents per year - from Florida to Maine.

Another study made by the same agencies in 1962 for the Pacific coast showed that with the same cautelative margin, 150 Curies of isotopes having a high (but not very high) toxicity can be dumped in selected areas of the shelf, provided that each container does not hold more than 40 soluble millicuries and 0.5 insoluble millicurie. In the case of deep oceanic basins the same study admits very much higher disposals, in Curies per year, for each selected area.

As far as the United Kingdom is concerned, the maximum amount permitted for the disposal on the shelf (Channel) has been 5,000 tons per year (probably more than 10,000 containers) having not more than 200 Curies of alpha and 4,000 Curies of beta-gamma radioactivity.

Actually, since 1963 no dumping has been carried out in the Channel owing to the relatively shallow water of the Channel

itself. All dumping is now carried out in the deep basins of the Atlantic Ocean, in depths of over 3,600 meters. The Ministry of Agriculture, Fisheries and Food does not specify an upper limit on the activity content, but each consignment is subject to a hazard assessment, taking into account the dumping areas, the nuclides present, etc. From 1965 to 1968 drums having an estimated activity of about 1,000 Curies of alpha emitters and about 90,000 Curies of beta emitters were disposed of. In 1967 the United Kingdom participated in the ENEA sea disposal operation to which reference is made below.

No exact information is available on the number of containers dumped in deep ocean basins and on the places of dumping; the disposals in deep Atlantic basins have been usually confined to waste material with significant associated radioactivity. The amount disposed in this way is regularly recorded by the competent national authorities.

Recently an initiative of ENEA resulted in a disposal operation carried out in the Atlantic Ocean in 1967. A group of experts calculated that the disposal of solid radioactive wastes into deep basins of the Atlantic Ocean, carried out at a rhythm of 10,000 Curies per year approximately, could only result in ingestions of radioactivity by man which are much lower (by several orders of magnitude) than the maximum values presently recommended by ICRP. The same experts concluded that this will have no significant effect on living organism. This expectation is valid for basins more than 2,000 meters deep. Following these requirements ENEA selected an area in the North-East Atlantic Ocean, very far from the nearest European coasts, where the depth is higher than 5,000 meters; drums were normalized in their characteristics and three main methods of packing were adopted, according to the nature and the activity of wastes (sludge containers; containers for wastes set in concrete; inner containers with concrete shielding.).

Following the above mentioned criteria, 36,000 drums coming from five different Countries (United Kingdom, Federal Republic of Germany, Netherlands, Belgium, France) were dumped in 1967 during four different trips of the same ship. The total weight was of more than 10,000 tons; the total alpha activity was evaluated at 250 Curies, the beta-gamma activity - at 8,000 Curies. A second operation based on

similar conditions was carried out by the ENEA during the summer 1969.

As far as the Soviet Union is concerned, we have to recall here that the attitude of that country has always been negative with respect to the use of the sea bottom (and more generally of the sea) for the disposal of radioactive wastes. Departing from the principle of freedom of the high seas in international law, the Soviet Union considers contamination of the sea (and implicitly the dumping of potentially contaminating materials) incompatible with this principle. During an international Conference (1959) a Russian delegate said that "it is inadmissible that freedom of the high seas should mean freedom to contaminate the seas with radioactive wastes; should mean freedom to prejudice the interests of other States". Consequently, we must assume that the Soviet Union has not used the dumping system in deep basins for the disposal of its wastes.

7. Future implications for the dumping areas

It appears from what was just said that the dumping of drums on the sea bottom represents or at least may represent a sort of bond, or tie, for the subsequent use of given areas.

First of all, let us consider the duration of such potential hindrance. Obviously, if isotopes with half-lives not higher than one or two years were disposed, the implications — even in the hypothesis that the dumped material would remain indefinitely within the containers and would not be released — would not last longer than some tens of years: that is to say — one human generation. Generations following the one which operated the dumping would not find any more significant amount of activity. The only inconvenience, as with any other dumped material, would be the presence of foreign bodies on the sea bottom.

It should be recognized that the dumped wastes and the wastes that will be dumped, usually contain mixtures of fission products, and therefore also Sr 90 and Cs 137 which have half-lives of about 30 years. If we take into consideration only

the decay of such isotopes (without considering the dispersion and the dilution of the dumped material) some centuries are required for the material to become completely harmless. This means that the generation which operated the dumping transmits to future generations a mortgage, restraining the possibility of using for other aims given areas of the sea bottom.

This mortgage is perhaps not severe, but certainly, its spontaneous redemption will take a long time. In any case, such inconvenience does not seem very different from that created in the case of dumping areas for explosives, already existing in many places in the seas. In such areas fishing is forbidden, the deposition of cables should not be admitted and the drilling of the sea bottom should also be carried out with care for the protection of workers.

The problem becomes more serious when wastes containing significant amounts of Pu 239 would be dumped. We already mentioned that the half-life of this isotope is 24,000 years; consequently, the bond in time on the sea bottom becomes definitive, even considering plenty of human generations. It is also true that in such a long time — which may be compared with geological time — the corrosion and the subsequent dispersion are more important, from the point of view of the neutralisation of the material, than the physical decay, and, therefore, it would not be necessary to wait for the decay in order to consider the dumping area as available. But in any case, the inconvenience would last for a very long time, scarcely subject to a possible evaluation, and practically equivalent to an exclusion of given areas from different, successive forms of use.

It must be emphasized, however, that the above considerations do not apply to the disposal of wastes containing very small amounts of Pu which owing to their characteristics do not raise any health problem.

Obviously, the limitation of use is heavier with respect to the dumping areas on the shelf, where trawling is more commonly used, than with respect to such areas on deep basins. But both involve some limitations for the deposition of cables and for subsequent dumping of various materials which could, in their fall or following chemical interactions, be the cause of damage to active drums, accelerating their destruction which might have been foreseen after a long time.

These observations lead us to confirm the dumping in great depths as preferable in comparison with shallow depths; great depths in fact, at least for many years from now, will be less used than small depths where human activities will become more intense owing to fishing, aquaculture (concerning depths of 200 meters as a maximum) and exploitation of geologic resources. It must, however be admitted that at the end of this century only a very small fraction of the sea bed will be exploited.

In any case, since dumping represents a bond for decades and possibly centuries, it must be planned as far as its sites are concerned, trying to avoid the multiplication of the sites themselves.

Still another observation about dumping should be made, in order to obtain a perspective evaluation of this kind of disposal. The values of activity for each dumping site and the adequate distances between sites allow for evaluation of the maximum receptivity of the oceans for packaged solid wastes — with the full respect of health requirements. The experts convened under the chairmanship of Brynielsson under the auspices of IAEA were able to make these evaluations (1961). The Brynielsson panel has accepted the principle that disposal of radioactive wastes into the sea should not be permitted to restrict the harvest of marine products or any other normal use of the sea by man. In this framework the panel has calculated what proportion of wastes from nuclear industry could be safely disposed in the deep ocean waters. Assuming a future power industry producing 1,000 metric tons of fission products per year, less than 2 % of this material could be placed in the deep sea without raising the Sr 90 content in the upper layers beyond a convenient permissible concentration.

We are thus discussing a very small percentage of the foreseen production of wastes. Actually the disposal of solid wastes into the sea has been in the past, and still is, a limited phenomenon in the framework of nuclear industry, also as a consequence of resulting economics of land disposal, which is attractive and usually preferred. In 1963 some experts in the United States were already aware of the fact the ocean disposal would no longer be an important service in that country, as evidenced by the fact that more than 95 % of low level solid

packaged wastes were then buried on land in the States. Actually the United States practically discontinued in recent years dumping operations, which, however, are still of interest to other countries, as ENEA campaigns demonstrate.

8. *The international regime of dumping*

At the end of this paper we would like to make some general observations which may give rise to a discussion on the regime to be adopted for dumping of radioactive solid waste on the sea-bed.

The method of dumping is scarcely under control. This applies both to the position of drums on the bottom, and to the identification of the exact areas selected, after a long period of time. The control is also lacking — and the relative present knowledge is still scanty — with respect to the ruptures of drums, to the velocity of diffusion and transport; in a word — with respect to the fate of the content of the drums. The dumping on the shelf results in a more rapid return of radioactivity to man; but in the case of the dumping on deep basins it is rather difficult to say whether oceanographers are right in evaluating the residence time in deep waters in terms of centuries; or other experts are right in considering mixing time in terms of a few decades.

In any case, the returning contamination may involve several countries, either on their coasts, or insofar as their ships and various uses of the sea bottom are concerned. To-day the human activities at sea are mainly limited to fishing, but in a near future also aquaculture and geological resources of the sea-bed could be of an interest too. This clearly points out that an adequate solution of the problem may be reached only under international control, and with application of the principle of liability to dumping operations. The problem should be approached in a wider framework, taking into consideration also other uses of the sea bottom, possibly international in character.

In the present increasing awareness that human activities must respect the natural environment and preserve it for future generations without introducing severe or irreversible alterations,

the motivation for dumping must be found in a well balanced and harmonic view of the modern industrial development. Such motivation should be, in a word, a recognised common interest of mankind, and a common use of natural resources by all Nations.

From this point of view it will be necessary to make a distinction between dumping on the shelf and dumping in deep basins. For the latter, the identification of areas of international jurisdiction might be a worthy goal. In the selection of sites for dumping, the reconciliation of different users — navigation, fishing, industrial exploitation, research — should be taken into consideration.

It is generally agreed that national authorities should publish information about the intention to use an area for disposal of packaged waste, and should subsequently report details as to the number of drums and total amount of activity disposed of each year. The unrestricted publication of such data will at least allow experts to make independent evaluations of the permissibility of disposal procedures and the extent of the need for safeguards.

Before the auspicious situation for an international ruling is reached it would be advisable that each waste disposal site should be designated by an international authority. This authority should set out conditions of disposal for the site, adequate to ensure that no unacceptable degree of hazard to man is involved. It should provide for surveillance and — when technically justified — for monitoring of the area in order to verify that safe conditions are maintained; it should also collect all necessary records of disposal to maintain an adequate knowledge of the state of the disposal site. Only in this way low and intermediate level wastes may safely be disposed of into the sea deep bottom under controlled and specified conditions and limitations.

The perspectives of an international action are based on the United Nations Conference on the Law of the Sea (1958) and its deliberations. At that time, concern about pollution of the sea water which had originated from the spills of oil extended also to pollution by radioactive materials. The following provision was included in the Convention of the High Seas: "Every State shall take measures to prevent pollution of the seas from dumping of radioactive waste, taking into account

any standard or regulations which may be formulated by the competent international organization. All States shall cooperate with (that) organization ”.

At its tenth Plenary Meeting the Conference adopted a resolution on the pollution of the high seas by radioactive materials which reads: “The IAEA, in consultation with the existing groups and established organs having acknowledged competence in the field of radiological protection, should pursue whatever studies and take whatever actions necessary to assist States in controlling the discharge or release of radioactive materials to the sea, in promulgating standards and in drawing up internationally acceptable regulations to prevent pollution of the sea by radioactive materials in amounts which would adversely affect man and his marine resources ”.

The panel presided over by Brynielsson (already quoted) was set up by the Agency to implement this resolution. A report which was produced (1961) remains a primary source of reference and a guide for the disposal of wastes into the sea.

Hoping that the action aimed at regulating the procedures for and international control of dumping will continue, we should appreciate the regional, but still international initiatives, such as those promoted by ENEA, which enabled a certain number of countries to agree on a dumping programme in a selected site in deep basins, after having carefully evaluated the possible risks in a cautious way and in a spirit of mutual help and respect for the principle that the deep sea bottom has to be considered as a common resource for the benefit of mankind.

References

- AMPHLETT C.B., *Treatment and disposal of radioactive wastes*. Pergamon, New York, 1961.
- BELTER W.G., *U.S. operational experience in radioactive waste management (1958-1963)*. Proceed. 3rd Interntl. Conf. Peac. Uses Atomic En. United Nations, New York, 1965, vol. 14, page 302.
- BELTER W.G., *Personal communication on recent sea disposal in the U.S.A.*, 1969.

- BURNS R.H., *The disposal of radioactive solid wastes*. In: *Radio active wastes, their treatment and disposal*, editor J.C. Collins. Spon, London, 1960, page 181.
- BURNS R.H., *Radioactive waste control at the United Kingdom Atomic Research Establishment Harwell*. Report AERE-M 1335, 1964.
- BURNS R.H., *Personal communication on recent sea disposal in the U.K.*, 1969.
- GLUECKAUF E., *Long-term aspect of fission product disposal*. Proceed. Internatl. Conf. Peac. Uses Atomic En. United Nations, New York, 1956, vol. 9, page 3.
- HYDEMAN L.M., BERMAN W.H., *Legal and administrative problems of controlling the disposal of nuclear wastes in the sea*. In: *Disposal of radioactive wastes*. IAEA, Vienna, 1960, vol. I, page 565.
- JOSEPH A.B., *U.S. sea disposal operations*. A summary to December 1956. Report USAEC, WASH-734, 1957.
- KRAWCZYNSKI S.J.B., *Radioaktive Abfalle*. Thiemig, Munchen, 1967.
- MANNER E.J., *Some international legal aspects of the enclosed seas, especially the Baltic Sea, with regard to their protection against pollutive agents*. In: *Disposal of radioactive wastes*. IAEA, Vienna, 1960, vol. I, page 591.
- MAWSON C.A., *Management of radioactive wastes*. Van Nostrand, Princeton 1965.
- QUENEUDEC J.P., *Le rejet à la mer de déchets radioactifs*. Annuaire Franc. droit internat., 11, 750, 1965.
- RECHT P., VAN HOECK F., *Aspects scientifiques et sanitaires de la contamination radioactive de la mer*. Report EURATOM, EUR-407, 1965.
- ROBERTS I.C., SMALL S.H., *Impact of legal control of discharge of radioactive materials on the responsible departments*. In: *Agricultural and public health aspects of radioactive contamination in normal and emergency situations*. FAO, Rome, 1964, page 345.
- ROMANOV V.L., *Contribution to the discussion on papers*. In: *Disposal of radioactive wastes*. IAEA, Vienna, 1960, vol. I, page 601.
- SOULE H.F., *Personal communication on recent sea disposal in the USA*, 1969.
- WALDICHUK M., *Containment of radioactive waste for sea disposal and fisheries off the Canadian Pacific coasts*. In: *Disposal of radioactive wastes*. IAEA, Vienna, 1960, vol. 2, page 60.
- ENEA, *Opération d'évacuation de déchets radioactifs dans l'Océan Atlantique*, 1967. Rapport OCDE-ENEA, Paris, 1967.

- IAEA, *Radioactive waste disposal into the sea*. IAEA Safety Series n. 5, Vienna, 1961. Report of a Panel under the chairmanship of H. Brynielsson.
- UNITED NATIONS CONFERENCE ON THE LAW OF THE SEA, OFFICIAL RECORDS, vol. II, 1958, pages 22 and 138; 24 and 143.
- USA *National Academy of Sciences-National Research Council, Considerations on the disposal of radioactive wastes from nuclear-powered ships into the marine environments*. Publ. n. 658, Washington, 1959.
- USA *National Academy of Sciences-National Research Council, Radioactive waste disposal into Atlantic and gulf coastal waters*. Publ. n. 655, Washington, 1959.
- USA *National Academy of Sciences-National Research Council, Disposal of low-level radioactive waste into Pacific coastal waters*. Publ. n. 985, Washington, 1962.
- USA *National Bureau of Standards, Radioactive waste disposal in the Ocean*. Handbook 58, Washington, 1954.

SUMMARY OF DISCUSSION

WORKING GROUP I

Resources of the Sea-Bed; Conditions of their Exploitation, and its Possible Economic Consequences

It was pointed out that in assessing wealth of the sea and of the sea-bed one must make a distinction between the resources which can be exploited and just an element in the environment. It is, e.g., estimated that there are trillions of tons of aluminium on the floor of the three oceans and ca. 5 billion tons of gold in the sea-water. But costs of their separation would be incomparably higher than prices at which they may sell and, therefore, they cannot be regarded as exploitable resources of the sea.

It was furthermore stated that insofar as oil and natural gas are concerned, their extraction is likely to extend rather rapidly outward to the deeper waters along with the advancement of technology and reduction of costs of the deep-sea operations. However, large oil and natural gas deposits are not likely to be found beyond the continental slope. In any case, exploitation of oil and natural gas is not likely to take place beyond the slope.

Attention was also drawn to the fact that at present the prices of oil — sometimes artificially maintained — as, e.g., by depletion allowances, etc., make the offshore operations economically attractive in spite of their costs. It would be, however, incorrect to maintain the costs of extracting oil and natural gas from the sea-bed must always be higher. This is true now and will remain true in the nearest future. But it must not necessarily be always so — in view of changing technology. On the other hand — it was pointed out — there exist

factors which may decrease the attractiveness of the deep-sea mining operations, as e.g.:

- additional costs of preventing pollution of the sea;
- discovery of large oil deposits on land (as e.g. in Alaska), which may reduce the prices of oil.

As regards other minerals present in the deep-sea area, cobalt and manganese were considered perhaps as the most likely objects of exploitation.

In this connection the question was raised whether there are any essential differences between the exploration and exploitation of oil on the one hand, and of the ores on the other hand, in terms of expenditures, risk of pollution, etc.

An opinion was expressed that differences are quite tangible. E.g., manganese nodules lie on the surface of the sea-floor and their value may be determined at a fairly low cost, while an evaluation of an oil deposit is very costly. Also the problems of pollution are different here and there. One of the techniques of dredging nodules is likely to raise sediments which would then fall on neighbouring area, thus making the dredging much more difficult for an eventual next producer. It is therefore probable that the exploration and exploitation of different resources may require different rules.

The question was also raised when the exploitation of marigenous minerals may start on an economic scale. Although the participants in the discussion felt it difficult to make predictions, some opinions were expressed or quoted. According to one of them, exploitation of manganese nodules may start in some areas in 3-4 years. According to other opinions, this is rather a question of a decade or two. This opinion appeared more likely. But the fact is that some companies are doing all the preparatory work for starting the exploitation of marigenous minerals and this in itself raises all the questions which are now being considered by the Symposium.

According to one participant, it may well happen that — for strategic reasons — the exploitation of marigenous minerals may develop even though it may be uneconomic.

Another speaker referred in this connection to the Report of the President's Advisory Committee on Marine Science, Engineering and Resources (U.S.), in which it was stated

that government subsidies towards the development costs might make the exploitation of manganese nodules even economically viable. It was added, however, that at present this does not appear to be the position of the U.S. Government.

Another participant raised the question of a danger of unhealthy competition and of overproduction along with the development of undersea exploitation of minerals. And the opinion of a social scientist was that the answer to this question would depend on time horizons. In the pioneering stage no such danger exists. Also in the short run — with 4-5 producers operating — there is little probability of competition for sites and of overproduction. The situation may change in the long run — especially if exploitation develops on the basis of the principle “first come — first served”. It may lead to a severe competition and economically wasteful practices in an attempt to reserve exclusive rights on specific sites. It is difficult to forecast the danger of overproduction. On one hand, even one producer may cause overproduction. On the other hand — we may expect new uses for these raw materials at lower prices.

It was generally recognised that the exploitation of the sea-bed resources, especially of manganese and cobalt, may affect the world market prices and thus affect the economy of the developing countries producing these metals. Two ways to provide for relief in this case were proposed in the discussion:

- production control;
- compensation to the developing countries affected.

A suggestion was made that payment of compensation would require some international fund and, consequently, some international control. However, according to another view, such a mechanism — whatever its desirability — should not be relied upon within a decade or two. E.g. insofar as manganese is concerned, the first pioneers would probably not make much money on their deep-sea ventures. The situation may be different with respect to oil production.

An oil expert, however, clarified that also with respect to oil, the prospects are uncertain, since:

- it will take some time until the exploitation of marine resources develop on an economic scale;

— investments are very costly and the return of the costs of investments will take still more time;

— even if a product is extracted, marketing may become more difficult; it is hard to forecast the demand for oil in 10-20 years from now. Opinion was also expressed that since the future developments on the sea-bed may deepen the gap between “haves” and “have nots”, an effort should be made to combine the exploitation of the resources of the sea-bed with the economic aid to the developing countries.

Possible Conflicts of Uses

The question was raised of the possible conflicts of interests in exploiting oil and natural gas, other mineral resources, and the living resources, and, consequently — of the need to establish some principles to prevent mutual interference between these three categories of uses of the marine environment.

On the other hand, it was pointed out that on the deep sea floor proper the living resources are very scarce and that the problem is not very acute in this respect. There are many more reasons to worry about possible adverse effects of industrial operations on the sea-bed upon the living resources of the high seas as such (pollution, mechanical injuries, restricted access to fishing areas, etc.). It was proposed in this connection to establish some priorities, as e.g. that:

- historic uses take precedence over new uses;
- economically more important uses take precedence over less important uses;
- special interests of the closest coastal states take precedence over the interests of other states, etc.

One of the participants submitted that the importance of fisheries is likely to decrease in the future.

A number of speakers felt that some internationally binding criteria of priority are needed to ensure an orderly development of marine resources. At the same time it was felt that it is rather difficult to make a generalised statement of criteria in advance, since the conditions may vary from area to area. In

one area, fishing may appear to be of paramount importance; in another area navigation, etc. All these are human activities and none of them is more protected by law than another.

Reference to historic uses as a legal title was challenged by some participants.

One participant referred to a forecast of the decreasing economic importance of fisheries. He felt that in order to evaluate the importance of any one of possibly conflicting uses one must look into the specific situation in each individual case.

In this connection a question was raised who will decide upon such matters — and an opinion was expressed that whatever rules of priorities are adopted, some international machinery would be needed to apply these criteria in individual situations.

An opinion was also expressed that the criterion of economic reasonableness, or importance, might prove not to be very helpful because, from the economic point of view there is only one common denominator for the evaluation of importance of different uses of the marine environment - i.e. money. Although this is an extreme position, it is still a valid one and should be taken as a starting point which may be corrected by other considerations, as e.g. social ones.

Some other speakers felt that it would not be proper to push the purely economic criterion to an extreme, so as, e.g., to deprive such a traditionally fishing nation, as Icelanders, of this occupation and of a source of food only because e.g. mining oil in the same area might produce higher income.

A social scientist remarked in this connection that a distinction should be made between the production and the distribution of income. It may be better to offer a compensation in such cases as the one just referred to. In reply to the question regarding the social problem of unemployment so created, the speaker expressed the opinion that it may be even worthwhile to compensate the costs of retraining of the affected part of population.

However, some other participants believed that also involved here are factors of tradition and convictions of the population which can hardly be compensated for, and that, generally, greater account should be taken of social factors.

Some participants were of the opinion that although the problem of the conflict of uses certainly does exist, in practice its intensity should not be exaggerated. An oil expert expressed the view that in the North Sea a fair accommodation of oil companies and fishermen was reached but he did not exclude that the situation may be different in other areas as, e.g., the Gulf of Mexico. In this connection another participant indicated that the conflict of interests between extraction of oil and navigation in that area was also smoothed down to a certain degree by tracing navigation lanes on which the implanting of oil rigs is prohibited. It was also noted that no one in this case made any calculation of the relative value of the conflicting uses. Another participant, however, gave as an example the East Bay on the coast of Louisiana, which was traditionally a fishing area and from which fishing was recently completely eliminated by implanting oil rigs there. At the same time attention was drawn to the fact that all these examples are taken from the continental shelf and that beyond that area the concentration may be not so great.

It was also observed that in solving the problem of conflicting uses of the sea-bed and of the superjacent waters it may be relevant to focus attention on the international river law where the conflict of different uses has been under consideration for a long period of time.

The Problem of Pollution

It was said that the problem of pollution may become more acute from different points of view once the exploitation of mineral resources of the sea-bed is developed.

It was mentioned that the U.S. is sinking yearly 1,800 coffins of nerve gas off New Jersey and it is not known if the area on which they land may be used for other purposes. Also another type of activities detrimental to the marine environment was mentioned, i.e. the dam on the Nile which reduces the supply of nutrition for the living resources in the Mediterranean.

It was also pointed out that the London Convention of 1954 relates only to the water pollution by oil from ships. IMCO

is drafting now two other conventions but there are gaps in them, even insofar as the pollution from ships is concerned.

The question was also raised to what extent lawyers may be anticipatory in drafting appropriate rules. Usually they react only after actual disaster.

A suggestion was made that strict measures of pollution control, especially relating to the dumping of radioactive waste, should be undertaken. It was furthermore suggested that the Working Group should endorse the resolution on the pollution of high seas by radioactive materials, which was adopted at the Geneva Conference on the Law of the Sea of 1958, as well as the work of the International Atomic Energy Agency on the subject. It was also proposed to endorse the conclusions contained in the paper presented to the Symposium by Dr. Polvani (see p. 195).

WORKING GROUP II

Resources of the Sea-Bed; Conditions of their exploitation, and its Possible Economic Consequences

The question was raised by a navy expert whether it is theoretically possible to extract all mineral resources from the ocean; and a geologist expressed the view that theoretically an answer to this question should be in the affirmative. But the opposite is true in practice since not all resources may be exploited on a sound economic basis. The speaker was of the opinion that the awareness of the difference between technological feasibility to get down to the sea-bed at a reasonable cost, and possibility of economic uses of the deep ocean is of vital importance. He believed, however, that one should not be absorbed too much by economic considerations when examining the question of the exploitation of natural resources. According to him, the behaviour of human beings shows that a drive towards a resource may be based on reasons other than purely economic ones, and one should not automatically discount such a drive in the case of the deep-sea resources just because their extraction may not be worthwhile economically.

In this connection an opinion was expressed by a geologist that if uneconomic exploitation of any resources might be warranted by other considerations, public subsidies must come in to support such an exploitation.

Another participant, referring to resources in areas of the seabed beyond possible limits of national jurisdiction, pointed out that what is largely talked about with respect to these areas are manganese nodules — a low-grade ore containing also some nickel and cobalt. He was, therefore, of the opinion that even

large amounts of manganese nodules may not warrant their economic exploitation. He did not insist on that view since — according to him — sampling is still insufficient, and we just cannot say anything conclusive at the moment. He added that dredging of manganese nodules would not require big fixed installations since the dredging technique resembles rather trawling.

Insofar as the extraction of oil and natural gas from the sea-bed is concerned, the prevailing opinion in the Working Group was that both from technological and economic points of view the prospects for their extraction appear to be better than those of extracting ores. However, the complexity of the problem also with respect to oil was pointed out.

One participant submitted that a possibility to find an oil deposit beyond the continental slope is very remote; and even if it is found there, a long time would pass still before such a deposit is economically exploited.

A geologist drew attention of the Working Group to the promising areas of oil exploitation off Australia, on the north slope of Alaska, north of Indonesia, and in the East China Sea off the coasts of Japan, Korea and Taiwan. Some of these prospective areas of exploitation were still not known three years ago. If these areas are exploited, this may result in the reduction of prices of oil, and would also reduce the need to go to greater depths in a search for oil.

It was also said that the impact of the production of oil and natural gas from the sea-bed on the world markets, and especially the effects of such a production on the economy of developing nations, should be borne in mind.

An oil expert, however, was of the opinion that the exploitation of new oilfields on the sea-bed is not likely to reduce prices of oil in any considerable degree. He based his opinion on the fact that the prices of oil are actually 5-6 times higher than the costs of production. The difference is in the sphere of distribution. He added that insofar as the costs of production are concerned, they are higher with respect to the extraction from the sea-bed than with respect to the extraction on land. Also costs of exploration and development are higher on the sea-bed than on land. Oilfields do not cover large areas but appear rather as small concretions in the sedimentary structures.

On land only 1 experimental drilling out of 10 yields satisfactory results. This proportion must be reduced to 1 : 20 with respect to drilling on the sea-bed.

The problem of the costs of development was also stressed by a navy expert who felt that the assessment based mainly on considerations of technological feasibility to exploit the sea-bed resources seem to be exaggerated. But technology itself creates some problems as well. One should be aware of the fact that the free surface of the sea — because of its movements — is the worst area to operate on. These difficulties may be overcome either by using fully submerged devices or by developing very stable surface platforms. He felt that this is a question of about 20 years and only then may one start thinking of large scale deep-sea operations. He also added that experience with small submersibles shows that the supporting vessels are much more expensive than the submersibles themselves.

With regard to the living resources of the sea, a biologist drew attention of the Working Group to the fact that the ocean is an environment rich in animal protein but very poor in carbohydrates. He also pointed out that there is a recognisable change in the nature of the resources on the continental shelf and slope on the one hand, and on the deeper sea-bed areas on the other. This is true both with respect to mineral and to living resources. He felt that some authors discuss the need of a separate regime for the deep ocean floor without, however, recognising the differences in the nature of these resources. He added that living resources, whether sedentary or demersal, beyond the continental slope are not at present, and are not likely to become in the future, of any commercial importance.

An international lawyer also supported the view that while discussing possible legal regimes of the sea-bed one must always have in mind the distinction in the nature of environment and techniques to be applied in its exploitation on the continental shelf on the one hand, and on the deep sea-bed on the other.

It was also pointed out that the changes in the character of the seabed resources do not coincide with the limits of national jurisdiction. It was, moreover, indicated that the biological categories of the marine fauna do not correspond to the geological or morphological division of the sea-bed.

A biologist indicated that the species really connected with the bottom of the sea appear mainly in the continental shelf area. Only some of them — like king crabs — live in the deeper parts of the ocean floor. Anyway, however, beyond the outer edge of the continental slope the living resources of the ocean floor — especially those economically exploitable — are almost none.

In this connection another participant recalled that actually about 95 % of the fish crop is being caught in the area of the continental shelf.

One of the speakers pointed out that it is extremely difficult to make an estimation of a possible revenue from the economic exploitation of the deep sea-bed. It is difficult even with respect to the continental shelf. The figure of \$ 5-6 bil. of the expected revenue from possible economic exploitation of the sea-bed beyond 200 m depth, quoted in the UN debate in 1967, was believed by him to be extremely generous and probably unrealistic. He felt that it was a disservice to give such promises which cannot be kept.

A geographer noted that no strong competition between the technologically advanced countries may be expected on the deep-sea floor since for a long time to come only the shelf and the slope will be exploited.

Possible Conflicts of Uses

A biologist drew attention of the Working Group to the fact that the living resources of the sea clearly divide themselves into two categories insofar as their protection is concerned, namely:

— those which cause the concern of the marine biologists because of possible adverse effects of the extraction of minerals;

— those which cause the concern of the marine biologists with respect to proper management and conservation.

On the deep-sea bed marine biologists are not worried about the latter question but only about the former one.

He distinguished three possible types of adverse effects of the exploitation of minerals from the sea-bed upon the living resources:

- killing by explosives;
- direct destruction of sedentary resources in the process of dredging (mainly on the continental shelf and slope);
- destruction of sedentary as well as of demersal and pelagic species by pollution (chemical processes) associated with the exploitation of minerals on the sea-bed.

He also believed that the first of these dangers could be minimised in two ways:

- use of non-explosive energy sources which might be perfectly effective geologically but not damaging to the living resources (e.g. impulses);
- proper zoning and control of mining practices with respect to the areas of large concentration of the living resources, if and when explosives are to be used.

He also indicated that installations on the sea-bed present a hazard to trawling. In some instances remedies were found to reduce such hazards. E.g., submarine cables and pipelines are to be buried; also in some places special sea lanes were selected, on which construction of installations is prohibited. Accordingly, he was of the opinion that in order to reduce these hazards and dangers the future regime of the sea-bed should include some legal devices, similar to those adopted in domestic legislations; and that a reasonable compromise should be found between different kinds of uses of the sea and the sea-bed. He admitted that in some respects the customary international law might prove to be satisfactory enough but he personally did not believe at the present moment that this would be sufficient.

This point of view was supported by an international lawyer who expressed the opinion that it should be realised and admitted that the use of the sea-bed means also the use of the high seas, e.g. — that installations on the sea-bed would interfere with navigation. Consequently, the use of the sea-bed is and must be subject to the rules relating to high seas. On the continental

shelf this interference is taken account of — regardless of the question of the regime of the continental shelf and its outer limits.

On the other hand, an oil expert was of the opinion that interference of the sea-bed installations with navigation and fishing seems to be exaggerated. Each such installation covers an area of only few hundred square yards and the number of drilling platforms, e.g. in the North Sea is not so great. He could not see much difference between such an installation and just another ship on the sea, and believed that it should be treated as a kind of a “fixed ship”. Accordingly, the same safety regulations which are in force to prevent the collision of vessels should also apply in this case.

Another participant believed that platforms on the sea may even be an asset for fishermen, from the point of view of chances of rescue.

The Problem of Pollution

Reference was made to art. 25 of the Geneva Convention on the High Seas and to the London Convention on the pollution of sea by oil as well as to the measures undertaken by the International Atomic Energy Agency to prevent the pollution of the seas by radioactive wastes. At the same time it was indicated that all existing rules may be extended and applied to the sea-bed by interpretation only. An opinion was expressed that the exploration and exploitation of the seabed would certainly create new dangers of pollution because of the new techniques used. An international lawyer was of the opinion that the Geneva Convention on the High Seas as well as other relevant legal instruments now in force should be examined in order to determine to what extent they are sufficient, and what additional protection against the hazards of pollution should be considered. Referring to the fact that within the United Nations system several bodies have the problem of pollution on their agenda, the speaker said that perhaps some concentration of efforts would be needed.

Another international lawyer recalled the resolution of the Conference on the Law of the Sea of 1958, regarding the disposal

of radioactive wastes. He also recalled that the International Atomic Energy Agency established a special panel of scientists which prepared a report on this matter. Then a group of lawyers was appointed to prepare on this basis a draft resolution on the prevention of pollution by radioactive wastes. The general feeling within this legal group was that the dumping of high-level radioactive wastes to the sea should be absolutely prohibited but the dumping of medium — and low — level wastes might be permitted under certain technical conditions. The area of possible dumping then discussed was that beyond 2,000 m depth line. This was in 1961 but the report of the legal working group was not approved by the Board of the I.A.E.A. and no further progress was made regarding that question. However, it should be made clear that the subject of those discussions was the pollution of the sea water and not of the sea-bed.

A marine biologist was of the opinion that the big discussions on the dumping of high-level radioactive waste into the sea largely died out since states found it more economical to dump such wastes on land. However, island countries or countries with a small territory may still be inclined to dispose of such kind of waste into the sea. It was suggested that in this case waste could be dumped by drilling holes in the sediment of the sea-bed in the areas which are tectonically stable. A geologist remarked in this connection that the danger must not necessarily be caused by external forces, such as tectonic movements. It may also be caused by internal pressure in the containers, which is often generated by the wastes themselves. Containers may explode because of this pressure and thus they cannot be considered as absolutely safe. Whatever is being done with these wastes and containers is always a calculated risk.

A navy expert, however, felt that the danger comes not so much from the natural forces as rather from the action of irresponsible salvagers. The question arises who would be responsible for such a secondary pollution. He felt that the question of salvage on the bottom of the seas (including the recovery of antiquities) should be generally taken account of in defining any future regime of the sea-bed.

An oceanographer noted that wartime ammunition disposed of on the bottom of the seas creates difficulties for scientific

research. Heretofore this has occurred mainly on the continental shelf but should also the deep sea areas be used for similar purposes, this would create an obstacle for their utilisation.

Referring to the "Torrey Canyon" case, an oil expert pointed out that it had no long-term effects. Two years after the disaster had occurred the crop of fish in the area in question was higher than usual. Oil companies and governmental agencies with which they cooperate have better knowledge of the matter and are in a better position to judge upon the extent and possible consequences of a disaster than local municipal councils and others who might be potential sufferers. He referred further to long discussions on a competent level on whether the "Torrey Canyon" case was handled in the best way, and what conclusions should be drawn for the future. The "Torrey Canyon" case alarmed public opinion and a great number of experiments have been made after that disaster. They have shown that rapid oil spills have to be treated very quickly.

A navy expert remarked in this connection that whatever might be true in the case of "Torrey Canyon", a general presumption of a community of interests between oil companies and nations would be rather a doubtful one.

A geologist drew the attention of the Working Group to the fact that the spillage of oil is not only a result of human activities. There are also cases of spillage caused by natural erosion. He believed that such a natural leakage is not of a less quantity than that caused by human activities.

This view was supported by an oil expert who indicated that in the deep sea the question of pollution by oil is not so acute as in the continental shelf areas.

A marine biologist believed that the question of pollution by oil is sometimes being exaggerated. This, however, does not mean that one should just go ahead with the present situation and not worry about doing anything to minimise the consequences of the pollution by oil. E.g., he pointed out to the nuisance which spillage of oil has caused to the uses of the sea for recreational purposes.

One participant raised the question of biological pollution upsetting the ecologic balance of one sea basin by intrusion of the species from another basin.

A marine biologist, however, was of the opinion that this is not specifically a problem of the sea-bed. Marine biologists — he added — are worried mainly by the pollution caused by human activities, which may have adverse effects on the living resources.

Another marine biologist recalled that F.A.O. is very much concerned about the use of deep sea trenches for the dumping of radioactive wastes and of great variety of other chemicals. F.A.O. is afraid of possible adverse effects of this dumping upon living resources, and is looking for some practical measure to be adopted before any formal agreement is reached. He felt that what would be essential for the protection of living resources of the sea is some kind of a registration system under which an international agency would keep a record of what is being dumped, in what quantities, where, and in what type of containers.

Such a registration system was supported by two other participants. One of them, however, felt that this would provide for very partial results only. The most important pollutants, as e.g. DDT, are being dumped in a way that cannot be registered.

An international lawyer believed that the Working Group should give a thought to possible new sources of nuisance created by new techniques of exploration and exploitation of the deep sea bed. He was of the opinion that future legal regulations in this respect should be focused first of all on the question of prevention of pollution, then — on the question of control and supervision, and finally — on the question of responsibility. He referred to the fact that international public opinion is alarmed by the dangers of pollution and other harmful interference with marine environment. Some statements in the Working Group seemed to be rather reassuring. He felt that, regardless of the differences of opinion as to degree of urgency and priorities, the problem, as such, undoubtedly exists. Caution is necessary since not enough is known about the effects of oil pollution and the effects of pollution by detergents. The developments should be followed closely, without overdramatising the situation, and more urgent and effective measures should be taken when the need arises.

WORKING GROUP III

Resources of the Sea-Bed and Conditions of Their Exploitation

A number of members of the Working Group felt that papers regarding the economic resources of the sea-bed should be taken as informational background material, without discussion on the substance of the matter. One of the speakers was of the opinion that the enormous amount of information contained in those papers hardly gives any indications as to a possible regime for the resources of the sea-bed. The same facts may lead to quite different conclusions. During the discussion, however, some remarks regarding the resources of the sea-bed were made.

It was indicated by one participant that in 10-15 years the estimated production of oil and natural gas from the sea-bed is likely to reach 0.5-1.0 billion tons per year, and that, according to estimates, undersea deposits of oil constitute 40 % of all remaining oil deposits on the Earth. These undersea deposits are located mostly under the continental shelf but quite significant proportion of these deposits is probably located also under the continental slope. However, oil is not likely to be found in the subsoil of the sea-bed beyond the slope. If production develops as estimated above, it may provide for an annual supply of oil and natural gas to the value of 15-25 billion dollars. Another big resource of the sea is fish. Total annual fish catch from the seas is now about 50 mil. tons of the value of about 5 bil. dollars. This figure may be increased up to some 10-20 bil. dollars annually. However, the value of the next item — local deposits of tin on the shelf — is lower by two orders of magnitude (about 200 mil. dollars yearly). The speaker estimated further that the exploitation of phosphorites which

appear in some areas on the edge of the continental shelf, and which may be recoverable may reach the value of about 50 mil. dollars per year; and the supply of manganese nodules from the deep sea bed, even if exploitation develops, is not likely to exceed the value of about 100 mil. dollars a year. Thus, according to the speaker, all the main sources of economic wealth are concentrated within the limits of the continental shelf and slope; and, consequently, the deep-sea area is actually not a big economic problem.

Another participant added that the value of hot muds in the Red Sea and some other areas, which has not been mentioned by the previous speaker, are estimated at 1-2 bil. dollars.

Referring to these estimates, an international lawyer conceded that there is probably little to be extracted from the deep-sea bed in the coming 25 years or more. He felt, therefore, that in the discussion on an international regime perhaps the main stress should be shifted from the question of exploitation of the sea-bed resources to the question of conservation and exploitation of the resources of the sea in general. Another participant, however, was of the opinion that the economic value of the sea-bed beyond the limits of national jurisdiction was underestimated by the first speaker. He referred to the recent reports that during experimental drillings oil has been found at several thousand meter depths. The speaker also noted that manganese nodules contain not only manganese but other important minerals as well. Apart from the fact that manganese nodules are not being exploited at present, it may well happen — according to the speaker — that states, in order to play safe, would appropriate the respective areas of the sea-bed. He did not think that the present discussion should also include the regime of living resources of the sea. Existing legislation and organisational arrangements in these fields are too complicated.

In the course of further discussion reference was made to the deposits on the bed of the Red Sea and similar deposits in the Gulf of California which may contain, e.g., chromites of potential commercial value. It was also remarked that the traces of oil at great depths, to which reference was made earlier, were found in the marginal sea and within the limits of the continental margin.

An oil expert remarked that oil drillings at the depths of 300-400 feet and more have given thus far no profit whatsoever on the invested capital. This should be taken account of when discussing the question of possible distribution of profits drawn from the exploitation of the sea-bed resources.

One of the participants drew attention to the fact that exploitation of the sea-bed — especially if carried out on a massive scale — would inevitably affect the status of the superjacent waters. One cannot exploit the sea-bed when traffic is going over. He believed that with an effective international regime of the sea-bed it will be possible to reconcile the different uses of the marine environment. But the problem should not be overlooked.

One of the participants submitted a series of principles for discussion in the Working Group. The passages relating to the question of development of the resources of the sea-bed read as follows:

“ The beneficial exploitation of the resources of the sea-bed and technological developments for this purpose should be encouraged.

Means are needed to ensure the conservation and wise use of all ocean resources, including the resources of the sea-bed. For this and other purposes, there should be international coordination of operations involving the sea-bed outside the agreed limits of national jurisdiction. Means are needed to minimise interference among uses of different marine resources or different uses of the same resource ”.

Another participant proposed to add that:

“ The uses of the sea-bed and its subsoil beyond the national jurisdiction shall in no way interfere with the freedom of navigation, freedom of fisheries, maintenance of submarine cables and pipelines ”.

These principles attracted wide support in the Working Group. It was stated, e.g. that the statement regarding wise exploitation is extremely important, especially having in mind some deplorable experiences in the past in the field of fisheries.

Number of participants proposed some drafting changes in the above quoted principles. E.g., it was proposed to add that the beneficial exploitation of the resources of the sea-bed should be not only encouraged but also "advanced". It was also proposed that the second sentence of the next paragraph should appear in another place. Regarding non-interference of the uses of the sea-bed with the existing freedoms of the high seas, it was stated that it is hardly possible from the technical point of view to eliminate such an interference totally and it would be more appropriate therefore to submit that the uses of the sea-bed "shall interfere in a minimum possible way" with these freedoms.

Some minor drafting changes in the passage in question were also proposed.

Account being taken of the observations made by the members of the Working Group, the proposed principles in the redrafted form appeared in the report of the Working Group.

Problem of Pollution

One of the participants noted that the problem of pollution now becomes one of tremendous importance. According to the speaker, only one or two countries promulgated progressive and effective regulations against pollution, and overwhelming majority of states leave the problem up to oil companies. In the North Sea, however, a blow in an oil rig may destroy the whole economy of the region, and this is not only the question of the continental shelf. The speaker felt that as the exploitation of oil is extending to ever deeper waters it becomes ever less possible to apply all safety measures. But pollution may cause tremendous losses.

Another participant submitted a set of principles for discussion in the Working Group. The passage relating to the problem of pollution reads as follows:

"Means are needed for the effective control of pollution of the oceans, including control of pollutants coming from land such as pesticides, radioactive wastes, poisonous chemicals and sewage; pollution by ships and submarines; and pollution resulting from drilling for and production of the oil".

He was of the opinion that discussions on the question of pollution are too much concentrated on the disposal of radioactive wastes. Dozens of other poisons are being produced by industrial civilisation. According to him, greater stress than heretofore should be put on the question of pollution by pesticides as DDT is one of the most widely spread pollutants to-day. Some species of fish are threatened with full extinction by DDT. And it is accumulating in the human body when people eat such poisoned fish. The speaker also noted that the amount of lead in the surface waters is now 10 times higher than it was 40 years ago.

Some participants felt that what is actually needed is not so much "control" as "prevention" of pollution. These speakers submitted that speaking of "control" implies acceptance of the very fact of pollution which is only subject to control.

Other participants, on the contrary, felt that speaking of "prevention" of pollution was not appropriate since it would be unrealistic to believe that pollution may be totally avoided. The question at stake is to minimise as much as possible the degree of pollution and harmful effects thereof.

It was also noted that what should be the aim is not just "means" but international measures coordinated on the global scale. Other means, e.g. on national scale, are being undertaken but do not seem to be sufficient.

An international lawyer referred to the existing provisions of international law regarding measures against pollution, particularly to art. 24 and 25 of the Geneva Convention on the High Seas. He felt that the first requirement is that states should strictly observe their obligations undertaken under this Convention.

Another international lawyer, however, felt that there is a need for an internationally coordinated action going beyond the provisions of the Geneva Convention of 1958 on measures against pollution. Still another participant expressed the opinion that pertinent articles of the Geneva Convention on the High Seas are so worded that they are of little help for any practical action against pollution — whether on national or international scale.

Some members of the Working Group indicated that measures against pollution should have in view not only pollution of sea-water but also pollution of sea-bed.

Views were further exchanged on whether it is worthwhile to specify different sources of pollution when speaking of measures to be taken against it. According to one view, they should be specified since different sources of pollution require different kinds of action. According to another view, any specification should be better omitted since it never can be exhaustive, and in any case it can not encompass all constantly emerging new sources of pollution. One participant pointed out that the discussion should avoid confusion between sources of pollution and types of pollutants.

Question of international responsibility of states for damages caused by pollution was also raised. One international lawyer, however, was of the opinion that this question should be treated as a part of a more general question of the responsibility of states for all national activities on the sea-bed. Another international lawyer felt that the discussion should not get involved at all into an extremely complex problem of state responsibility.

The following opinion appeared in the report of the Working Group:

“more effective means are needed than presently exist for the prevention and control of any kind of pollution of the ocean. This will require internationally coordinated action concerning pollutants coming from the land, or the air, for example pesticides, radioactive substances, poisonous chemicals and sewage; pollution from ships, submarines or other equipment used at sea, and pollution resulting from exploitation of marine resources, for example exploration, production, storage, and transportation of oil and gas”.

PART III

THE PRESENT REGIME AND POSSIBLE
FUTURE REGIME OF THE SEA-BED

THE PRESENT REGIME OF THE EXPLORATION
AND EXPLOITATION OF SEA-BED RESOURCES
IN INTERNATIONAL LAW AND IN NATIONAL
LEGISLATION: AN EVALUATION

BY

EDWARD D. BROWN, LL.M.

Senior Lecturer in International Law, University College London

Introduction

The scope of the subject on which the writer was invited to prepare this paper is limited geographically to the area beyond the outer limit of the legal Continental Shelf and jurisprudentially to a consideration of the present law.

The geographical limitation is implicit in the purpose of the Rome Symposium — the study of various aspects of the activities which are taking place, or may take place in the future, on the ocean floor and in the subsoil thereof, beyond the limits of present national jurisdiction. In the context of the exploration and exploitation of sea-bed resources, it is clear that the term “beyond the limits of present national jurisdiction” refers to the submarine zone beyond the outer limit of the Continental Shelf. It follows that this paper should be devoted to the legal regime applicable in that zone under international law and municipal law. So far as the writer is aware, however, the only municipal law dealing with sea-bed resources refers to the Continental Shelf (in the legal sense) or to submarine areas landward of the Continental Shelf. Similarly, international law has developed fairly detailed rules for the Continental Shelf but still relies on the undeveloped and uncertain rules of international customary law so far as the resources of the deep ocean are concerned. It is, however, to the analysis of this body of rather primitive rules that attention must be primarily directed.

In considering the legal regime of "inner space", one is tempted by the poverty of international customary law and the apparent opportunities for international legislation to proceed rather too hastily from a cursory examination of the present regime to the elaboration of proposals *de lege ferenda*. The invitation to limit the discussion to *les lata* has thus provided a useful discipline and stimulated a more thorough consideration of the scope and limitations of the existing law.

At the present time, this subject may be approached from two different angles depending on the basic assumption on which the inquiry is based. Each has something to contribute. In one perspective, the assumption would be that an elaborate new conventional regime is both necessary and feasible and the object would be to identify those problems which the exploitation of ocean-bed resources would raise and for which international customary law is apparently incapable of providing a solution. Such a study would provide a basis on which to construct a treaty regime.

In a second perspective, the assumption would be that, failing a successful outcome of the current attempts to devise a comprehensive regime for inner space, exploitation would have to proceed on the basis of international customary law. Even if a new conventional regime eventually materialises, it seems likely that its preparation and negotiation will take many years and that, even then, there will be a number of States unable to subscribe to the new rules. Viewed from this angle, the inquiry would then have a different emphasis — less to identify the deficiencies of international customary law than to consider its flexibility and its capacity to expand and provide a legal framework for the new uses which advancing technology is creating.

*Status and legal regime of sea-bed and subsoil beyond
the continental shelf*

In drafting the Geneva Convention on the Continental Shelf (1958), an attempt was made to define the status of the sea-bed and subsoil of the Shelf and to provide for the many

problems which its exploration and exploitation would raise. The problems which will arise in the area beyond the Continental Shelf are, of course, basically the same and for this reason the Convention provides a convenient framework for the analysis of the rules of international customary law relating to this area. In determining what these rules are, it may also be useful to refer to the rules of international customary law on the Continental Shelf where these differ, or may be thought to differ, from those laid down in the Geneva Convention.

The main operative provisions of the Geneva Convention on the Continental Shelf deal with the following matters:

1. Geographical Scope of Continental Shelf (Articles 1 and 6).
2. Legal Status of Continental Shelf. Nature of State Rights in Continental Shelf (Article 2).
3. Presentation of Principle of Freedom of High Seas. Reconciliation of Exclusive Rights of Exploration and Exploitation of Natural Resources with Other Users of the High Seas (Articles 3-5).

The following consideration of the status and legal regime of the area beyond the Continental Shelf falls under the same three heads.

1. *Geographical Scope*

Perhaps the most fundamental question in any discussion of the regime of the ocean floor is the determination of the outer limit of the Continental Shelf. Indeed, those who favour an extreme literal interpretation of Article 1 of the Geneva Convention on the Continental Shelf would contend that there is little need for any such discussion; the regime of the Continental Shelf will gradually extend outwards to regulate the deeper areas in the wake of advancing technology, leaving eventually no distinct deep-sea area for separate consideration. At the other extreme are those who favour the 200-metre isobath as the outer limit of the Continental Shelf, either *de lege lata* or *de lege ferenda*.

The writer has contributed to this doctrinal debate in earlier papers ¹ and it would be superfluous in this context to do more than restate in summary form a few of the conclusions arrived at. Briefly, the writer's view is that the Continental Shelf extends to the submarine area beyond territorial waters which is:

(1) adjacent ² to the coastal State;

(2) *either* not more than 200 metres in depth *or*, if greater than 200 metres, of such depth that the natural resources of the seabed and subsoil are exploitable; and

(3) not more than a reasonable, but yet to be defined, distance from the coast. In the writer's view, Article 1 cannot be properly interpreted so as to restrict the extension of the Shelf by reference to the geological character of the sea-bed and, thus, the conventional Shelf may extend beyond the "natural prolongation" ³ of the land territory; on the other hand, a limit on the seaward extension of the Shelf was intended. The writer has suggested criteria in accordance with which the limit might be determined ⁴ but recognised that a precise quantification is a matter for future agreement.

The quality of adjacency referred to above was understood to mean that the *area* (not merely any random point within the area) must satisfy the depth criterion or the exploitability criterion continuously and without a break from the outer limit of the territorial sea to the extremity of the area claimed. It was recognised, however, that on equitable grounds exceptions might be permitted for relatively narrow deeps or troughs in the Shelf. ⁵ 'Exploitability' was understood to mean economically feasible exploitability. ⁶

1. E.D. BROWN, *Report on the Legal Regime of Deep-Sea Mining*, 1968 (I.L.A., British Branch, Committee on Deep-Sea Mining and "The Outer Limit of the Continental Shelf", *The Juridical Review*) Part 2 - August, 1968).

2. In the sense defined below.

3. For the use of this term by the International Court of Justice in the North Sea Continental Shelf Cases (1969), see below, pp. 12-13.

4. In Report cited in note 1 above, at pp. 26-27.

5. *Ibid.*, pp. 6-7.

6. *Ibid.*, pp. 7-8.

State Practice

Unless States are able to reach agreement on the outer limit in the relatively near future, it will be left to State practice to determine where the regime of the Continental Shelf ends and that of the deep seas begins. Claims will be made either by parties or by non-parties to the Geneva Convention and their effects in relation to other States will differ according as those other States are or are not parties to the Convention.

Claims made by parties to the Convention in relation to other parties. As the capacity to exploit at ever-increasing depths is acquired, it seems likely that claims will extend further sea-wards and that they will purport to find their legal basis in the Geneva Convention. If such claims are numerous, are made by a cross-section of the more influential maritime powers and remain uncontested, it is clear that they may well abuse the elasticity of Article 1 of the Convention and, in the process, make it all the more difficult to reach ultimate agreement on a more moderate distance criterion. It would nevertheless be hard to deny the effect of such practice on the interpretation of the Convention. It is true, of course, that a certain degree of international order would thus be preserved in the area of such claims, since their exploitation would be subject to the various limiting rules of the Convention, whereas claims justified under international customary law might be free of some of these restraints. The main point, however, is that, as between the parties to the Convention, such practice would tend to support an extensive interpretation of Article 1 of the Convention.

It is true that some of the major maritime States, especially the United Kingdom and the United States, would regard an unlimited extension of the Continental Shelf as an unacceptable threat to the freedom of the high seas, the preservation of which remains an important policy objective.⁷ It is conceivable, therefore, that and other States parties to the Geneva Convention

7. Hence the reluctance of both to follow the general trend to claim a territorial sea of a breadth greater than 3 miles and their opposition to the extensive claims made by some Latin American States.

will limit the claims which they make on the basis of the Continental Shelf doctrine and base claims to more seaward areas on the less specialised rules of international customary law. Such practice might be expected to provide evidence of the establishment of the outer limit of the Continental Shelf at a moderate distance from the coast and at the same time confirm the rules of international customary law on the acquisition of title to submarine territory. At the present time, the adoption of such policies appears improbable if only because they would put these States at a disadvantage in relation to others acting on a more extensive interpretation of the Convention. Non-parties would also probably be entitled to a more extensive Shelf on the basis of international customary law.⁸ Moreover, State claims based on the uncertain rules of international customary law are hardly likely to inspire investors with the same confidence as the more reliable regime of the Continental Shelf.

Claims made by parties to the Convention in relation to non-parties. Such claims would be governed by international customary law and are therefore subject to the same considerations as those made by non-parties to the Convention. They would, however, if advanced on the basis of the Geneva Convention formula, constitute evidence of the claimant State's interpretation of Article 1 of the Convention.

Claims made by non-parties to the Convention. Whether in relation to parties to the Convention or to other non-parties, such claims clearly have to be considered on the basis of international customary law. The International Court recently described it as a fundamental rule of international customary law on the Continental Shelf that the coastal State enjoys *ipso facto* exclusive rights in respect of the area of the Continental Shelf that constitutes a natural prolongation of its land territory under the sea.⁹ In accordance with this dictum, it would seem that the outer limit of the continental terrace (or, possibly, the continental rise)¹⁰ would mark the extreme

8. See below, pp. 12-13.

9. *Loc. cit.* in note 36 below.

10. The continental terrace includes both the geological continental shelf and the continental slope. The continental rise is the apron of sediments which

outer limit within which exclusive claims to the sea-bed and subsoil would be recognised under the Continental Shelf doctrine. It would follow that any claim to an area beyond the terrace would have to be founded on the rules of international customary law relating to the bed and subsoil of the deep oceans.

Current Practice. So far, the significance which State practice is likely to have in relation to the scope of the Continental Shelf has been discussed in the abstract and in terms of the possible direction of future policies. But, of course, claims are already being made. Australia is reported to have granted exploration permits for areas 200 miles from the coast and Honduras and Nicaragua at distances of 225 miles from the coast.¹¹ And, as will be seen below, United States practice is even more extensive.

Most of the relevant municipal legislation purports to be based on the doctrine of the Continental Shelf and embodies more or less reasonable interpretations of the geographical scope of the Continental Shelf. Before turning to examine more closely some of the questions which this practice has raised, brief mention must be made of a second category of claims which are much more difficult to justify on the basis of the Continental Shelf doctrine. The question whether these claims can be justified in terms of the less specialised rules on the acquisition of title to areas of the sea-bed will be considered subsequently.¹²

Claims to 200-mile maritime zones. These claims are related to the concept of the Continental Shelf only in the sense that they appear to have been prompted by, and initially to have sought their justification in, the precedents created by the Truman Proclamation and the similar claims which followed it. They are, however, defined in terms of a specified distance from the coast and refer neither to depth of waters, exploitability of submarine resources nor the geological nature of

slopes very gently from the base of the continental slope to the abyssal ocean floor.

11. W.T. BURKE, "Contemporary Legal Problems in Ocean Development", in SIPRI, *Towards a Better Use of the Oceans, A Study and Prognosis*, 1968, at p. 26.

12. See below, pp. 17-18.

the sea-bed. And - their most radical feature — they extend also to the superjacent waters.

At least seven States have now claimed sovereignty over maritime zones of a breadth of 200 miles.¹³ El Salvador's claim is incorporated in Article 7 of its Political Constitution of 1950:

The territory of the Republic within its present boundaries is irreducible. It includes the adjacent seas to a distance of two hundred sea miles from low water line and the corresponding air space, subsoil and continental shelf¹⁴.

In this case the exclusive rights to the natural resources of the sea-bed and subsoil of the 200-mile zone clearly follow from the language of the Constitution.

Equally clear is the recent Decree of the Republic of Dahomey which, in its rather unusual formulation, has added further variety to State practice. Under Article 3 of a Decree dated March 7, 1968, the Republic reserved to itself all rights to the exploitation of the subsoil under the sea out to "the first obstacle to navigation."¹⁵

The position is less clear in relation to the 200-mile claims made by Argentina,¹⁶ Chile,¹⁷ Costa Rica,¹⁸ Ecuador,¹⁹ Pa-

13. For the text of the Agreement (Declaration of Santiago, 1952), in terms of which Chile, Ecuador and Peru proclaimed their sole jurisdiction and sovereignty over the area adjacent to and extending 200 nautical miles from their coasts, including the sea floor and subsoil of the said area, see U.N. Doc. A/AC.135/10/Rev. 1, p. 11. Costa Rica subsequently acceded to the Agreement. See also the supplementary Agreement of 4 Dec. 1954 (*ibid.*, p. 12), ratified by Peru and Ecuador (*ibid.*, p. 12, note 2) under Para. 4 of which the parties undertake "not to enter into any agreements, arrangements or conventions which imply a diminution of the sovereignty over the said zone".

Note too the extensive claims to national and territorial waters asserted by Indonesia and the Phillipines, both of which apply the straight-baseline method of delimitation to their archipelago territories.

14. U.N. Legislative Series, *Laws and Regulations on the Regime of the High Seas*, Vol. 1, 1951, p. 300. The United States protested against this Article but not specifically in relation to the submarine area.

15. United Nations Secretariat, *Survey of National Legislation concerning the Sea-bed and the Ocean Floor, and the Subsoil thereof, underlying the High Seas beyond the Limits of Present National Jurisdiction* (A/AC. 135/11) Add. 1, 13 Aug., 1968), p. 11.

16. Law No. 17094 - M. 24 of 29 Dec. 1966, Article 1 (VI I.L.M., 1967), p. 663, or A/AC. 135/11, pp. 7 and 10). See also Decree No. 5106 of 4 Jan. 1967 (*ibid.*, p. 8) and Law No. 17,500 of 25 Oct. 1967 (VII I.L.M., 1968), p. 324.

17. See note 13 above.

18. See *ibid.*

19. See *ibid.*

nama²⁰ and Peru²¹. The main interest which has prompted these claims is undoubtedly in the fishery resources of the offshore regions but the laws are framed widely and would almost certainly cover all natural resources of the sea-bed and subsoil as well.

It would not seem possible to justify such claims in terms of the Continental Shelf doctrine either as it has developed in international customary law or as defined in Article 1 of the Geneva Convention. The Geneva formula is the more extensive of the two. On one interpretation, the Shelf may extend beyond even the continental terrace but such an extension, or any extension beyond the 200-metre depth, depends for its validity on proof of exploitability. Any of the 200-mile or 100-mile claims which satisfy neither of these conditions would not therefore fall within the terms of the Convention. Similarly, if reference is made to what the International Court of Justice has referred to as the most fundamental rule relating to the Continental Shelf — that the coastal State enjoys an *ipso facto* exclusive right in the shelf (sea-bed and subsoil) which constitutes a natural prolongation of its national territory — the very most that could be claimed would be the continental terrace. Once again, any 200-mile claim lying beyond the terrace would thus be invalid.

The legal basis of titles to the bed of the deep seas beyond the Continental Shelf and the possibility of justifying these 200-mile claims under the rules on acquisition of title to submarine territory are discussed further below.²²

Claims based on the doctrine of the Continental Shelf. The great majority of States do not of course specify in their legislation where the outer limit of the Continental Shelf lies. Instead, they adopt a formula based on Article 1 of the Geneva Convention, thus leaving themselves a good deal of room for manoeuvre. In such cases, administrative practice in granting exploration permits or exploitation leases will normally provide some guidance on the extent of the State's claim. Since, however, it is only in the technologically advan-

20. A (AC. 135) 11, p. 7.

21. See note 13 above.

22. See below, Section II.

ced countries that such permits and leases are likely to be sought at the outer margins of the Continental Shelf,²³ the evidence is for the time being rather thin.

The most extensive practice is that of the United States and it is proposed to illustrate the questions which the gradual seawards extension of the Continental Shelf will raise by examining some aspects of this practice. United States practice has taken a number of different forms, all of which seem to be officially regarded as affirmative assertions of United States jurisdiction. Jurisdiction has been asserted by way of (1) exploitation leases; (2) exploration permits; (3) the publication of leasing maps showing areas open to leasing; and (4) the exercise of jurisdiction by the Secretaries of the Interior and the Army, the latter under powers granted by the Outer Continental Shelf Lands Act to prevent obstructions to navigation arising from artificial islands and fixed structures located on the Outer Continental Shelf. Some of the landmarks in this practice are listed in the following table²⁴ and discussed further in the text.

United States Continental Shelf Practice

	Location	Distance from Coast	Depth	Purpose
1. <i>Exploitation Leases</i>	Forty Mile Bank, off California	40 miles and separated from coast by 4000-5000 feet troughs	240-400 feet	Phosphates
	Off Oregon coast	30 miles	1500 feet	Oil and Gas

23. According to Burke (*loc. cit.* in note 11 above, at p. 25), by early 1968 15 States had issued permits for activity beyond the 200-metre isobath.

24. The writer is indebted to the following writers for some of the information from which the table was prepared: F.J. Barry, "The Administration of the Outer Continental Shelf Lands Act", 1 *Natural Resources Lawyer* (N.R.L.) (No. 3, July 1968), pp. 38-48; Burke, *loc. cit.* in note 11 above, especially at p. 26; R.B.

	Location	Distance from Coast	Depth	Purpose
2. <i>Exploration Permits</i>	Atlantic Coast		4000-5000 feet	Drilling
	Gulf of Mexico	100 miles	3000 feet	Drilling
	East Coast Continental Slope (Florida to Cape Cod)	300 miles	650-5000 feet	Oil and Gas
3. <i>Department of Interior Leasing Maps</i>	Southern California coast	100 miles	up to 6000 feet	
4. <i>Federal Action under Outer Continental Shelf Lands Act</i>	Cortes Bank off Californian coast	50 miles from San Clemente Island; 100 miles from mainland; separated from coast by 4000 5000 feet troughs	Shallow	Creation of Artificial Island

The assumption lying behind the different forms which these assertions of jurisdiction have taken throws a good deal of light on official American thinking on the outer limit of the Continental Shelf. It may still turn out, however, that the

Krueger, "The convention on the Continental Shelf and the Need for its Revision and Some Comments regarding the Regime for the Lands Beyond" 1 *N.R.L.* (No. 3, 1968), pp. 1-18 and Question in 1 *N.R.L.* (No. 2, June, 1968), at p. 33; C.F. Luce, "The Development of Ocean Minerals and the Law of the Sea", 1 *N.R.L.* (No. 3, 1968), pp. 29-35.

trend towards an extensive interpretation of the Geneva Convention will be reversed if the recent recommendations of the United States Commission on Marine Science, Engineering and Resources prove to be influential.²⁵

Much of the official thinking has been based on an Opinion rendered in 1961 by the Associate Solicitor of the Department of the Interior and submitted to the Departments of State and Justice.²⁶ No objections to the Opinion were registered by these Departments. The Opinion advised that leasing was permissible in an area 40 miles from the Californian coast where the depth of the water ranged from 240-4000 feet and which was separated from the mainland by a trench descending to 4000-5000 feet. The Opinion was based on the contention that United States ratification of the Geneva Convention constituted an assertion of rights to the sea-bed and subsoil as far seaward as exploitation is possible.

There are several features of this Opinion to be noted. First, the area to which it related — the Forty Mile Bank area, off California — appears to be part of the continental terrace of the United States,²⁷ despite the existence of deep trenches landward of the area. In fact, all of the United States Continental Shelf practice has related to areas identified geologically with the mainland.

Secondly, the Opinion has recognised that the United States Continental Shelf rights extend beyond the deep trench separating the Forty Mile Bank from the mainland. Provided the trough is not unreasonably wide or the seaward area can still be regarded as part of the natural prolongation of the mainland territory, such an extension is not objectionable. The possibility of the equitable extension of the Shelf in this way was envisaged in the Commentary of the International Law Commission on its draft articles on the Continental Shelf.²⁸ Both the

25. *Our Nation and the Sea*. The Report of the Commission on Marine Science, Engineering and Resources, January 1969. See especially Chap. 4, Part Three, VII.

26. Memorandum Opinion (M-36615/94127-61) from the Associate Solicitor to the Director of the Bureau of Land Management, 5 May, 1961. See also Barry, *loc. cit.* in note 24 above, at p. 46.

27. *Ibid.*, at p. 47.

28. *Yearbook of the I.L.C.* 1956, Vol. II, p. 297, para. (8). See further Brown, *Report* cited in note 1 above, p. 6 *et seq.*

Soviet Union²⁹ and Venezuela³⁰ have made specific reference to such extensions in their Continental Shelf legislation and, of course, the extension of the Norwegian Continental Shelf beyond the Norwegian Trough has been recognised in bilateral treaty practice.³¹

Thirdly, it may be noted that the underlying criterion in accordance with which the Opinion was given was that of exploitability.

Both in terms of the International Court's natural-prolongation-of-territory rule³² and Article 1 of the Geneva Convention, the Opinion seems to be well founded.

The well-known assertion of jurisdiction in 1967 over the Cortes Bank would appear to be justified for the same reasons. Though the Bank is situated 50 miles from San Clemente Island and 100 miles from the mainland, and is separated from them by trenches of from 4000-5000 feet, it is said to be an extension of the land mass of Southern California³³ and is clearly exploitable (it is only 22 1/2 feet deep at its shallowest point). The area was covered by leasing maps issued by the Department of the Interior and was marked by the emplacement of a Coast Guard buoy. Such acts are useful indications of the scope of jurisdiction asserted by the United States but would not of course, of themselves, establish an area as constituting part of the Continental Shelf if the area was neither exploitable nor within the 200-metre isobath.

The fourth way in which assertions of jurisdiction have been made is by the grant of exploration permits. This is similar to the publication of leasing maps in the sense that neither of these acts is necessarily related to the present exploitability of the area concerned. It is akin, in its international legal effect, to the issue of an exploitation lease for an area lying at such depths as to be presently unexploitable.

29. Edict Concerning the Continental Shelf, 6 Feb. 1968 (VII I.L.M., 1968, p. 392). Para. 3 of section 1 specifically incorporated shelf depressions of any depth in the Soviet Continental Shelf.

30. Act of 27 July 1956 Concerning the Territorial Sea, Continental Shelf, Fishery Protection and Air Space, Article 4 (A/AC. 135/11/Add. 1, p. 23).

31. Anglo-Norwegian Agreement relating to the Delimitation of the Continental Shelf between the two Countries, 10 March 1965 (Cmnd. 2757), Article 1.

32. See below, p. 12.

33. BARRY, *loc. cit.*, in note 24 above, at. p. 47.

Leasing maps have been published relating to areas as far as 100 miles from the coast and at depths of up to 6000 feet. And exploration permits have been granted in respect of areas out to 300 miles from the coast at depths of from 650-5000 feet, that is, on the American continental slope. It is essential, in considering the implications of these grants, to appreciate that capacity to *explore*, for example by core-drilling, at such depths does not necessarily mean that capacity to *exploit* at these depths is also enjoyed. Core material has recently been recovered from 2,500 feet beneath the floor of the Gulf of Mexico from a ship over a water depth of 9,259 feet but this would certainly not justify the conclusion that this area is exploitable.³⁴

If, then, exploration permits have been granted in unexploitable depths in the United States continental slope, is the United States justified in international law in claiming exclusive rights in the area? In justifying United States jurisdiction in the region of the Forty-Mile Bank, emphasis was placed on the rights which the United States derived from the Geneva Convention and, as argued above, this seems a reasonable proposition. It is doubtful, however, the United States can justify exclusive rights to areas of the slope at currently unexploitable depths by reference to the Convention. Article 1 of the Convention, in referring to areas beyond the 200-metre isobath, speaks in terms of the sea-bed and subsoil "where the depth of the superjacent waters admits of the *exploitation* (emphasis added) of the natural resources...". The exclusive rights of *exploration* recognised under Article 2 are enjoyed only in relation to the area defined in Article 1. On the assumption, therefore, that it is not yet possible to exploit the east coast slope in, say, 4000 feet of water, the United States assumed right to regard this area as part of its Continental Shelf is very questionable.

The argument recently put forward by a Department of the Interior Solicitor³⁵ in support of the right to grant exploration permits in such areas is, for the same reason, of very doubtful validity. The argument is that neither the Truman

34. VI *International Marine Science* (Nos. 3/4-1968), p. 49. In any case, some exploration may be carried out by seismic methods without contact with the sea-bed.

Proclamation nor the Outer Continental Shelf Lands Act, which vests jurisdiction over exploration of the Shelf in the United States, limits the United States Continental Shelf to areas which can be exploited. Whatever may be the correct position in relation to the Department's rights to issue permits under United States law, it is clear that, by subsequently ratifying the Geneva Convention, the United States accepted in relation to other States whatever limitation on the area of its Continental Shelf are implied by Article 1 of the Convention.

In the light of the recent judgment of the International Court of Justice in the North Sea Continental Shelf cases, however, an alternative argument must be considered. In view of the fact that Germany was not a party to the Geneva Convention, the Court had to consider the rules relating to the Continental Shelf under international customary law. In doing so, the majority judgment referred to

the most fundamental of all the rules of law relating to the continental shelf, enshrined in Article 2 of the 1958 Geneva Convention, though quite independent of it — namely, that the rights of the coastal State in respect of the area of the continental shelf that constitutes a natural prolongation of its land territory into and under the sea exist *ipso facto* and *ab initio*, by virtue of its sovereignty over the land, and as an extension of it in an exercise of sovereign rights for the purpose of exploring the sea-bed and exploiting its natural resources³⁵.

It must be said that the reference to “natural prolongation of... land territory” makes this passage a rather free rendering of Article 2 of the Geneva Convention but the main point is the Court's emphasis here and later in the judgment³⁷ on this concept of natural prolongation of land territory as being the factor conferring *ipso facto* title to the Continental Shelf on the coastal State.³⁸

35. BARRY, *loc. cit.* in note 24 above, at p. 43.

36. North Sea Continental Shelf, *Judgment*, *I.C.J. Reports* 1969, p. 3, at p. 22.

37. *E.g.*, in Para 43.

38. In another passage (Para. 41), it is true, the Court stated that “it is evident that by no stretch of the imagination can a point on the Continental Shelf situated say a hundred miles, or even much less, from a given coast, be regarded

It is of course true that Court was considering in this case the rules and principles in accordance with which a delimitation of an acknowledged shelf should be carried out but this does not detract from its characterisation of the principle of natural prolongation as being the most fundamental of all the rules relating to the Continental Shelf.

Assuming that the whole of the continental terrace falls within the notion of the natural prolongation of the land territory, it might be argued that the United States would be entitled to enjoy exclusive rights of exploration and exploitation of the natural resources of the bed and subsoil of the entire continental terrace irrespective of considerations of exploitability and distance from the coast. It would follow that exploration permits granted for areas within the continental terrace would have to be respected by other States. There is, however, a flaw in this argument. As a party to the Geneva Convention, the United States must be regarded as having accepted the conventional definition of the Continental Shelf and this definition must prevail, at least vis-à-vis other parties to the Convention, even if it turns out to entitle the United States to a smaller area of Continental Shelf than it would have enjoyed under international customary law. Accordingly, until such time as the United States has the technological capacity to exploit the whole area of the terrace, it would seem that its exclusive rights will be limited to the area beyond the 200-metre isobath, the natural resources of which are technologically exploitable.

Conclusion. The above review reveals the variety and confusion which characterise current State practice on the outer limit of the Continental Shelf. It is clearly desirable that the limit should be conventionally determined. Failing such

as adjacent to it, or to any coast at all, in the normal sense of adjacency This would be even truer of localities (like the United States coast) where, physically, the Continental Shelf begins to merge with the ocean depths''. This passage must, however, be read in its proper context. It occurs in a section of the judgment in which the Court is minimising the significance of the concept of adjacency or proximity as compared to the fundamental notion of prolongation of territory and in which it is stressed that the notion of adjacency only implies proximity in a general sense. Thus, the fact that there are points in the North Sea 170 miles from the nearest coast which are not adjacent to any coast does not lead the Court to the conclusion that they are not subject to a coastal State's sovereign rights on the Continental Shelf but rather to the conclusion that they *are* because they lie on the natural prolongation of that State's territory under the sea.

a solution, it seems likely that State practice will push the line out to the limit of the continental terrace. In the case of parties to the Geneva Convention, such an extension will be possible only when technology permits economic exploitation at such depths and, pending that time, it is probable that States will be confronted with problems similar to those discussed above in relation to United States practice.

2. *Legal Status*

On the assumption that there is some seaward limit on the elasticity of the concept of the Continental Shelf, claims made beyond the outer limit raise the question of the legal status of the sea-bed and subsoil of the deep seas.

Article 2 of the Geneva Convention on the Continental Shelf clearly provides that the coastal State enjoys *ipso jure* sovereign rights for the purpose of exploring and exploiting the Continental Shelf. And the International Court, as has been seen, has described this exclusive right as the most fundamental rule on the Continental Shelf.

Unfortunately, certainty of legal status terminates at the outer limit of the Continental Shelf. What, then, would the legal position be if, say, a company registered in the United Kingdom were to begin exploitation in an area of the ocean bed acknowledged to lie beyond the outer limit of the Continental Shelf and found that its investment was threatened by a foreign company which started operations in the same area?

The Company's rights vis-à-vis the United Kingdom, the question of whether an exploitation permit is required and the conditions to which its issue may be subjected are questions of municipal law. So far as international law is concerned, any right to exploit the sea-bed and subsoil and to protect nationals engaging in such exploitation is that of the State.

Confronted with such a situation, two courses of action would be open to the United Kingdom Government. First, it might consider the right to extract minerals from the sea-bed and subsoil of the oceans as being a right underlying the freedom of the high seas and akin to the right to dredge for fish. If so, the right might be regarded as non-exclusive in nature and the Government would not be able to afford protection

against the operations of the foreign company unless they were of a piratical character.

This viewpoint could be adopted by any State, irrespective of whether it regarded the sea-bed and subsoil of the oceans as being *res communis* or *res nullius*. For any State adhering to the latter theory, an alternative policy exists. It may attempt to acquire exclusive title to part of the sea-bed and subsoil and sell leases to the area. For any State wishing to adopt this policy, the main question to settle is whether it is possible to acquire exclusive titles to the sea-bed and subsoil beyond the Continental Shelf. This is a question with a long history but it remains a disputed area of international customary law where doctrine tends by far to outweigh more reliable forms of evidence.

The Bed of the Sea. As regards the bed of the sea, exclusive State rights in sedentary fisheries (oyster, pearl and sponge) have been generally recognised. In all cases, it would seem that there has been an element of long usage and, for this reason, doctrine has tended to hold that 'prescription' is the legal basis of such exclusive rights. There has also been present in all these cases, however, the element of effective usage (in the sense that they have been regulated by domestic legislation, that foreigners have been excluded and that in some cases the banks or beds have been watched and protected); and, on this basis other writers have favoured 'occupation' as the relevant mode. More recently, a number of writers, following Professor de Visscher's lead, have adopted a refreshing approach to this rather sterile dispute over what Professor Jennings has described as "an awkward corner of international law that has tended hitherto perhaps to remain too near to its private law origins".³⁹ Speaking of historical consolidation of title, Professor de Visscher writes:

Proven long use, which is its foundation, merely represents a complex of interests and relations which in themselves have the effect of attaching a territory or an expanse of sea to a given State. It is these interests and relations, varying from one case to another, and not the passage of a fixed term, unknown in any event to international law, that are taken

39. R.Y. JENNINGS, *The Acquisition of Territory in International Law*, 1963, p. 26.

into direct account by the judge to decide *in concreto* on the existence or non-existence of a consolidation by historic titles.

In this respect such consolidation differs from acquisitive prescription properly so called, as also in the fact that it can apply to territories that could not be proved to have belonged formerly to another State. It differs from occupation in that it can be admitted in relation to certain parts of the sea as well as on land. Finally, it is distinguished from international recognition — and this is the point of most practical importance — by the fact that it can be held to be accomplished not only by acquiescence properly so called, acquiescence in which the time factor can have no part, but more easily by a sufficiently prolonged absence of opposition either, in the case of land, on the part of States interested in disputing possession or, in maritime waters, on the part of the generality of States”.

In similar vein, Professor Schwarzenberger has pointed out that

The more absolute a title becomes, the more apparent becomes the multiplicity of its roots. In its movement from relativity to absolute validity, it undergoes a process of historical consolidation ⁴¹.

Thus, the search for the correct basis of submarine titles in either ‘occupation’ or ‘prescription’ seems rather futile. It is probably more helpful to recognise that, in the acquisition of titles to submarine areas today, the effective control which provides a basis for both these traditional modes will be supplemented by numerous consolidating acts of acquiescence and express or implied recognition, together constituting the “complex of interests and relations” to which Professor de Visscher has referred. Just as the Arctic and inaccessible regions of Greenland demanded relatively little evidence of effective State control to establish title, ⁴² so the nature of the marine environment would govern the degree of control required to establish title to the sea-bed.

Granted that exclusive titles might be established in this way, it must still be recognised that this international customary law regime contains considerable potential for conflict. Thus

40. CH. DE VISSCHER, *Theories et Réalités en Droit International Public*, 1953, pp. 244-245; 2nd ed. 1960, pp. 255-256; English translation by Corbett, 1957, pp. 200-203; also cited by Jennings, *loc. cit.* in note 39.

41. G. SCHWARZENBERGER, *A Manual of International Law*, 1967, p. 125.

42. See Judgment of P.C.I.J. in *Eastern Greenland* case (1933-A/B 53).

in relation to any geologically promising area, competition for exclusive titles must be expected and, accordingly, recognition of, or acquiescence in, any one State's exclusive claim will be difficult to establish. On the other hand, the economics of submarine exploitation may well serve to minimise the number of companies prepared to engage in this work and, by thus reducing the possibility of conflict, facilitate the establishment of exclusive titles.

Although, therefore, the present regime is ill-designed to offer security of investment or to grant recognition to any international community interest in the resources of the sea-bed, it may still provide a rough and ready foundation from which, in the light of gradually increasing practice, more refined rules of customary law might well develop in the absence of agreement on a more comprehensive regime.

The Subsoil. State practice in relation to the subsoil of submarine areas outside the territorial sea, apart from activities following the growth of the Continental Shelf doctrine, has been in connection with mining carried on by way of shafts extending from land or territorial waters. It has been generally recognised that such effective 'occupation', which does not interfere in any way with the superjacent high seas, creates a title to the area occupied, irrespective of the distance of the extension seawards (assuming that it does not extend to the Continental Shelf of another State). State practice on exploration and exploitation of the subsoil from above is both much more recent and, being so insignificant in quantity, much less helpful in indicating the direction of a developing rule of law. However, the lack of any protest in relation to the small amount of activity there has been, the general agreement on the possibility of acquiring title to the subsoil by horizontal tunnelling and the consensus that interference with other users of the high seas caused by exploitation of the sea-bed may in certain circumstances be legitimate, suggest that title to specific areas of the subsoil may also be acquired by effective occupation from above, gradually consolidated by acquiescence and recognition.

The Effect of Latin American claims. That the extensive claims to exclusive maritime areas made by some Latin American

43. See above, pp. 6-7.

and other States are not justified on the basis of the Continental Shelf doctrine has already been shown.⁴³ Their status as claims to the bed and subsoil of the deep seas beyond the Shelf can now be considered.

The fact these claims cover a very large area of the sea-bed is not in itself a barrier to the acquisition of title. It does, however, place a considerable onus on the claimant States to prove the existence of that minimum exercise of effective State jurisdiction which is necessary to found a title.

As is well known, many of these States have been active in enforcing their fishery laws against foreign vessels entering the 200-mile zones. It has been reported, for example, that, since 1961, half of the United States tuna vessels have either been chased, shot at or seized and the release of seized vessels and crews has only been secured by payment by the United States of a total (to June 1967) of \$ 332,702.⁴⁴ To the writer's knowledge, however, there has not been any appreciable activity in relation to the exploitation of the natural resources of the sea-bed and subsoil of these vast and, in the main, very deep areas and it can hardly, therefore, be said that the foundation of a title has been laid. Moreover, the claims have been consistently protested against since they were first made and the United States has attempted to strengthen its paper protest by requiring the Secretary of State to withhold from any foreign aid funds an amount equal to the unpaid United States claim against a country which has seized a United States fishing vessel.⁴⁵

It must therefore be concluded that these claims do not satisfy the requirements, reviewed above, for the establishment of title to submarine territory. The fact that there are signs that the earlier state of shock at the extent of these claims is gradually being softened by the enlightened self-interest of those who cannot ignore the obvious parallels between exclusive mineral rights in a 200-mile 'Continental Shelf' and exclusive fishery rights in a 200-mile maritime zone,⁴⁶ can hardly affect this conclusion.

44. Report cited in note 25 above, preprint edition, p. 4-II-49.

45. Under the Fishermen's Protective Act 1954-68. See further Report cited in note 25 above, preprint edition, pp. 4-II-49/50.

46. See, *e.g.*, Krueger, *loc. cit.* in note 24 above, at p. 14.

3. *The Principle of the Freedom of the High Seas: Reconciliation of Exclusive Rights of Exploration and Exploitation of Natural Resources with Other Users of the High Seas.*

The exploration and exploitation of the natural resources of the Continental Shelf by parties to the Geneva Convention must clearly be carried out subject to the rules of the Convention. In particular, they must observe the rules designed to reconcile exploration and exploitation of the Shelf with the various rules underlying the principle of the freedom of the high sea.

When the doctrine of the Continental Shelf was still in its early formative stages, a number of writers⁴⁷ commented on its apparent inconsistency with the principle of the freedom of the high seas. It was pointed out that the exploitation of the sea-bed and subsoil would involve the presence of structures on the surface of the high seas and that they might well interfere with fishing and navigation and give rise to jurisdictional problems. These were and continue to be very real dangers and it must be considered whether the rules incorporated in the Geneva Convention and in subsequent municipal legislation have effected a successful reconciliation of the two principles.

The same kind of potential conflicts do, of course, exist in the relations between States not bound by the Geneva Convention and also in relation to the area beyond the outer limit of the Continental Shelf. It is hoped, therefore, that a study of the degree to which the Geneva Convention has successfully reconciled the conflicting interests in the Shelf area will provide a useful framework for a consideration of the corresponding rules which must be relied on to effect a reconciliation in these other two contexts.

An appreciation of whatever differences there may be in the conditions of exploitation under these alternative regimes is clearly a factor that may influence State policies on the limits of the Continental Shelf and affect the degree of urgency they will display in attempting to reach agreement on a new conventional regime for submarine exploitation.

47. See, e.g. G. SCHWARZENBERGER, *International Law*, Vol. 1, 3rd ed., 1957, pp. 349-352.

Article 3 of the Geneva Convention provides that:

The rights of the coastal State over the Continental Shelf do not affect the legal status of the superjacent waters as high seas, or that of the airspace above those waters.

Perhaps the most important uses of the high seas which might be affected by exploitation of the Shelf are freedom of navigation, freedom of fishing, freedom to lay submarine cables and pipelines and freedom of scientific investigation. The protection afforded by the Geneva Convention to the exercise of these freedoms in the high seas above the Continental Shelf is examined below in relation to each freedom in turn.

Freedom of Navigation. This traditional freedom is now, of course, codified in the Geneva Convention on the High Seas (1958) and it is worthwhile to dwell for a moment on the characteristics of this freedom as laid down in the Convention.

Under Article 2, "no State may validly purport to subject any part of (the high seas) to its sovereignty", and freedom of navigation, in common with the other freedoms of the high seas, is to be exercised "with reasonable regard to the interests of other States in their exercise of the freedom of the high seas".

It follows from the principle of freedom that, unless in accordance with exceptional rules such as those on piracy or permissive rules provided by treaty, a State must not interfere with a ship of foreign nationality on the high seas. Much of the remainder of the High Seas Convention spells out this rule in detail,⁴⁸ and, even where recognising rights of interference with foreign shipping, closely circumscribes their exercise.

Thus, although every State is authorised to seize a pirate ship on the high seas (Article 19), in doubtful cases the procedure of boarding, document checking and examination of the ship provided for in Article 22 would first have to be observed. Even in the case of ships engaged in the slave trade, jurisdiction to prevent and punish those responsible lies with the flag State (Article 13). Unless further interference is justified by treaty, other States are limited to boarding the vessel to check its right

48. See, e.g., Article 11 which reserves penal jurisdiction over collisions and other incidents of navigation to the flag State or State of nationality of the offender, and Articles 8 and 9 on the complete immunity of warships and public non-commercial vessels from the jurisdiction of other States.

right to its flag if there is reasonable ground for suspecting that the ship is engaged in the slave trade (Article 22).

Again, under Article 23, the right to arrest foreign ships on the high seas following hot pursuit, exists only where the hot pursuit has followed a violation by the ship of the laws and regulations of the pursuing State. If the pursuit has commenced from the contiguous zone, it may only be undertaken if there has been a violation of the rights for the protection of which the zone was established.

Similarly, though States accept an obligation to prevent pollution of the seas by oil or radioactive waste and to prevent injury to submarine cables and pipelines (Articles 24-29), jurisdiction over vessels on the high seas is reserved to the flag State.⁴⁹

How has this freedom of navigation, so long established and so closely guarded by these detailed rules, been affected by the recognition of exclusive rights in the Continental Shelf?

Under Article 3 of the Geneva Convention on the Continental Shelf, this freedom is not to be affected by the rights of the coastal State over the Continental Shelf. Article 3 must, however, be read in the light of Article 5. It has been seen that the right of freedom of navigation is one which must be exercised with reasonable regard to the interests of other States. Article 5 (1), in a similar vein, provides that the exploration of the Continental Shelf and exploitation of its natural resources must not result in any *unjustifiable* interference with navigation; and Article 5 (6) prohibits the establishment of installations or devices, and safety zones around them, where interference may be caused to the use of recognised sea lanes *essential* (emphasis addee) to international navigation.

The problem has already been faced in the Gulf of Mexico and a reasonable balance seems to have been worked out between the potentially conflicting interests. In that area, where it is reported⁵⁰ that there were, in 1965, over 5,000 oil installations,

49. See also the London Convention for the Prevention of Pollution of the Sea by Oil, 1954 (Cmnd. 595-1958), as amended 1962 (Cmnd. 1801-1962), Articles IX and X and the Convention for the Protection of Submarine Cables, 1884, Article 10, (N. Singh, *Internationale Convention of Merchant Shipping*, 1963, p. 275, at p. 276).

50. W. L. GRIFFIN, "Accommodations of Conflicting Uses of Ocean Space

2000 of which were in or near shipping areas out to 50 miles from the coast, 'Shipping Safety Fairways' have been marked on Nautical Charts after consultations between the Government and Oil and Shipping organisations. The system is a flexible one. The fairways are subject to modification and are not obligatory shipping routes. It was felt that, in the interests of safety, discretion must be left to the Master, but, clearly, in the event of collisions outside the fairways, the departure from the recommended route would have a bearing on the determination of liability.⁵¹

It would be a mistake, however, to consider this development only in the context of the exploitation of the Continental Shelf. Encroachments on — or, perhaps better, regulation of freedom of — navigation is better seen as the inevitable result of technological progress and the resultant more intensive use of the seas. As been pointed out,⁵² it is also becoming necessary to provide sea-traffic separation lanes in busy shipping areas such as the Dover Straits and the approaches to the larger United States ports. Proposals have been made, for example, for the establishment of safety zones near points of convergence of routes in the North Sea. In short, as the use of coastal zones is intensified, whether by competing interests (mineral extraction and shipping) or by the same interests (a greater volume of larger, faster ships), freedom of navigation can only survive as a regulated freedom.

Although Article 5 prohibits unjustifiable interference with navigation and the establishment of installations where interference may be caused to recognised sea lanes essential to shipping, it does require ships of all nationalities to respect the 500-metre safety zones which may be established round installations and devices for the exploration and exploitation of the Shelf and permits States to take in those zones measures necessary for their protection (Paragraphs 2 and 3). Precisely what powers of interference with foreign shipping are implied in this provision is not entirely clear. The installations and devices are under

with Special Reference to Navigation Safety Lanes", in L.M. Alexander (ed.), *The Law of the Sea. The Future of the Sea's Resources*, 1968, p. 73.

51. See further, Griffin, *loc. cit.* in note 50.

52. *Ibid.*, pp. 78-79 and M.W. Richey, "The Separation of Traffic at Sea", 19 *Journal of the (U.K.) Institute of Navigation* (1966), pp. 411-435.

the jurisdiction of the coastal State, but in relation to the safety zone it is merely said that the State must take the measures necessary for the protection of the installation and devices and appropriate measures for the protection of the living resources of the sea from harmful agents.

There seems little doubt, however, that United Kingdom legislation goes further than these provisions warrant. Under Section 2 of the Continental Shelf Act 1964,

The Minister of Power may for the purpose of protecting any installation in a designated area by order made by statutory instrument prohibit ships, subject to any exceptions provided by the order, from entering without his consent such part of that area as may be specified in the order.

Prima facie, this is a very far-reaching power. It should be borne in mind, however, that, though the Act refers potentially to the whole or any part of the United Kingdom's Continental Shelf (by reason of the definition of "designated area"), the purpose of any such prohibitory order would be the protection of installations. Any attempt to prohibit navigation in extensive areas around installations would certainly, therefore, be *ultra vires*. In terms of the Geneva Convention, on the other hand, a prohibition enforced against foreign shipping anywhere outside the 500-metre safety zones would certainly be illegal. In practice the only two orders so far issued under section 2 are in fact restricted to such 500-metre zones. These same orders certainly imply that the sanctions provided for in the Act may be imposed upon foreign shipping entering the safety zones, since foreign vessels are not included in the exceptions to the scope of the orders. However, this seems a reasonable interpretation of the power recognised in the Convention to take measures necessary for the protection of installations and devices on the Shelf.

Section 3 of the Act also seems to stretch rather too far the powers recognised to inhere in the coastal State. Section 3 (1) provides for the application of the criminal law to acts or omissions, on, under or above installations or within the 500-metre zone on condition that they would have constituted offences had they taken place in the United Kingdom. Under section 3 (2), power is assumed to determine questions arising out of acts or omissions taking place in a designated area, or in any part of such an area, in connection with the exploration

of the seabed or subsoil or the exploitation of their natural resources and to confer jurisdiction on Courts in any specified part of the United Kingdom.

Examples of the object of such powers are to be found in sections 6 and 7 which provide for the treatment of installations and safety zones as if they were in the United Kingdom for the purpose of the Wireless Telegraphy Act 1949 and the Radioactive Substances Act 1960.

Once again, the assumption of jurisdictional power over foreign nationals under this provision would not be justified outside the 500-metre zones though within these zones the general application of the criminal law is probably sufficiently closely linked to the object of protecting the installations to come within the powers recognised in the Convention.

Professor Oda, commenting on this British legislation, has suggested that

inherent in the adoption of the concept of the continental shelf is an inevitable change in the entire concept of the high seas so as to permit the exercise of coastal State jurisdiction with a view toward controlling the exploration of the continental shelf and the exploitation of its resources. And logic, I submit, would require that the coastal State be competent to prevent on the superjacent waters of the continental shelf an infringement of its regulations on the exploitation of its continental shelf and to punish such infringements committed in this area⁵³.

Professor Oda proposed, therefore, that the superjacent waters of the Continental Shelf should be given the same status as the contiguous zone (thus empowering the coastal State to prevent and punish the infringement of its regulations for the exploration and exploitation of the Shelf).

Professor Oda cited the United Kingdom Act as having moved towards such a modification. For the reasons suggested above, this development seems more potential than real. Moreover, it seems questionable whether any further inroads on freedom of navigation are necessary to protect the coastal State's interests. Adequate rights already exist to protect the safety of installations and either obligatory or optional traffic systems

53. S. Oda, "The Geneva Conventions on the Law of the Sea: Some Suggestions for their Revision", 1 *N.R.L.* (No. 2-1968), p. 103, at p. 107.

are likely in the near future to take care of further navigational difficulties in particularly congested areas. Moreover, it seems inconceivable that anyone would be so foolhardy as to attempt to exploit an area recognised by international law to be subject to the exclusive rights of the coastal State. Freedom of the high seas is not a licence permitting foreign nationals to exploit resources recognised by international law as subject to the exclusive rights of the coastal State and it seems unlikely that any State would challenge the right of the coastal State to take whatever action is necessary to protect these rights even if it involved the exercise of jurisdiction over the law-breaking vessel. The recent Soviet Edict on the Continental Shelf⁵⁴ makes the attitude of that Government quite clear. Article 5 prohibits foreign individuals and juridical persons from *inter alia* exploring and exploiting the Shelf's natural resources without Soviet consent. Offenders are liable to heavy fines and/or deprivation of freedom under Article 6 and may have their vessels confiscated, together with "all implements and instruments used by the violator" and everything extracted (Article 7).

Finally, reference must also be made to one further provision in Article 5 of the Continental Shelf Convention which affects freedom of navigation in the sense that such freedom would be impaired in the absence of adequate information on the establishment of structures on the Continental Shelf and adequate means of warning of their presence. Article 5(5) provides that due notice must be given of the construction of any such installations, and permanent means for giving warning of their presence must be maintained. Furthermore, abandoned or disused installations have to be entirely removed.

Freedom of Fishing. Under Article 5 (1) of the Geneva Convention on the Continental Shelf, exploration and exploitation of the natural resources of the Shelf must not result in any unjustifiable interference with fishing or the conservation of the living resources of the sea; and under Article 5(7) the coastal State is obliged to take appropriate measures in safety zones around installations for the protection of the living resources of the sea from harmful agents.

54. See note 29 above.

These very general rules offer no easy solutions to conflicts of interest except in extreme cases where, for example, the expected value of Shelf resources clearly far outweighs that of minor fishery interests. In more difficult cases it is a question of making a value judgment on the basis of the best available economic and social data, which would include — but not overemphasise — the economic and social consequences of the priority in time of the establishment of the fishery interest.

There are over 2000 oil rigs in the Gulf of Mexico; already, at least 18 productive wells and 104 other wells have been drilled on the United Kingdom Continental Shelf⁵⁵; and interest has been shown in the oil possibilities of the Grand Banks off Newfoundland and the Georges Bank off New England. The possibility of conflict may be expected to grow as the search is intensified and more interest is taken in other submarine mineral stocks. The most difficult problems are likely to arise where the high seas fishery has been traditionally exploited by foreign fishermen for, in such cases, the conflict will be an international one and the coastal State will not have the power to make a rational choice between competing interests.

It has to be admitted that current international law has little to offer to the solution of such conflicts beyond the general concepts of reasonableness and equity. The problem is similar to that which has to be solved whenever a major international river system is subject to a variety of uses by a number of States and it is likely that Continental Shelf conflicts will ultimately have to be settled by using the tools and techniques developed in international river treaty practice to devise conventional regimes on an equitable basis.⁵⁶

That it is easy to exaggerate the difficulties of reaching an accommodation between the two users has been shown by experience off the Californian coast and in the Gulf of Mexico. For example, research on the effect on fisheries of seismic exploration and subsequent modification of the techniques used helped to reconcile Californian fishermen to the use by oilmen

55. Continental Shelf Act, 1964, *Report for Year 1967-68*, p. 3.

56. Cf. GRIFFIN, *loc. cit.* in note 50, at p. 76 and A.H. Garretson, R.D., Hayton and C.J. Olmstead (eds.), *The Law of International Drainage Basins*, 1967.

of such methods.⁵⁷ Similarly, interference with trawling and damage to nets can be largely avoided by requiring a specified distance to be left between neighbouring rigs and enforcing rules on the complete removal of abandoned installations.⁵⁸

The fact remains that accidents do happen as in the major leakage of oil off Santa Barbara in February, 1969. Comparable incidents on the Dogger Bank in the North Sea or on the Newfoundland Grand Bank could have serious effects on the living resources of the seas and those who harvest them. This would seem to be no more, however, than another of the factors which must be borne in mind in assessing the reasonableness of the exploitation of the sea-bed in the vicinity of a fishery bank.

Freedom to Lay Submarine Cables and Pipelines. This freedom is codified in Articles 2 and 26-29 of the Geneva Convention on the High Seas.⁵⁹

Under Article 26 (2) of the High Seas Convention and Article 4 of the Continental Shelf Convention, the coastal State may not impede the laying or maintenance of submarine cables and pipelines on the Continental Shelf subject, however, to its right to take reasonable measures for the exploration of the Continental Shelf and the exploitation of its natural resources.

Here again, any alternation of the routes of cables or pipelines and any measures which the coastal State might require for their protection in an area of the Continental Shelf subject to exploitation should not be considered only in the context of the exploitation of the Continental Shelf. It is part of a more general problem. Thus, already, pipelines in the Gulf of Mexico must be laid in 6 to 8 foot trenches so as not to cause a hazard for trawlers.⁶⁰ Similarly, in the North Sea, pipelines laid on the sea-bed would constitute in very shallow areas a hazard to the navigation of the deep-draft, mammoth oil tankers.⁶¹

57. See further M.B. SCHAEFER, *I Proceedings of Conference on Law, Organization and Security in the Use of the Ocean* (1967), at p. A-14.

58. *Ibid.*, p. A-15.

59. See also, in relation to protection of submarine cables, the Submarine Cables Convention, 1884 (see note 49 above).

60. SCHAEFER, *loc. cit.* in note 57 above, at p. A-15.

61. A.E. MAXWELL, in *Proceedings* cited in note 57, at p. A-16.

Freedom of Scientific Investigation. No mention is made of this freedom⁶² in the High Seas Convention but Article 5 (1) of the Continental Shelf Convention requires that exploration and exploitation of the Continental Shelf must not result in *any* interference with fundamental oceanographic or other scientific research carried out with the intention of open publication. This paragraph thus seems to grant to scientific research a relatively greater degree of protection than navigation, fishing or conservation of living resources, all of which are merely protected from *unjustifiable* interference. This provision is considerably weakened, however, by the vague nature of Paragraph 8 of the Article which subjects research concerning the Continental Shelf and undertaken there to the condition of the prior consent of the coastal State, which "shall not normally withhold its consent..." The disquiet felt by the scientific community at the way in which these provisions have been interpreted is summed up in the statement adopted by the Scientific Committee on Oceanic Research in June 1968:

Evidence is accumulating that the Convention on the Continental Shelf ... is on occasion being applied so as to hinder scientific investigation of the circulation of ocean waters, the biology of the sea floor, the origin and movement of continents and other problems of considerable scientific importance. Accordingly, SCOR decided to ask its Members, National Committees, and their parent organisations, to urge their governments to adopt liberal interpretations of the articles of this Convention in order to facilitate the carrying out of oceanographic research⁶³.

There can be little doubt that this is one of the least satisfactory of the provisions of the Geneva Convention on the Continental Shelf and that there is a considerable danger that the wide discretion vested in the coastal State to deny a permit for particular research will be exercised for reasons which have

62. See further on this freedom, E.D. BROWN, "Freedom of Scientific Research and the Legal Regime of Hydrospace", *Indian Journal of International Law* (1969); W.T. BURKE, *International Legal Problems of Scientific Research in the Ocean*, 1968 and *op. cit.* in note 11, p. 150 *et. seq.*; L.F.E. GOLDIE, "Submarine Zones of Special Jurisdiction under the High Seas — Some Military Aspects", in Alexander, *op. cit.* in note 50 above, pp. 106-109; and M.B. SCHAEFER, "The Changing Law of the Sea — Effects on Freedom of Scientific Investigation.", in *ibid.*, at pp. 113-117.

63. VI *International Marine Science* (Nos. 3/4 - 1968), p. 57.

little or no connection with the only purpose for which the exclusive rights of the coastal State in the Shelf are recognised — the exploration and exploitation of its natural resources. A number of factors aggravate the difficulties of the scientists. First, the outer limit of the Continental Shelf is uncertain and there is therefore, doubt as to the zone in which scientific research requires a permit. Secondly, the line between exploration and exploitation of the Shelf's natural resources on the one hand and the recovery of samples for scientific purposes on the other may in some cases be sufficiently thin to offer a pretext for the refusal of a permit. Thirdly, some states may interpret Article 5-8 so as to give them control over scientific research concerning the sea-bed but conducted from the surface and involving no physical contact with the sea-bed. And since such research is difficult to distinguish from, and may in some cases be complementary to, investigation of the superjacent waters, the scientist may find it advisable to seek permission for what in reality is scientific research in the high seas. Finally, even if a permit is available, it will often be useful only if granted within a certain time in order to fit into the costly preparations for submarine research.

*Reconciliation of conflicting users of the high seas
under international customary law*

Such being the way in which the Geneva Convention on the Continental Shelf attempts to reconcile exploitation of the Continental Shelf with the various freedoms of the high seas, the next question is to determine how international customary law deals with the same problem in relation to exploitation of (a) the Continental Shelf by States which are not bound by the rules of the Convention as such and (b) the bed and subsoil of the oceans beyond the Continental Shelf.

It is clear that the coastal State enjoys *ipso facto* exclusive rights over the Continental Shelf for the purpose of exploring it and exploiting its natural resources. It has been suggested above that, in certain circumstances, States may also acquire exclusive minerals titles to specified areas of the ocean bed beyond the Continental Shelf. Even in the absence of such

exclusive titles, it is generally recognised that States and private entrepreneurs are free to exploit sea-bed resources on a non-exclusive basis.

In the present state of technology, it would be illogical to recognise these rights without also recognising the corollary — the right to exploit these resources by means of structures or devices situated in, or extending into, the superjacent high seas. To recognise this right, however, is to recognise a further freedom of the high seas. And, like other such freedoms, it must be exercised with reasonable regard to the interests of other States in their exercise of the freedoms of the high seas, including the four discussed above — freedom of navigation, fishing, laying of submarine cables and pipelines and scientific research. The general rule is thus the same as that incorporated in the Geneva Convention. It would be difficult to argue, however, that the more detailed rules through which the Convention develops this general rule may now be considered to be declaratory of international customary law even in relation to the area of the Continental Shelf. Bearing in mind the International Courts' rejection of the contention that Article 6 of the Convention was declaratory of international customary law⁶⁴ and that it may well be questioned whether even the definitions of the Continental Shelf in Article 1 and of 'natural resources' in Article 2 (4) reflect customary law, this cannot be lightly assumed. Nevertheless, the differences between the regimes would not seem to be very significant.

Freedom of Navigation. There can be no doubt that exploitation of submarine resources would not comply with the general rule if it involved the placing of navigational hazards in or near "recognised sea lanes, essential to international navigation". Moreover, in less clear-cut cases, the same balancing process would have to be adopted as in the case of the application of Article 5, Paragraphs 1 and 6 of the Continental Shelf Convention. The reasonable use of installations and devices for exploitation would also clearly require prior notice of erection, adequate warning systems and complete removal on termination of the operation.⁶⁵ In these respects, therefore, the existing

64. In the Judgment in the *North Sea Continental Shelf Cases* (1969). See Para. 60 *et seq.*

65. Cf. Article 6/5 of the Geneva Convention on the Continental Shelf.

rules of general international law would not seem to differ from the requirements of the Geneva Convention on the Continental Shelf.

As regards safety zones, the prohibition of shipping from such zones and the exercise of jurisdiction within the zones, the position is rather less clear.

In the absence of conventional provision to the contrary, *prima facie* there would seem to be no justification under international customary law for the establishment of safety zones or for the application of a State's laws and the exercise of its jurisdiction within such zones and on installations for the exploitation of the ocean bed. Normally a State is entitled on the high seas to exercise personal jurisdiction over its own nationals, including juridical persons having its nationality. It may exercise jurisdiction over foreign nationals, however, only if they are on board a vessel to which the State's quasi-territorial jurisdiction extends. Principally, ships and aircraft registered in that State fall within this category but it has not hitherto been recognised as extending to non-ship installations and devices used for submarine exploration and exploitation.

It is perhaps arguable, however, that the right to establish at least a modest 500-metre safety zone and to exercise jurisdiction within it is necessarily implied in the recognition of the State's exclusive rights of exploration and exploitation. It is difficult to see how a State could ensure respect for other users of the high seas without enjoying such powers. The maintenance of law and order is essential to the safe operation of such devices and to the prevention of, *inter alia*, hazards to navigation and pollution of the seas. Such law and order could only be effectively secured by the licensing State.

In practice, it seems unlikely that the assertion of the right to establish safety zones will give rise to any difficulty provided they are of reasonable dimensions. Moreover, even though Article 5 of the Geneva Convention is not directly applicable, municipal legislation of non-party States based on the Convention's safety-zones provisions may well gradually transform them into rules of international customary law. Pending such a development, a prohibition on intrusion into a safety zone by ships flying the flag of the licensing State — assuming

that there will be one — coupled with a recommendation to foreign shipping would no doubt suffice to maintain order.

Freedom to Fish and Freedom to Lay Submarine Cables and Pipelines. In relation to these two freedoms, the rule requiring exploitation to be effected with reasonable regard to the interests of other States raises the same problems as Article 5 of the Geneva Convention. Under international customary law as under the Convention, the task will be to balance conflicting interests against one another and the criteria in accordance with which an evaluation is to be made are no more and no less precise in the one case than in the other.

Freedom of Scientific Research. As has been seen, the freedom, recognised by international customary law, to indulge in scientific research on the sea-bed and in the subsoil of the high seas has been severely curtailed by Article 5 (8) of the Geneva Convention on the Continental Shelf. And, in practice, the operation of this provision is inhibiting research in the high seas above the Shelf. In theory, at least, the position under international customary law is much more favourable to the scientist. Both in relation to the Shelf and the area beyond, there is no justification for the importation of the condition of prior consent to which research on the Continental Shelf is subject under the Geneva Convention, and reconciliation of freedom of research with freedom to exploit submarine resources would be based on the same considerations of equity and reasonableness as were discussed above. In practice, however, wherever the research involves core-drilling, seismic exploration or the taking of samples, difficulties may arise. Such difficulties would probably be fairly simple to resolve in the area of the Continental Shelf where the exclusive right of exploitation clearly belongs to the coastal State. In areas in which competing claims are being advanced to the ocean bed beyond the Shelf, distinguishing between research and prospecting might well be more difficult.

Regulating the Activities of the Private Entrepreneur. So far it has been assumed in this paper that the private entrepreneur is free, under international customary law, to explore the sea-bed and subsoil beyond the Continental Shelf and to exploit its natural resources. The home State of such an operator is of course entitled to require the operator to apply for a licence

for such an undertaking and to subject its issue to whatever financial and other conditions it pleases. On the other hand, the home State is not *required* to regulate such activities of its nationals. The danger thus exists that the private enterprise might not execute its exploration and exploitation work with the required regard to the interests of other States. This would seem to be a very good reason why every State whose nationals engage in such activities on the basis of the still-fluid rules of international customary law should ensure that its municipal law requires operators to act in accordance with licence conditions so framed as to ensure respect for the interests of other States; and to provide for the application of its laws to any structures erected for the purpose of such work.

The uncontrolled activities of the private entrepreneur on the basis of the present rules may also give rise to difficulties over 'claim-jumping' or 'poaching'. Until such time as it can be quite clearly stated that the law provides rules under which exclusive minerals titles may be acquired in submarine areas beyond the Continental Shelf, the danger will remain that operators may find that the heavy costs of exploration have not secured for them any exclusive rights of exploitation. Current international law would seem to offer no solution which could clearly avoid the possibility of international conflict. In the absence of anything better, however, it may be worthwhile to recall that States would be entitled, on the basis of self-defence, to take, on the high seas, whatever action, including the use of force, as might be necessary to protect from interference by foreigners the exercise by its nationals of the freedom to exploit submarine resources.⁶⁶ In some cases, of course, such interference might amount to an act of violence or depredation directed against nationals of the State or their property; the exercise of jurisdiction on the basis of the rules on piracy *jure gentium* would then be justified. The political factors which would militate against action in accordance with these rules except in very exceptional circumstances hardly need to be stressed.

66. The legality of the affirmation by force of the exercise of a right illegally denied was confirmed by the International Court of Justice in the *Corfu Channel Case* (I.C.J. Reports 1949, p. 4) in relation to the denial by a State of the exercise of a right of passage. *A fortiori*, action in defence of a right illegally denied by an object of international law would be legal.

Conclusions

Three main conclusions seem to stand out from this study.

First, although an agreed delimitation of the Continental Shelf is desirable, its absence is unlikely seriously to inhibit States (and their investors) from extending claims out to the limit of the continental terrace. The extension of Continental Shelf claims beyond this limit will not be justified under international customary law. Moreover, it seems likely that before technology provides a basis for a further extension⁶⁷ beyond the terrace on the basis of the Conventional test of exploitability, a quite different regime will materialise for the ocean bed either on a treaty basis or as a result of the further development of international customary law. The exploitation of shallow areas far removed from the coast may provide a stimulus for the development of such rules.

Secondly, so far as legal status is concerned, security of investment would clearly be promoted by a more certain regime than that provided by the customary rules examined in section II. Nevertheless, if necessary, these rules would provide a workable framework within which States could establish exclusive titles and protect licensees against interference by third parties.

Thirdly, the problems of reconciling the exploitation of ocean bed resources with the freedom of the high seas are not appreciably different from those which arise from the Geneva Convention on the Continental Shelf.

More generally, therefore, the conclusion seems justified that international customary law is capable of stretching to accommodate and regulate this new user of the oceans.

To draw this conclusion is not, of course, to suggest that it is desirable that it should be left to international customary

67. A rough indication of the time scale involved may be derived from the following data. Estimates as to the average depth at which the continental terrace meets the abyssal ocean floor vary between 6,000 feet (1,830 metres) (See Brown, Report cited in note 1 above, note 139) and 8,200 feet (2,500 metres) (Report cited in note 25 above, at p. 4-III-68). The U.S. Commission on Marine Science, Engineering and Resources has recently recommended (*ibid.*, p. 2-25) as national goals the achievements of the capability to *explore* the ocean depths at 20,000 feet within a decade and to *utilize* the ocean depths to 20,000 feet by the year 2000. The more immediate goal, however, is to exploit to the 2,000 feet level (*ibid.*, p. 2-24).

law to provide a regime for the exploitation of the ocean-bed. Such a regime would have considerable deficiencies. It would not permit recognition to be given of any community interest in ocean-bed resources and would thus be opposed by the developing States and those who recognise the need to legislate for an equitable apportionment of sea-bed resources. Moreover, this regime would provide a bare minimum of rules and serious difficulties might be expected to arise especially over the drawing of Shelf boundaries and the establishment of exclusive titles to the ocean-bed.

If the need is not yet urgent for a new comprehensive regime for the ocean-bed it is certainly clear and it is to be hoped that the present labours within the United Nations framework will enable progress to this end to be made.

THE PRESENT REGIME OF THE EXPLORATION
AND EXPLOITATION OF THE SEA-BED RESOURCES
IN INTERNATIONAL LAW AND IN NATIONAL
LEGISLATION

BY

Dr. FRANCESCO DURANTE

*Professor of International Law, The University of Catania,
Catania*

1. Article 1 of the Geneva Convention on the Continental Shelf and the problem of juridical limitations to a possible future total repartition of the sea-bed between coastal States

Devising a specific legislation for the sea-bed and submarine subsoil implies finding first a solution to the question of the geographical limitation — actual or potential — of the exclusive right of the coastal States to exploit the resources of the sea-bed.

If it is assumed that the present technical possibilities to exploit the natural resources of the sea-bed and marine subsoil automatically entitle the coastal States to an exclusive right to carry out this exploitation and govern the use of such right, then a special legislation on the peaceful use of the sea-bed — if not aimed at replacing the present international régime of the sea-bed as envisaged in the Geneva Convention on the Continental Shelf and brought about by customary rule, on which the Convention itself was based — will necessarily have to be quite narrow in scope.

The outlook changes considerably if it is assumed that the submarine areas reserved to coastal States have a certain actual or potential limit such as to exclude the possibility of a future total partition of the sea-bed to the sole benefit of coastal States. Only on the basis of this assumption the drawing up of a specific international régime of the peaceful uses of the sea-bed and ocean floor acquires an autonomous significance.

The principle whereby the right to the exclusive exploitation and control of submarine resources by the coastal State, better known as right on the "continental shelf", is to be deemed granted regardless of actual or symbolic occupation of the submarine areas concerned, or of any action for the formal recovery of this right, is an uncontroversial fact within the frame of the present international legislation governing the sea-bed. This legislation was initiated and developed over the last twenty years. It was derived from the constant attitude of all States, starting with the Truman Proclamation of September 28, 1945, and was confirmed by Article 2 of the Geneva Convention on the Continental Shelf and the recent judgment of the International Court of Justice of February 20, 1969.

This right appertains *ope legis* to each coastal State and seems to be an accessory right to the right of sovereignty exerted on the emerged land. It has also been considered as automatically granting to the coastal State any submarine area which might be practically used albeit at later times. This explains why if no limit, though abstract and potential, is put to the possibility of extending the legal concept of continental shelf to the deep sea-bed, the possibility and usefulness of an autonomous regime concerning any part of the sea-bed which can be directly reached and used must also be denied. This is because in such a case the sea-bed would automatically fall under the exclusive control of a coastal State as falling into into the legal concept of continental shelf. A separate regime that would not interfere with the rights of the States on their respective continental shelves could be envisaged then only for such submarine areas the depth of which is too great for possible exploitation. In this case, however, the separate régime would have no practical meaning.

While there is no doubt about the automatic effectiveness of the rule providing for an exclusive right of the coastal State on its continental shelf, the evaluation of the significance and the range to be attributed to the concept of continental shelf — the object of the exclusive right — is much more controversial.

In fact, the meaning to be given to customary rule and subsequent conventional codification thereof — with respect to the assessment of submarine areas subject to exclusive right status — is the very core for the solution of this question which

is a preliminary requirement in studying a special régime for the sea-bed and ocean floor: that is, whether the sea-bed is already — if only potentially — partitioned by the coastal States.

The most widely known and juridically most significant formulation concerning the definition of submarine areas now subject to the exclusive right of the coastal State, is in fact Article 1 of the Geneva Convention on the Continental Shelf.

2. *The interpretation of the Article 1 of the Geneva Convention in the light of ratio to be inferred from international practice prior to the Convention*

Essentially, the core of the problem then is to determine whether Article 1 of the Geneva Convention should be taken to mean that any zone of the sea-bed and submarine areas beyond a depth of 200 metres, the natural resources of which may be exploited through the superjacent waters, may form the subject of an exclusive right on that ground alone, that is, regardless of the actual exploitation. Or, instead, whether it should be taken to mean that the automatic extension of the exclusive right of the coastal State should be limited to the submarine areas which are in fact one geophysical unit with the emerged territory of that State, it being understood, however, that the possibility to acquire an exclusive right over the sea-bed because of its actual exploitation shall remain unaltered.

The interpretation of Article 1 of the Geneva Convention is inextricably bound with its very scope, the written consolidation of customary principles that were taking shape during the previous ten years.

An examination of international practice before and after the written formulation of the rule in question, is therefore an essential element in an accurate and correct interpretation of the same rule.

From the very outset, the claims of the States to their exclusive right to exploit the natural resources of the sea-bed and subsoil of submarine areas were limited to specific submarine areas having such characteristics — as close connection with the emerged land, shallowness of the superjacent waters, that made them naturally connected with the coastal State.

According to the science of oceanography, the submarine areas just described constitute the continental shelf.

The continental shelf, construed as a natural extension of the State, is the very one covered in the Truman Proclamation of September 28, 1945, explicitly or implicitly referred to on subsequent international practice when describing the sea-bed and subsoil of submarine areas over which the United States claim exclusive rights.

Explicit reference to the continental shelf, not to the sea depths in general but to that specific submarine area which maintains a close morphological and geological unity with the continent ¹ is made not only in this decree but in all acts claiming exclusive rights on the submarine resources by: Australia, Brazil, Chile, Costa Rica, Ecuador, El Salvador, England (Bahamas Islands, Falkland Islands, Jamaica), Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, the Philippines, Venezuela.

It must be inferred that the principle whereby an exclusive right cannot indiscriminately extend over any area of the sea-bed but is admissible only for certain specific submarine areas has been accepted also by such States which, though not making use of the term "continental shelf" in their documents, have limited the object of the exclusive right to the sea-bed which: *a*) is closely connected with the emerged land, usually referred to as "adjacent" or "contiguous"; and *b*) has superjacent waters of rather shallow depth, not exceeding 100 fathoms or 200 metres, or remains within a "reasonable" distance from the coast.

The acceptance of this meaning was also voiced by Pakistan and some Arab Princedoms of the Persian Gulf, such as Abu Dhabi, Ajman, Bahrain, Dubai, Kuwait, Qatar, Ras el Khaiman, Sharjah, Umm al Qaiwain.

It should finally be recalled that in international practice no State had explicitly asserted its sovereignty or claimed exclusive rights over submarine areas located beyond the limits of the continental shelf prior to the Geneva Convention on the Continental Shelf. Only two States have voiced their claims to the resources of the sea-bed and submarine areas so as to

1. Argentina, Decree No. 14.708 of October 11, 1946.

consent, in a more or less near future, the extension of the exclusive rights on any part of the sea-bed.² However, even these States refer to previous international practice which limits the extension of an exclusive right of a coastal State only to submarine areas having geophysical characteristics of the continental shelf. Even the attitude taken by these two Governments implies no specific intent to extend their respective exclusive right beyond the continental shelf.

The widespread opinion among the majority of States that had taken a definite stand on the existence of exclusive rights to submarine resources was that there had existed a limit of the possibility to assert such rights, which had to be linked to the geophysical characteristics of the submarine area. And this has not changed even during preliminary works for the Geneva Convention on the Continental Shelf. Even if it is true that the International Law Commission has felt that it could not *sic et simpliciter* adopt the scientific definition of continental shelf, since it would not permit a clearcut delimitation of submarine areas subject to the exclusive rights of the coastal State, it would be inaccurate to believe, on the other hand, that the Commission intended to depart from that basic criterion constantly advanced by international practice, which has linked, and at the same time limited, the existence of exclusive rights to the specific features of the sea-bed.

The fact that the scientific definition of the continental shelf has not been accepted does not mean a rejection of the substantial notion which forms the very basis for this definition. This is clearly evidenced in the International Law Commission's commentary to the text of the provision which has then become the present Article 1 of the Convention.

Paragraphs (5) to (9) of the commentary of the Commission are quoted in full below:

(5) The sense in which the term 'continental shelf' is used departs to some extent from the geological concept of the term. The varied use of the term by scientists is in itself an obstacle to the adoption of the geological concept as a basis for legal regulation of this problem.

2. Act of July 13, 1952 of the Dominican Republic; Proclamation of the State of Israel, August 3, 1952.

(6) There was yet another reason why the Commission decided not to adhere strictly to the geological concept of the continental shelf. The mere fact that the existence of a continental shelf in the geological sense might be questioned in regard to submarine areas where the depth of the sea would nevertheless admit of the exploitation of the subsoil in the same way as if there were a continental shelf, could not justify the application of a discriminatory legal régime to these regions.

(7) While adopting, to a certain extent, the geographical test for the 'continental shelf' as the basis of the juridical definition of the term, the Commission therefore in no way holds that the existence of a continental shelf, in the geographical sense as generally understood, is essential for the exercise of the rights of the coastal State as defined in these articles. Thus, if, as is the case in the Persian Gulf, the submarine areas never reach the depth of 200 metres, that fact is irrelevant for the purpose of the present article. Again, exploitation of a submarine area at a depth exceeding 200 metres is not contrary to the present rules, merely because the area is not a continental shelf in the geological sense.

(8) In the special cases in which submerged areas of a depth less than 200 metres, situated fairly close to the coast, are separated from the part of the continental shelf adjacent to the coast by a narrow channel deeper than 200 metres, such shallow areas could be considered as adjacent to that part of the shelf. It would be for the State relying on this exception to the general rule to establish its claim to an equitable modification of the rule. In case of dispute it must be a matter for arbitral determination whether a shallow submarine area falls within the rule as here formulated.

(9) Noting that it was departing from the strictly geological concept of the term *inter alia*, in view of the inclusion of exploitable areas beyond the depth of 200 metres, the Commission considered the possibility of adopting a term other than 'continental shelf'. In considering whether it would not be better, in conformity with usage employed in certain scientific works and also in some national laws and international instruments, to call these regions 'submarine areas', the majority of the Commission decided to retain the term 'continental shelf' because it is in current use and because the term 'submarine areas' used without further explanation would not give a sufficient indication of the nature of the areas in question. The Commission considered that some departure from the geological meaning of the term 'continental shelf' was justified, provided that the meaning of the term for purpose of these articles was clearly defined. It has stated this meaning of the term in the present article³.

3. Yearbook of the International Law Commission, 1956, vol. II, p. 297.

During the Geneva Conference on the Law of the Sea itself, the principle whereby the assertion of the exclusive rights of the coastal State is justified only insofar as the sea-bed's characteristics are such that it is practically an extension of the emerged territory of the State concerned, was explicitly re-affirmed, just like the fact that this is the principle inspiring the rule determining the submarine areas which are subject to the exclusive right.⁴

Having thus disclosed the prevailing attitude of States on the delimitation of submarine areas on which a claim for the exclusive right to exploit natural resources thereof could be laid, it is now necessary to see whether Article 1 of the Geneva Convention is in line or rather in conflict with this attitude.

In this connection it is first of all worthwhile to note that Article 1 makes explicit reference to the "continental shelf" to indicate the submarine areas that are the subject of the exclusive right set forth in Article 2 and that all efforts and attempts at removing this term from Article 1 and replacing it with another more general one were constantly rejected both by the International Law Commission and during the preliminary works of the Geneva Conference itself because, as has just been mentioned, the great majority of the States always felt that it should refer to a well circumscribed area of the sea-bed.

In addition, the description of submarine areas, contained in Article 1, which for legal purposes are to be considered as "continental shelf", in no way conflicts with the scientific concept of continental shelf, but rather enhances its two basic characteristics: *a*) physical unity and continuity between the emerged land and the sea-bed, and *b*) the relatively shallow depth of the sea-bed until the beginning of the continental slope established as a rule at 200 metres depth.

Both characteristics are explicitly mentioned in Article 1 of the Convention ("submarine areas *adjacent* to the coast" (emphasis added); "to a depth of 200 metres"), and thus the exclusive right of the coastal State is well framed within specific sea-bed.

4. First United Nations Conference on the Law of the Sea, Official Records, vol. VI, Fourth Committee, pp. 3-5, 7, 8, 11, 13, 39-42, *et seq.*

3. *The interpretation of the Article 1 of the Geneva Convention in the light of ratio to be inferred from international practice following the Convention*

The fact that the coastal States do not feel entitled to assert *jure proprio* their exclusive rights to the natural resources of the sea-bed or subsoil of the submarine areas irrespective of location, even though they may be technically and directly exploitable, is confirmed by the attitude taken after the signature of the Geneva Convention.

The foregoing interpretation of Article 1 has been explicitly accepted by France. This country, while ratifying the Convention, has in fact stated:

In the opinion of the Government of the French Republic, the term 'adjacent' regions refers to a notion of geophysical, geological and geographic dependence which in itself excludes an unlimited extension of the continental shelf.

Of no lesser significance is the fact that no State expressed any opinion contrary to this statement.

Even the Soviet Union, by the Decree of February 6, 1968, after substantially reproducing the contents of Article 1 of the Geneva Convention, in order to determine the submarine areas where the "sovereign rights" shall be exerted, refers to the "continuous mass of the continental shelf of the USSR".

The interpretation of Article 1 of the Convention on the Continental Shelf accepted here seems to be confirmed, *a contrario*, also by the attitude of Norway. In the report of the Norwegian Foreign Secretary attached to the Law of June 21, 1963, on submarine natural resources, it is specifically stated that Norway does not feel she should adhere to the Geneva Convention since her adhesion could be construed to mean that Norway's exclusive rights should not extend beyond the so-called Norwegian Trough which ends the Norwegian continental shelf in its geographic-geological meaning. For the same reason, the foregoing Norwegian Law does not even employ the words "continental shelf".

After reviewing the individual reactions of the States, consideration should be given to the international agreements

covering the exclusive exploitation of submarine resources: it will then be seen that all submarine areas that have been subject to delimitation even if located at depths exceeding 200 metres, constitute in fact a part of the continental shelf construed as a submarine continuation of the territory of at least one of the contracting States.⁵

Even when the delimited sea-bed areas are not referred to as "continental shelf" (such is the case of the Treaty between Saudi Arabia and Bahrain) but more generally as "under-water areas", these submarine areas, however, do form part of the continental shelf of the contracting States, in its geographic-geological meaning.

The more recent and weighty confirmation of this interpretation of international practice and conventional provision (Article 1 of Geneva Convention on the Continental Shelf), which codifies the rule that may be derived from that practice, is contained in the recent judgment of the International Court of Justice on the North Sea Continental Shelf Cases of February 20, 1969.

The Court considers

the most fundamental of all the rules of law relating to the continental shelf, enshrined in Article 2 of the 1958 Geneva Convention, though quite independent of it, namely that the rights of the coastal State in respect

5. See *e.g.*: United Kingdom — Venezuela, Treaty relating to the submarine areas of the Gulf of Paria, February 26, 1942; Saudi Arabia — Bahrain, Treaty relating to the delimitation of the continental shelf, February 22, 1958; Federal Republic of Germany — Kingdom of the Netherlands, Treaty concerning the lateral delimitation of the continental shelf near the coast, December 1, 1964; United Kingdom — Kingdom of Norway, Agreement relating to the delimitation of the continental shelf, March 10, 1965; Finland — USSR, Agreement regarding the boundaries of sea waters and the continental shelf in the Gulf of Finland, May 20, 1965; United Kingdom — Kingdom of the Netherlands, Agreement relating to the delimitation of the continental shelf under the North Sea, October 6, 1965; Norway — Denmark, Agreement concerning the delimitation of the continental shelf, December 8, 1965; Federal Republic of Germany — Kingdom of Denmark, Treaty concerning the delimitation of the continental shelf of the North Sea near the coast, June 9, 1965; United Kingdom — Kingdom of Denmark, Agreement relating to the delimitation of the continental shelf, March 3, 1966; Netherlands — Denmark, Agreement concerning the delimitation of the continental shelf under the North Sea, March 31, 1966; USSR — Finland, Agreement on continental shelf boundary in Baltic Sea, May 5, 1967; Italy — Yugoslavia, Agreement on delimitation of the continental shelf, January 8, 1968; Sweden — Norway, Agreement concerning the delimitation of the continental shelf, July 24, 1968.

of the area of continental shelf that constitutes a natural prolongation of its land territory into and under the sea exist *ipso facto* and *ab initio*, by virtue of its sovereignty over the land ⁶.

The basic principle whereby acquiring an automatic right — that is, regardless of actual occupation of the submarine areas — is limited and restrained by the existence of a close complementary connection between the emerged land and the sea-bed, was repeatedly affirmed by the Court according to which

what confers the *ipso jure* title which international law attributes to the coastal State in respect of its continental shelf, is the fact that the submarine areas concerned may be deemed to be actually part of the territory over which the coastal State already has dominion, in the sense that, although covered with water, they are a prolongation or continuation of that territory, an extension of it under the sea ⁷.

The concept was again re-affirmed with the observation that the institution of the continental shelf has arisen out of the recognition of a physical fact; and the link between this fact and the law, without which that institution would never have existed, remains an important element for the application of its legal régime. The continental shelf is, by definition, an area physically extending the territory of most coastal States into a species of platform which has attracted the attention first of geographers and hydrographers and then of jurists. The importance of the geological aspect is emphasized by the care which, at the beginning of its investigation, the International Law Commission took to acquire exact information as to its characteristics ... ⁸.

In conclusion, it can be said that neither international customary law nor written rule (Article 1 of the Geneva Convention on the Continental Shelf) grants the State exclusive rights on the sea-bed and subsoil of submarine areas unless they appertain to that State's continental shelf in its geographic-geological meaning, except insofar as actual use is made of such submarine areas.

6. I.C.J., Reports 1969, p. 22.

7. *Ibid.*, p. 31.

8. *Ibid.*, p. 51.

4. *Exploitability as an integrating criterion*

It must be noted, however, that scientific investigations disclosed that the beginning of the continental slope does not always occur at a depth of 200 metres, but also below or beyond such depth. Also the geophysical and geological characteristics marking the continental shelf extend to such part of the sea-bed constituting the continental slope, which does therefore contribute to form the submarine continuation of the emerged land, that identifies the continental shelf.

On the other hand, it is imperative to permit easy and secure delimitation of the exclusive right of the coastal State; it is equally imperative, on the other hand, not to exclude submarine areas which, though lying at depths beyond 200 metres, form a geographic-geological unity with the State coastline. These two requirements led to the inclusion in Article 1 of the Geneva Convention of the words: "beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources".

Under this wording, the possibility of exploitation through superjacent waters can have no other meaning but that of permitting the coastal State to claim exclusive rights on such parts of the sea-bed or subsoil of submarine areas which, though being part of the continental shelf, are located at depths beyond 200 metres.

Therefore, if exploitation possibilities exist also with regard to natural resources in the sea-bed that do not in fact constitute a morphological unit with the State's emerged land, that is, do not constitute its continental shelf, the State concerned shall not be entitled to lay claims on such resources except insofar as it actually carries out exploitation thereof.

5. *The criteria of repartition under Article 6 of the Convention and the international practice*

Submarine morphology does not always permit clear-cut detection of the specific characteristics of the continental shelf on the sea-bed which divides the territory of two or more States

even if such submarine areas form, geographically and geologically speaking, a continental shelf. An example of this is provided by the situation existing in the North and Adriatic Seas. Therefore, quite a few States could legitimately claim exclusive rights on the sea-bed and subsoil of submarine areas to the extent of the outer limit of the territorial waters of another State.

A similar situation occurs when the coast appertaining to one continental shelf belongs to two or more States.

The question of the delimitation of submarine areas as the object of exclusive rights arises not only with respect to the sea-bed located beyond the geographic-geological boundaries of the continental shelf but also with respect to the sea-bed within its boundaries.

International practice followed before the Geneva Convention is poor in examples on the question of the delimitation of the common continental shelf. E.g., the Truman Proclamation announces that such delimitation will be made "in accordance with equitable principles". The same holds true with respect to the Acts issued by Saudi Arabia and the Arab States on the Persian Gulf. The Geneva Convention devoted Article 6 to this question, which contemplates both the delimitation of the shelf between States whose coasts are opposite to each other or delimitation between States whose coasts are adjacent.

As regards international practice after the Geneva Convention, it can be noted that certain States only referred to the conventional rule in their domestic legislation. An example of this is Sweden, with her "Law relating to the continental shelf" of June 3, 1966. Other States, instead, have directly and specifically inserted in their domestic legislation the same criteria as those adopted by the Convention. An example of this latter case is Italy which in her Law No.613 of July 21, 1967 (Article 1), established that, failing specific agreements with other States, the delimitation of the common continental shelf shall be made according to the principle of the median line. A similar attitude was taken by Norway (Law of June 21, 1963); Iraq (Statement of the Government, published April 10, 1958); Soviet Union (Decree of February 6, 1968); and Belgium (Draft Law, October 23, 1967).

Finally, certain States unilaterally determined their common continental shelf with other countries by having specific recourse to the criteria voiced in the Geneva Convention, and especially the principle of equidistance from the coast⁹.

Even the States who have delimited their common continental shelf by means of agreement, in general and only with minor variations, adhered to the principle of equidistance as the basic principle for the delimitation. The following examples may be given: German Democratic Republic — Poland — USSR, Declaration on the continental shelf of the Baltic Sea (October 23, 1968); agreements between: United Kingdom — Norway (March 10, 1965); United Kingdom — Netherlands (October 6, 1965); Norway — Denmark (December 8, 1965); United Kingdom — Denmark (March 3, 1966); Netherlands — Denmark (March 31, 1966); USSR — Finland (May 5, 1967); Sweden — Norway (July 24, 1968).

All previous agreements specifically stated that the criterion to be applied in the delimitation was the principle of the equidistant line from the State coasts where the continental shelf appears to be jointly shared by the States. In other words, explicit reference is made to Article 6 of the Geneva Convention.

Other agreements do not specifically mention this guiding principle but do in fact apply it; and when they depart from it, this occurs because of the special circumstances which under Article 6 of the Geneva Convention justify an amendment to the principle of the equidistant line. Let us mention some of these agreements: Saudi Arabia — Bahrain (February 22, 1958) and Italy — Yugoslavia (January 8, 1968).

The draft agreement between Belgium and the Netherlands for the delimitation of the continental shelf common to the two States is also based on the principle of the equidistance.

6. *Special circumstances permitting derogation of the criterion of equidistance from the coasts*

The interpretation of international practice constitutes the main subject of the recent decision of the International

9. *E.g.*, Australia with her "Petroleum (Submerged Lands) Act, 1967".

Court of Justice concerning the North Sea Continental Shelf Cases. Though the Court focuses its attention almost solely on the hypothesis contemplated in Article 6, para. 2, of the Geneva Convention, that is, the hypothesis of delimitation between States with adjacent coasts, it also mentions the hypothesis envisaged in para. 1 (opposite coasts). While the Court, in connection with the first hypothesis (Article 6, para. 2) asserts the non-existence of any criterion derived from customary practice, which would be binding upon States that have not adhered to the Geneva Convention, it appears to recognise, however, that, as regards the second hypothesis (Article 6, para. 1), the criterion of the median line for the delimitation of the shelf between opposite coasts, is implicit in the very *ratio* of the law on the continental shelf.

The Court so states:

The continental shelf area off, and dividing, opposite States, can be claimed by each of them to be a natural prolongation of its territory. These prolongations meet and overlap, and can therefore only be delimited by means of a median line; and, ignoring the presence of islets, rocks and minor coastal projections, the disproportionately distorting effect of which can be eliminated by other means, such a line must effect an equal division of the particular area involved. If there is a third State on one of the coasts concerned, the area of mutual natural prolongation with that of the same or another opposite State will be a separate and distinct one, to be treated in the same way¹⁰.

The review of international practice regarding the existence of a binding criterion for States at general international law level, done by the Court, is not fully convincing. True, the attitude of States on this matter prior to the Geneva Convention is scattered and gives no indication as to the prevailing trend on this question. It is, however, equally true that the practice subsequent to the Convention — if not borne out of the conventional rule — can provide evidence of a widespread certainty on the logical interconnection between the recognition of an exclusive right on some submarine areas accessory to the right of territorial sovereignty and the delimitation of these areas by application of the equidistance principle in the event of a common shelf, except of special circumstances.

10. I.C.J., Reports 1969, p. 36.

The decision seems to raise greater interest by the fact that consideration has been given to unwritten law in determining the special circumstances that should form basis for exception from, or, in better words, integration of the principle of equidistance.

The Court emphasized three circumstances which, considered either jointly or separately, may fall within the notion of special circumstances calling for departure from the principle of equidistance as a general basis for the delimitation of continental shelves that are common to two or more States.

The first one is the alteration of the required unity between emerged land and its submarine continuation. If the principle of equidistance should alter it, this relation should be restored in favour of the State whose coasts appear to be naturally better suited for the exercise of control over the submarine areas. This principle has been so expressed by the Court:

The contiguous zone and the continental shelf are in this respect concepts of the same kind. In both instances the principle is applied that the land dominates the sea; it is consequently necessary to examine closely the geographical configuration of the coastlines of the countries whose continental shelves are to be delimited. This is one of the reasons why the Court does not consider that markedly pronounced configurations can be ignored; for, since the land is the legal source of the power which a State may exercise over territorial extensions to seaward, it must first be clearly established what features do in fact constitute such extensions. Above all is this the case when what is involved is no longer areas of sea, such as the contiguous zone, but stretches of submerged land; for the legal régime of the continental shelf is that of a soil and a subsoil, two words evocative of the land and not of the sea¹¹.

The second one is strictly linked to the first: it covers in fact the hypothesis where the principle of equidistance, if strictly applied, would lead to ignoring the requirement for a natural balance between the length of the coasts of the States concerned, and the width of the continental shelf area granted to each of them.

A final factor to be taken account of is the element of a reasonable degree of proportionality which a delimitation effected according to equi-

11. *Ibid.*, p. 51.

table principles ought to bring about between the extent of the continental shelf appertaining to the States concerned and the lengths of their respective coastlines, — these being measured according to their general direction in order to establish the necessary balance between States with straight, and those with markedly concave or convex coasts, or to reduce very irregular coastlines to their truer proportions,¹²

The special circumstances heretofore mentioned refer to hypotheses of delimitation between States with contiguous and adjacent coasts.

The third one considered by the Court refers to the hypothesis when the delimitation concerns the shelf common to two States with opposite coasts.

The principle of equidistance does not take account of the geological and mining features of the subsoil of the submarine areas. It ensues from this that a single mining deposit may be separated by the delimitation line and subject to exploitation in its entirety by the continental shelf areas belonging to two different States.

In this latter case, the Court feels that the delimitation line as resulting from the principle of equidistance or median line requires no modification. The Court feels instead — along the lines of procedure followed so far in practice¹³ — that the States concerned are committed to engage in a type of exploitation that would take into account the mutual interests and requirements.

According to the Court, in fact,

another factor to be taken into consideration in the delimitation of areas of continental shelf as between adjacent States is the unity of any deposits.... The Court does not consider that unity of deposit constitutes anything more than a factual element which it is reasonable to take into consideration in the course of the negotiations for a delimitation¹⁴.

12. *Ibid.*, p. 52.

13. *E.g.*, Agreement between the Government of the Kingdom of the Netherlands and the Government of the United Kingdom relating to the exploitation of single geological structures extending across the dividing line on the continental shelf under North Sea, October 6, 1965.

14. I.C.J., Reports 1969, pp. 51-52.

REFLECTIONS ON THE PRESENT AND FUTURE REGIME OF THE SEA-BED OF THE OCEANS

BY

Dr. GAETANO ARANGIO-RUIZ

*Professor of International Law, University of Bologna and the John Hopkins
University Center, Bologna*

Introduction

- i. The present paper is divided into five Sections:
 - i) The present régime of the sea-bed and its possible line of evolution;
 - ii) International *versus* national "control" of the sea-bed;
 - iii) Some features of an international régime of the sea-bed;
 - iv) The "reservation for peaceful uses";
 - v) The sea-bed in the context of the régime of the oceans in general;
 - vi) Tentative conclusions.

The author aims not at exploring the matter thoroughly. His only purpose is to set forth a few reflections on some of the issues that the Symposium will discuss.

Emphasis has been placed on the economic exploitation and development of the sea-bed, particularly on the equitable distribution of Sea-bed resources. Except for a few general remarks in Section IV, the reservation of the sea-bed for peaceful purposes has been left aside: first in view of our total incompetence in the field; second because the far greater difficulties of "demilitarizing" the sea-bed in any measure should not, in our opinion, prejudice the adoption of a really efficient system for the international control of peaceful Sea-bed activities in the general interest.

Section I. *The present regime of the sea-bed and its presumable evolution.*

2. As other international gatherings on the subject, we are concerned, basically, with the issue whether the present régime of the sea-bed is the most suitable to further given ends. The determination of the present legal régime of the sea-bed and subsoil, and/or the resources thereof, must, therefore, be the starting point.

However, for the purposes of the present Symposium (not devoted to the *legal* issue *per se*), the determination of the present legal condition of the Sea-bed need not be as "final" and detailed as it would have to be if it were to be presented to a court in view of the decision of a case. A brief assessment of the main trends of doctrine and practice should suffice.

3. A) According to one doctrine¹, the Geneva Convention on the Continental Shelf "has committed itself with respect to deep sea areas". Under this doctrine, deep sea resources have already been placed by the Continental Shelf Convention under the control of certain specified States. "The exploitation of submarine resources at any point — Oda wrote last year — must always be reserved to the coastal State, which is empowered to claim the area when the depth of the superjacent waters admits of exploitation. It can be inferred that, under this Convention, all the submarine areas of the world have been theoretically divided among the coastal States at the deepest trenches. This is the logical conclusion to be drawn from the provision approved at the Geneva Conference³.

According to this doctrine — if we understand correctly — acquisition of exclusive rights on the ocean bed (and subsoil)

1. See for example MUNCH, *Die Internationale Seerechtskonferenz in Genf* 1958, *Archiv des Völkerrechts*, vol. 8 (1959), p. 180 ff., at p. 206; and ODA, *Proposals for Revising the Convention on the Continental Shelf*, *The Columbia Journal of Transnational Law*, vol. 7 (1968), pages 5-6 of the reprint; and *Comments on Professor William T. Burke's Report*, in *Towards a better Use of the Oceans - A Study and Prognosis*, Sipri, Stockholm, 1968, p. 295-296.

2. From the *Comments* quoted in footnote 1 above. Professor Oda makes clear, in the quoted article in the *Columbia Journal of Transnational Law* (page 5) that in setting forth his view concerning the interpretation of the Shelf Convention of 1958 he "takes no position regarding future policy".

would thus be already provided for and would be subject only to exploitability. For appropriation to be excluded in any areas, an amendment of the Geneva Convention would be required, such an amendment to set forth a negative rule³.

It would also seem that the exclusive rights acquired or to be acquired under the same doctrine are understood as exclusive rights in the "spatial" or "territorial" sense explained below, namely rights territorially or spatially determined, or having the very area as their object, although perhaps limited to the purposes of exploitation of resources⁴.

4. B) According to other theories, the régime of the part of the Sea-bed in question is still what it was before the relatively recent development of the law with regard to the Shelf, and the acquisition of "exclusive rights" by States — in a "territorial" or "spatial" sense — would be more problematic. By "exclusive rights" in a "spatial" or "territorial" sense we mean exclusive rights — limited or not to the exploitation of resources — *covering areas* of the Sea-bed, namely "territorially" or "spatially" determined or having the very "area" as their object. We do *not* refer *merely* to rights — however exclusive — that a State could enjoy on a fixed sea-bed installation, on a vehicle or on persons on the sea-bed, or more generally to the "right" (or freedom) of any State to carry out, on the Sea-bed and in the subsoil thereof, any activities compatible with, and protected by, the freedom of the high seas.

For the subsoil, it is pretty widely accepted that the acquisition of "exclusive rights" is theoretically possible (mining

3. It is not quite clear to me whether or to what extent, according to the doctrine under consideration, the rules of the 1958 Convention on the Continental Shelf coincide with customary international law, and how far, therefore, the regime described above obtains *erga omnes*. Although the ICJ seems to believe that the Convention reflects customary law (*North Sea Continental Shelf Cases, ICJ Reports, 1969 page 22*) we may leave that question open. It can be assumed, however, that in the measure in which the doctrine under consideration understood the Convention correctly — in the sense that exclusive rights of coastal States would automatically follow exploitability also in Sea-bed areas situated beyond any line determined on the basis of the geographical notion of the shelf, of adjacency, of continuity, etc. - customary law would conform sooner or later.

4. *Infra* the following paragraph 4.

excavations or communication tunnels dug horizontally from land or by a vertical approach from the water surface).

As regards the ocean sea-bed, various trends can be discerned, into all of which we need not go. According to the main trend, the acquisition of "exclusive rights" is not compatible with the freedom of the high seas and thus excluded. This would follow either from the operation of *negative* principles or rules, or merely from the *absence of a rule* attributing "exclusive rights" under given conditions.

According to these views, the sea-bed areas in question remain under the operation of the general principles or rules governing the uses of the high seas in general (surface and submarine navigation, fishing, cables, pipelines, scientific research etc.), including of course the special rules and legal situations concerning the so-called "permanent utilizations" of the seas (sedentary fisheries). Activities on the sea-bed would be free, subject to the respect of the freedom of others to carry out similar or alternative activities.

5. Thoroughly to discuss the complex issues involved in doctrines A and B would not only take too much of the time of the Symposium but reveal itself in the end non essential for our purposes.

Of course, *concrete* steps could not be taken towards the "reform" of international and/or national law relating to the sea-bed — far less towards the adoption of some provisional régime — without determining with the utmost accuracy what the present state of the law is.

In the measure, however, in which *this Symposium* is concerned with finding the best ways and means to secure the utilization of the sea-bed in the interests of mankind, a general evaluation of the state of the law will suffice. The more so as:

i) the doctrines very summarily referred to in the preceding paragraphs may well prove to be, in the last resort, less distant than they seem to be from the point of view of the purposes of this Symposium;

ii) for the purposes of this Symposium the general "evolutionary trend" (or the most likely or less unlikely

evolutionary trend) is more important than the determination of the present state of the law in detail.

6. We are unable to accept the theory that "exclusive rights" of States over *specially* defined areas of the ocean sea-bed would follow automatically from exploitability as in the case of the exclusive rights provided for under the 1958 Convention with regard to the Shelf.

However anxious the 1958 Convention (or the customary rule it reflects) may have been to satisfy the special interests of coastal States (together with the exigency of avoiding anarchy), there is sufficient ground, at least in Articles 1 and 2 of the Shelf Convention, to maintain that the acquisition of the exclusive right by the coastal State — a limited "economic" right, for that matter, to be understood within the framework of the freedom of the seas — is subject *also* to conditions *other* than exploitability. Neither the wording and *ratio* of the Articles, nor the "travaux préparatoires", nor the tenor of statures, proclamations, administrative acts or agreements concerning the Shelf, justify the "disposal" of requirements resulting from terms such as "continental shelf", "adjacent to the coast", "coastal State", "said areas" and others, including the ICJ's "natural prolongation of land territory".

However elastic the indication of the outer limit of the Shelf may be rendered by the addition of the "exploitability" element to the indication of the "depth of 200 metres", a limit does exist, albeit difficult to determine. The elastic piece in the definition's structure — "exploitability" — *is attached to the emerged land*. As any piece of elastic material, it cannot be stretched indefinitely. It is bound to break at one point before reaching 10, 5, 3 or 2 thousand metres depth.

7. But we would not get involved with this argument any further. It matters more, here and now, to see where we would stand, in comparison, under the other doctrines (B).

Surely, the acquisition of exclusive rights would be legally "open" under doctrine A and legally "closed" or "unopen" under doctrines B. But what is likely to happen in practice? And what would be the most probable evolution of the law as envisaged by doctrines B?

Under doctrine A, the acquisition of "exclusive rights" would take place once the condition of exploitability were met. Exploitability being not around the corner for the largest part of the ocean bed, a good part of 20 or 25 years would elapse before the condition were met and acquisition accomplished.

Under doctrines B, acquisition of those rights would be either "closed" by the principle of the freedom of the seas (or by a rule based upon that principle) or — less probably — "not opened" by a positive rule.

Given a continuous scientific and technical progress, activities on the sea-bed (including research necessary to ensure progress) will be carried out at increasingly lower depths. It is conceivable — given always continuity of progress — that for some time all the parties and States directly involved in sea-bed activities will be happy with the legal protection afforded them by international law — directly or indirectly — *as non exclusive users* ("freedom of the seas").

While only a few people and nations will be involved, this might be considered satisfactory. Matters would probably remain — from the legal point of view — within the traditional lines of the regime of activities on and in the high seas, such as fishing. Each State would enjoy a claim to "free use" of the environment, subject to equally free use by others, and to the protection of its "ressortissants" and its interests on the basis of nationality and/or flag.

At a further stage, when more substantial operations were to be carried out on the sea-bed by more numerous parties and by means of more permanent and extended installations, "limited" or "qualified" exclusive rights would make their appearance, such rights resembling the exclusive rights enjoyed by certain States with regard to *sedentary* fisheries and similar "permanent" utilizations of the marine environment. And it is very likely that in the meantime a considerable pressure would be exerted by coastal States against the obstacle represented by the negative customary rule (or, less probably, by the absence of a positive rule) and for the law to evolve in the direction of acquisition of exclusive, *spatially* determined, and less limited, States rights.

Even conceding all the differences between deep Ocean beds and the Continental Shelf, it does not seem that such a

development would be any less probable than the evolution of the law that took place with regard to the Continental Shelf in the two decades that preceded the Geneva Convention.

8. Considering that for the deep sea-bed there would not operate factors such as "appurtenance", "prolongation of the land", "adjacency" or "rayonnement of territorial sovereignty", it is of course possible that the evolutionary process of the legal régime of "oceanic" sea-beds be slower.

It is also likely that for the same reason the acquisition of exclusive rights over the "new" areas be subjected by the law to more substantial conditions: for example, to a relatively more effective "occupation", or to an effective exploitation, rather than the general "exploitability" with which the authors of Articles 1 and 2 of the Shelf Convention contented themselves. However, one need not be a prophet to tell that an evolution of customary law leading to the acquisition of exclusive rights in a decidedly "spatial" sense — albeit not "territorial" because always limited, perhaps (as on the Shelf), to *economic* exploitation, and subject always to the respect of the freedom of the seas — would take place.

In addition to the growth of the interest of the most developed coastal States engaged directly or indirectly in deep sea-bed operations to secure for themselves, individually, the exclusive control of given, increasingly extended, areas, two factors are likely to influence legal development in the sense indicated:

i) one factor would be — assuming that sea-bed resources became "business" — that the absence of exclusive "spatial" rights enjoyed by given States in delimited areas might create difficulties. Under the present "freedom of the seas" régime, sea-bed activities could only be protected in the relatively less effective manner in which the uses of the high seas are generally protected on the basis of nationality and/or the flag. The absence of "spatial" criteria of delimitation of the sphere of action of each "protecting" State, might bring about confusion, conflict and perhaps anarchy.

Before this situation became a deterrent for investment, the protagonists in the "sea-bed race" would naturally be led to press for spatial delimitation.

ii) another factor is the concurrence of interests that would arise between the most developed and the least developed coastal countries in securing "spatial" delimitation. Developing countries, unable to proceed by their own means, would have to rely on concessions or licenses to foreign companies: but to subject the activities of these to their own laws they would normally need a "spatial" basis.

At such a stage, if international custom were to prove too slow in its "adaptation", the acquisition of exclusive "spatial" rights by States would be pushed through by coastal countries by treaty. Most coastal countries would find it indispensable to cut the bed of the ocean into slices: and they would feel entitled to do so in pursuit not only of their selfish interest but also of the interest of "order" threatened by "anarchy".

9. This is all the legal knowledge and foresight the Symposium needs.

It is possible that for the time being, and for a number of years ahead, the utilization of the sea-bed (and subsoil) be covered satisfactorily by the "freedom" of the seas, in the sense explained above (paragraph 7). However, the growing interests of coastal states to secure for themselves exclusive rights in given areas, combined with the possibility that the regime based upon the "freedom" of the high seas lead to serious shortcomings and eventually to a state of anarchy, is likely to determine, with regard to the sea-bed, a development of the law not dissimilar from the development that took place with regard to the Shelf. The more so as the delimitation of the Shelf is controversial.

There are sufficient elements, in other words, to justify the forecast, if not the conclusion, that the law of the sea-bed — written and unwritten — is at least likely to develop, at some time, in the sense of opening the way to the appropriation of the sea-bed — in one form or another — on the part of coastal States. Even if this forecast were to prove unjustified, it can surely be said, in our opinion, that the state of customary and conventional international law is *definitely not such*, at the present time, as to shut doors and windows for good — including the less near future — to the appropriation of the sea-bed (and subsoil) by coastal States.

In such a situation, a Symposium aiming at the future of the sea-bed had better put aside any attempt to reach a final and definite conclusion regarding the present régime of the sea-bed. It should consider instead whether a régime leading to the subdivision of the sea-bed among coastal States would be a satisfactory one. And since the alternative to such a régime would be some form of international control, the real issue for us is: "international *versus* national control" of the sea-bed (and subsoil), as a *de lege ferenda* matter.

Section II - "*International versus national control*" of the sea-bed of the Oceans.

10. To put it with Neild⁵ there is a host of arguments against national appropriations and in favour of an international régime: those concerning "order and harmony" and those concerning "economics and equity".

We would add a further distinction: arguments concerning the *sea-bed itself* and arguments concerning the repercussions of the régime of the sea-bed *in other fields*. Foremost among the latter are arguments relating to the best utilization of the *resources of the oceans in general* and the best harmonization of *all the uses of the seas*⁶.

Furthermore, it should not be overlooked that there are further arguments related to the impact of the régime of the sea-bed — and the seas in general — on *harmony and cooperation at large within the family of nations*.

From each one of these points of view, a régime of national appropriation would result either in a loss (*damnum emergens*) or in the preclusion of possible gains (*lucrum cessans*) or in both. I would indicate the main disadvantages — in one sense or the other — as follows.

a) Within a context of national appropriations of sea-bed areas, the utilization of the sea-bed would add a further element

5. In *Towards a better Use of the Oceans: a Study and Prognosis*, Sipri, Stockholm, 1968.

6. *Infra*, Section V.

of friction and conflict among States:

i) at the stage of assertion and delimitation of the respective areas of exclusive States rights; and

ii) in the course of the exploration and exploitation of the areas.

b) Positive and negative conflicts of jurisdiction would not be conducive to the efficient "administration" of the sea-bed (and subsoil) in the interest of achieving the best possible utilization of resources.

c) Multiplicity of jurisdictions on the sea-bed would jeopardize the "freedom" of the superjacent waters and endanger the free development of the various activities at present carried out by all within the framework of that "freedom", and add further cause of conflict among States⁷.

d) Multiplicity of jurisdictions on the sea-bed would add to the difficulties which already prevent an adequate coordination of governmental measures (legislative and administrative) that appears to be increasingly necessary for the protection and development of marine resources and for the promotion of any uses of the seas in general (conservation of fish resources, aquaculture, marine and submarine navigation, setting and conservation of submarine cables and pipelines, prevention of pollution by oil or nuclear waste, etc.)⁸.

e) Appropriation by single States would result in neglecting the economic interests of many States, especially land-locked States and their peoples, and in favouring particularly the interests of the most developed and powerful coastal nations.

f) A régime of national appropriation is apt to favour more than any other the consolidation and development of the military uses of the sea-bed. This would increase the difficulty of achieving disarmament or arms control, not only on the sea-bed but in any other marine environment; or, for that matter, in any environment.

7. *Infra*, paragraph 22.

8. *Infra*, paragraph quoted above.

Section III - *Some features of an international régime of the sea-bed of the oceans.*

II. Once the issue "international *versus* national control" of the sea-bed were resolved in favour of the first alternative, it should go without saying that the international régime should not be confined to a merely normative "internationalization" of the sea-bed. By *normative* internationalization I mean a basically unaltered "national control" system run by the various coastal States, coupled with a more or less extended and strict regulation of sea-bed activities by treaty.

While a solution of this kind is obviously among the possibilities, it would not seem likely to ensure the attainment of either of the two basic aims: "equitable distribution" of sea-bed resources and "reservation for peaceful uses". In the first place, there would be no real "internationalization" unless *international* organs or agencies took the place of the independent national authorities that would operate under a "*national control*" system.

Even conceding that the detailed rules adopted by treaty were sufficient to coordinate "national controls" in the measure necessary to reduce significantly the disadvantages of a "loose" "national control" system, the adoption of a treaty embodying a regulation of sea-bed activities in adequate detail would be neither feasible nor desirable. First, States are hardly likely to commit themselves, at the present stage of sea-bed development, beyond the acceptance of general, "programmatic" rules that would leave them a sufficient margin of discretion in future regulatory and administrative action. Secondly, it would be hard, if not impossible, to elaborate at present an adequate regulation containing "all the answers" to the normative problems that will arise as long as science and technology advance. It would be very bad "legislative policy" to attempt to do so.

International organs, endowed with a minimum of regulatory administrative and juricial power — able to formulate and apply the rules required at any future time for the "good government" of human activities on the sea-bed and subsoil — seem to be an essential feature of any régime other than more or less co-ordinated controls by States.

Bearing in mind in the first place the purpose of development and equitable distribution of resources — and leaving aside for the moment the reservation for peaceful uses⁹ — an organized system for the international “control” of the sea-bed should possess, in our tentative view, the following features.

12. *Main tasks of an international sea-bed agency.* The functions of the agency should be regulatory, administrative and judicial.

The agency should be not an industrial or commercial operator, even less the sole operator¹⁰. We do not believe that an “operating” agency would serve a useful purpose, especially at the present, highly *unconventional* stage of scientific and technical development. Apart from the difficulty that the agency would meet in obtaining adequate capital investment and staff, it would enjoy an absurd monopoly in sea-bed activities, chase out of business the private and public companies or concerns that should be allowed the fullest opportunities to play their part in sea-bed development, and suppress free competition in a field where that element would be even more necessary than in “conventional” industry.

The agency should exercise, within the “international control system”, the role that national governments in a wide sense would exercise within a “national control” system.

Direct operations by the agency would of course be a normal occurrence in the fields of sea-bed research and technology development. This would be a part of the agency’s “governmental” functions.

13. *Legal condition of the sea-bed under the “international control” system.* The controlling international agency should acquire at some stage a “right” on the sea-bed as similar as possible to the title which national States enjoy or would enjoy in its stead. Only such a title would put the agency in the position to exercise its governmental functions.

Considering that the international agency, should not, as a rule, be an “operator” in sea-bed exploration or exploitation,

9. *Infra*, paragraphs 18-19.

10. For the agency’s direct operations in research and technology see below in this paragraph.

ownership would not do. Apart from the fact that "ownership" only has its proper sense within the framework of the private law of a municipal legal system, the agency should enjoy "*eminent domain*" rather than "domain".

However, we think it would not be necessary to qualify the agency's "right" expressly (i.e. in the treaty) by such an imposing and controversial term as "territorial sovereignty". The treaty should simply exclude the possibility of acquisition of eminent domain, sovereignty, or any other exclusive international right by States or Governments, and assert the exclusive eminent control of the international agency. It would leave to lawyers (and to customary international law before them) to decide what would be the legal consequences, with regard to title, of the combined effect of the preclusion of acquisition by States and of the effective exercise by the agency of the powers and functions provided for in the "sea-bed treaty" ¹¹.

14. *Sea-bed operators and licensing.* The agency's direct licensees should preferably be, in our opinion, private and public *operators*, including States themselves, in so far as they are and remained *direct* operators in the financial, industrial, commercial, scientific and technical fields. Although forms of sub-licensing by any operator could usefully be envisaged under adequate control by the agency, we would not recommend a system by which States were able to secure exploration or exploitation rights over large areas, for their Governments to act in their turn as licensing authorities. A system of that kind would:

i) reduce the efficiency of the control of the agency over the licensees and relegate the agency, in the last resort, to the role of a purely intergovernmental organization deprived of "operational" (i.e. *direct*) powers;

ii) let in by the window the idea of national appropriation;

11. The only wish I would express with respect to terminology — but in the hope that the envisaged treaty does *not* contain *any* express definitions except for strictly technical terms (oceanographic, geological, physical, chemical, biological as opposed to legal terms) — is that the international "legislator" avoid, if he were really unable to resist the temptation of mentioning the legal nature of the agency's title, the term "jurisdiction". This term is already "abused" enough — to the confusion of "Roman" or "civil" lawyers — in the international law doctrine and practice of English-speaking countries.

iii) substitute a distribution of licenses on a "national" or "geographical" basis (as with posts in the secretariats of international organizations) for the idea (the only sound one) of a distribution of licenses based exclusively on economic and technical evaluations to be made by the agency in the interest of the best utilization of sea-bed resources for the benefit of all.

15. "*Royalties*" and allocation of income. Royalties (or any other forms of charge) should be collected by the agency. Once the costs of the agency's operation were deducted, the income should be distributed among member States according to general criteria to be set forth in the sea-bed treaty and applied by the agency's administrator on the basis of directives from the most representative body of the organization.

a) Among the criteria of apportionment, the special needs of developing countries should be taken into account but not exclusively. Some role should be played, *inter alia*, by the measure in which each "member country" contributed, in proportion with its national income, to the expenses of the agency during the years in which little or no revenues would be forthcoming.

b) We would be inclined not to favour, in the present circumstances, the allocation of the agency's net income to the United Nations, or to the financing of any given United Nations activities (peace-keeping, or economic and social cooperation) or of any specialized agency. The obstacle to the adoption of such a course would lie, in our opinion, in the inexistence, in United Nations bodies and in many specialized Agencies, of any satisfactory criterion of distribution of the voting power with regard to the deliberations concerning the use of the funds allocated by the sea-bed agency; and/or in the absence, in the same bodies, of a power of binding decision in the matters for which the sea-bed agency's funds could be earmarked.

We agree with Neild¹² that distribution of the agency's net income among member countries on the basis of population — as opposed to the allocation to the United Nations or to given "community" purposes — is not a very imaginative

12. Paper quoted above.

one. This is the reason why we would not favour population as the decisive criterion and would combine it with the *needs* of developing countries and the extent to which each nation participated, *in proportion to its possibilities*, in the financing of the agency's operations. It should be noted that the latter element would be far from insignificant during the (probably not short) period in which the development of sea-bed science and technology — one of the main tasks of the agency — is bound to be a financially passive operation under any régime.

While aware that providing the United Nations with an "independent source of income" is a noble aim, we believe that the obstacle to its attainment lies not in the difficulty of finding the source of income. The real obstacle is the unwillingness of a relevant portion of the United Nations membership to let the organization become financially less dependent.

c) This applies, in our view, to development programs not much less than to peace-keeping. Surely, a majority in the United Nations General Assembly would be more easily available behind a resolution making the organization financially less dependent on development programs, than behind a resolution concerning an independent source of income to finance peace-keeping. The difficulty would remain of overcoming the limitation of the powers of the General Assembly (in either field) to the adoption of nonbinding recommendations. And it need not be added that in so far as could the General Assembly be empowered to decide bindingly (on either matter), as the distribution of the voting power among the members were radically revised.

d) This is the reason why we suggest above that the sea-bed agency's income be simply apportioned among the member States of the agency. Such a destination of the agency's income seems to be, if I am not mistaken, the only chance (in so far as the *economic* purposes of a sea-bed treaty are concerned) to induce sovereign States to accept the establishment of a sea-bed agency as a really efficient body; and to accept, to that very end, any distribution of the voting power which would mark a departure from the deadly "one State one vote" system.

Be as it may of our suggestions — of the theoretical character of which we are aware — it would be pathetically hypo-

critical to attempt to promote the cause of world government through the roundabout device of injecting a bit of independence into the United Nations by providing the latter with funds to be drawn from the hardly reachable resources of the sea-bed of the oceans. The more so if one envisaged the Sea-bed Agency on the model of the United Nations organization itself.

16. *Nature, organization and powers of an international agency.* As we envisage its tasks, the agency should be comparable to a governmental structure, able to carry out:

i) the *direct* regulation and administration of the sea-bed and the settlement of disputes, and

ii) the secondary — although most important — task of engaging in direct sea-bed activities in the field of research and technology.

a) The agency should be thus endowed with features that would make it a “unique” intergovernmental organization at the universal level. Indeed, the agency should perform functions the effective exercise of which demands that it qualify as an “operative” organization, in the sense in which an operative character is recognized not so much to UN peace-keeping activities, or to ICAO regulatory functions, or WHO or IRO direct action “in the field”, as to the Commissions and the Court/European Communities (especially ECSC and ECAE). With these institutions, the “sea-bed agency” should have in common — if the international control system is to work — that feature which consists in the possibility of direct, normative and administrative “action” — within the sphere of its mandate — at least with respect to physical and juristic persons engaged or wishing to engage in certain activities irrespective of nationality, domicile or any other “attachment” to given States, and without the necessity, as a rule, for such States to take implementing action *ad hoc* within their municipal legal systems. In other words, the normative and administrative acts of the agency should not be binding upon member States only. The agency’s regulatory and administrative action should reach individuals and collective bodies directly.

b) Similar considerations apply to the judicial function within the framework of a “sea-bed control” treaty. We

would not envisage referring sea-bed treaty disputes to the ICJ. A special judicial body — open also to individuals and private and public bodies within States — should be established, more or less on the lines envisaged in Article XIII of Danzig's draft treaty.

17. *Role of the United Nations.* The tasks envisaged above should not be entrusted to the United Nations.

a) The United Nations does not possess the specific features that it would be necessary to deploy in the international "administration" of the sea-bed in the wide sense attributed to that term. No State participating in a sea-bed treaty of any significance, willing to comply with its provisions and decided to "get its worth out of it", could rely on the United Nations for effective governmental action.

This would be equally true for any one of the existing specialized Agencies or any new agency set up on their model.

b) While cooperation by the agency with the United Nations and any universal or regional institution (intergovernmental or private) should be open to the agency's and counterpart's choice and would be most fruitful, it would not be wise to have the agency established by the method usually followed to set up the specialized agencies of the United Nations. I refer to the method involving, as one of the steps leading to the establishment of the organization, the "adoption" of the statute by the General Assembly. Anything the United Nations may do, in the line of Resolution 2340, to promote the internationalization of the sea-bed would of course be welcome. It is our feeling, however, that in the measure in which the international control of the sea-bed were the best approach to the problem, the establishment of the agency would be better provided for by a "seabed treaty" negotiated and adopted — naturally with the good auspices of the United Nations — by an *ad hoc* — international Conference". Such a procedure would offer the advantages of:

i) emphasizing *ab initio* the intention of Governments to accomplish an effective step towards some measure of "international government" of the sea-bed (while the very word

“government” is considered bad language in United Nations circles); and

ii) avoiding another occasion — after the outer space and the non-proliferation draft treaties, for over-zealous super-powers to get together and “offer” a draft to the rest of the world for it to ... “take or leave”. With all the respect due by an international lawyer to superpowers, this is not a correct “international legislative procedure” (nor is it, for that matter, a healthy one).

With respect to the nature of the agency and the procedure for its establishment I believe one should be imaginative.

18. *Structure of the agency.* In view of the above, the sea bed agency’s structure should depart in considerable measure from the usual pattern of intergovernmental organizations.

a) Considering the “universal” participation of States and the necessity that one of the agency’s bodies be representative of the whole membership, a General Conference is “de rigueur”. The voting power in the Conference, however, should reflect, by the adoption of appropriate devices, the size, the needs, the degree of development, and the measure of contribution — in funds and skills — on the part of member States. These criteria should be “combined” in the manner most appropriate for the attainment of the basic aim of the treaty, namely the equitable distribution of sea-bed resources. Considering that the equitable distribution would be effected by the apportionment of the agency’s income among the members, the contracting parties in the sea-bed treaty should not be so unwilling to accept that the “voting power” in the agency’s bodies be distributed in the manner most suitable to ensure the highest efficiency of the organization in sea-bed administration and development. The same element ought to reduce — once the principle of internationalization were accepted and embodied in the treaty — the “political” factor in the deliberations of the agency’s bodies.

The obstacle would remain, of course, when one came to the “reservation for peaceful purposes”. (*infra*, paragraph 16)

Considering, in any case, the Governmental (“operational”) functions that the agency should carry out, and the necessity

that the agency operate directly towards individuals and collective bodies — including Governments themselves — it would be “naïf” to expect that all States accept, in the agency’s primary body, a *one vote per State* system.

b) The General Conference should elect a more restricted body — Board or Council — where the distribution of the voting power among the members should again be based upon criteria of proportional rather than “equal” representation. The Board or Council — preferably technical in composition — should carry out the activities of the agency under the guidance of the provisions of the treaty and of the standing or occasional directives of the General Conference. It would be responsible towards the Conference for good performance.

c) The Board or Council, in its turn, would appoint an Administrator who would operate, under the Board, as the head of the administrative machinery of the agency.

Section IV - *The problem of “reservation for peaceful uses” (“delimitarization”).*

19. As we stated at the outset, we are rather reluctant to express an opinion — tentative as it may be — with regard to the problem of the reservation of the sea-bed for peaceful purposes.

In the first place, we are puzzled by the political difficulties involved, and the “vanity” one is bound to discern in any discussion on disarmament and/or arms control in any area, particularly in an environment in which the installation of defensive or offensive weaponry:

i) is perhaps not more preoccupying than the installation of military devices anywhere else;

ii) is far less likely to be renounced — more or less completely — by the Powers of the Earth than it was in the case of Outer Space.

20. Secondly, we are afraid that the injection into the sea-bed régime discussion of the idea of total or partial “demilitariz-

ation", or prohibition of offensive military preparations, or even prohibition of given weapons, might:

i) either prejudice the whole idea of "internazionalization" of the economic and scientific activities on the sea-bed; or

ii) reduce the whole sea-bed exercise to the conclusion of a very bland "sea-bed treaty" equipped with a "harmless" international body of little practical, or ideal, impact.

We would not exclude the possibility of dealing effectively with the scientific, technological and economic aspects of the matter while leaving out — at least for some time — the "reservation" of the sea-bed for exclusively peaceful uses¹³. Functions such as exploration and exploitation licensing, regulation and control of economic and scientific activities on the sea-bed and in the subsoil, and collection of royalties, could be entrusted to an international agency and successfully carried out, even before the problem of military uses were settled.

Section V - *The regime of the Sea-bed and the regime of the Oceans in general.*

21. Whatever the fate of the military uses of the sea-bed, we are inclined to believe, with regard to the problem of the economic and scientific uses of the sea-bed, that one would be ill-advised, in attempting to establish an international régime, if one confined the discussion to the sea-bed alone.

We are fully aware of the excellent reasons why the men of good will — and the Maltese among them — have chosen the fate of the Sea-bed as an urgent matter for the attention of the public and the Governments. It is clear — apart from the good idea of doing one thing at a time — that the régime of the Sea-bed is a problem of very special "actualité" for two reasons.

13. We do not endorse, however, the idea — accepted it seems, by the General Assembly — that the matter of military uses should be reserved to the inconclusive ENDC, or to given powers, or that it should not be discussed by any special United Nations body called to consider the future régime of the sea-bed.

First: man is now approaching — for exploration and exploitation — the *geographical* limit of the continental shelf. It is now, therefore, that the régime of “national control” is taking those first steps beyond the geographical limit of the shelf, that may lead, in due course, to the “appropriation” of large areas of the sea-bed of the oceans and eventually to the partition of the whole sea-bed (five sevenths of the planet’s surface) among the naturally or technologically most “favoured” nations.

Second: It is *now* — if ever — that the issue of international *versus* national control of the sea-bed has any chance of being raised successfully. Once national appetites were awakened and vested interests created within a “national control” context, there would be hardly a chance to sell successfully to companies and Governments — especially those of the countries most advanced in sea-bed development — any idea of internationalization. At that time, “les jeux seraient faits...”.

However, we would not rely so much on those realistic assumptions as to overlook the fact that the problem of the sea-bed would more appropriately be discussed — and eventually solved — only within the wider context of the future regime of the uses of the oceans as a whole or at least of some of those uses.

22. The problem of the sea-bed is, in our time, only a minor aspect of the far more important problem of the uses of the seas in general.

However promising, the resources of the sea-bed and subsoil are far from reliably assessed. They are even farther from the technological and commercial reach of even the most advanced nations.

Knowledgeable people tell us that sea-bed and subsoil resources may acquire significant value on the world markets not earlier than 1985-1990. Even at that time, it is not certain that deep sea-bed resources would be quantitatively such — as compared to land and Continental Shelf resources — as to be of revolutionary impact on world economy. It will be the more so if the delimitation of the non-appropriable sea-bed were to be made with a view to widen rather than reduce the area to be left under the Continental Shelf régime, either by moving

outwards the 200 metres depth line to about 500, or by adopting an intermediate zone up to a depth of two or three thousand metres ¹⁴.

While agreeing therefore that any "reform" of the present condition of the sea-bed should not wait for the time when the accumulation of appetites and interests reached a no-return point obstructing any change, we are inclined to believe that the equitable distribution of sea-bed resources is only the *last* and *least* of the relevant arguments against "free national appropriation" of that environment and in favour of the establishment of an international régime.

Far greater — and in our view decisive — should be the concern of all countries, regardless of their degree of development, or of their present or future "chances" in the sea-bed and subsoil, for the incalculable losses caused and for the opportunities wasted in the past, and for the incalculable losses that would be caused and the immense opportunities that would be wasted in the future, as a consequence of the *unsatisfactory regime of the seas in general* (including, *inter alia*, the more or less open door to national appropriation of the deep Sea-bed).

The major losses and the main waste of opportunities seem to occur — if we have understood the evaluations of experts — in fields such as the conservation, the full development and the proper exploitation of the living resources of sea waters in general. We refer, in particular, to the impressive benefits that mankind could draw from the seas, through aquaculture and FPC programs, provided that really adequate international rules were adopted and really effective international machineries created in order to carry them out ¹⁵.

14. The danger involved in the adoption of the idea of an intermediate zone would be that an international régime of the sea-bed would be economically meaningless at least for a long time.

15. I refer to FYE, MAXWELL, EMERY and KETCHUM, *Ocean Science and Marine Resources*, in *American Assembly Uses of the Seas* (ed. by Gullion), 1968, pages 51 ff.

Section VI - *Tentative Conclusions.*

23. The above reflections lead us to the following tentative conclusions.

A. The condition of the sea floor and subsoil seems to be such as to leave the way open — either by way of extensive interpretation or through the modification of existing law (conventional and/or customary) — to the assertion by States of exclusive rights over portions of the sea-bed situated at increasing depths beyond any conceivable limit of the Continental Shelf in a proper, geographical sense (paragraphs 2-6). This might lead, sooner or later, to the consolidation of a spatial apportionment of the Sea-floor of the Oceans and its subsoil among coastal States (especially among the economically and technologically more powerful States) that would reduce both the chances of a more equitable distribution and/or utilization of resources and the chances of a partial or total reservation of the environment for peaceful purposes (“demilitarization”) (paragraphs 7-9).

B. An international régime of the sea-bed and subsoil would be preferable (paragraph 10).

C. Such régime should include, in addition to a rule defining the outer limit of the Continental Shelf (by way of amendment of the controversial definition adopted in 1958), and in addition to general principles and rules concerning the uses of the sea-bed and subsoil, the establishment of an international agency entrusted with the effective administration of Sea-bed activities, such administration extending to direct licensing and control of the activities to be conducted by private or public parties and States themselves, to the collection of royalties and to the allocation of revenues, and to direct (although far from exclusive) sea-bed and subsoil activities by the agency itself in the field of scientific and technical development (paragraphs 11 and following).

D. For the reasons indicated in paragraphs 11 to 15 above, the agency should be so structured and should possess such powers as to be an adequate, efficient substitute for States in carrying out the regulatory, administrative and judicial functions

indispensable for the "government" (in a wide sense) of the Sea-bed and its subsoil.

E. Details concerning the agency's organization, the distribution of voting-power in the agency's bodies, the destination of revenues and the agency's relationship with the United Nations are tentatively indicated in paragraphs 16, 18 and 15.

F. The serious difficulty of solving satisfactorily the problems connected with the reservation of the sea-bed and subsoil for peaceful purposes should not constitute an obstacle to the adoption of an international régime. The problems involved in the so-called "demilitarization" of the sea-bed might be tackled — totally or in part — even after the establishment of an international régime of the peaceful uses of the Sea-bed and its subsoil (paragraphs 19 and 20).

G. Although the adoption of an international régime *might* be less difficult to achieve for the Sea-bed and subsoil alone, the present writer wonders whether (in view of the considerations set forth in paragraphs 21 and 22) it would not be more appropriate to deal with the Sea-bed in the wider and far more promising context of the régime of the high seas in general. This seems to be particularly important with regard to aquaculture and other activities and initiatives aimed at increasing the benefits that mankind could draw from a more rational utilization of the marine environment beyond reasonably determined limits of the "jurisdiction" of States, and at reducing the loss of resources and opportunities deriving from the lack, or inadequacy, of coordination of the policies and measures of national Governments.

POSSIBLE FUTURE REGIMES OF THE SEA-BED RESOURCES

BY

Dr. EMILIO BETTINI

*Deputy Permanent Representative of Italy to International
Organisations, Geneva*

Introductory remarks

1. In examining the possible future regulatory regime of the sea-bed resources we must, first of all, consider four sets of problems. Their importance and character may determine or affect the choice of the possible solutions. The four groups of problems are the following:

i) distribution of the earth's crust emerged from, or submerged in water;

ii) main forms of utilization by States, or subjects under their authority, of the sea and ocean waters, of the sea-bed and ocean floor and the subsoil thereof;

iii) ways and means by which the sea-bed and the ocean floor may be exploited;

iv) the most characteristic principles, concerning the utilization of the sea-bed and ocean floor, which were brought out during discussions within the United Nations.

Distribution of the earth's crust

2. The earth's crust is roughly distributed as follows:

- emerged lands: about 29%;
- continental shelf up to a depth of 200 metres under the water level; about 5%;
- continental shelf, from a depth of 200 to 1,000 metres under water level; about 3%;

— plains, plateaux and hilly abyssal zones from 1,000 to 10,000 metres under water level; about 63%;

— abyssal trenches beyond a depth of 10,000 metres: less than 1%

Considering the present development in technology, we can for all practical purposes — at least in the very near future — exploit up to a depth of 1,000 metres.

Most of the so-called inland and marginal seas are considered as belonging to this zone.

According to the experts, the day when deeper exploitations can be carried out is not far off. In fact, experiments off the coast of the United States have already reached a depth of 3,000-4,000 metres.

However, the situation in the belt which is made up of the first 1,000 metres depth may affect two essential concepts relating to the utilization of seas and oceans: one concerns the delimitation between zones under national jurisdiction and zones beyond it; the other concerns the particular situations of some basins such as, for example, the so-called inland and marginal seas. These two concepts, rather similar in nature, should be taken into account in defining any type of regulatory regime.

Principal forms of utilization of seas, oceans and submerged lands.

3. The following are the principal forms of utilization, by States, or subjects under their authority, of the sea and ocean waters and the sea-bed and ocean floor and the subsoil thereof.

a) maritime traffic, on the basis of the freedom of the seas with respect to the high seas; and on the basis of some universally accepted servitudes for territorial seas;

b) communications by cable (for which there also exists an international servitude on the sea-bed under territorial seas) and pipe-lines under the water for the passage of oil products from ships or from oil-wells in the sea (oil pipelines);

c) exploitation for nutritional purposes: fisheries, the utilization of seaweed or other sea-plants;

d) exploitation of minerals: at present this concerns only the utilization of liquid and gaseous fuels. However, in several parts of the world, experiments are being carried out for the exploitation of solid minerals, such as: manganese, copper, gold, diamonds,¹ etc.;

e) tourism: the most important form of tourism, above all in summer, involves the sea and ocean shores, where very important infrastructures have been built, which involve investment and revenues of billions of dollars;

f) military activities: seas, oceans, sea-bed and the ocean floor are used for defensive purposes by littoral countries;

g) exploitation of hydrological resources: because of the gradual exhaustion of land hydrological resources due to a greater consumption, to water pollution and to the progressive depletion of underground water sources, the world must rely upon resources from desalinated water; for this reason several experiments are being carried out;

h) sources of energy; the movement of tides constitutes a latent source of energy for all coastal States, which could be utilized at any time;

i) discharge of waste: seas and oceans have always been the most important basin for discharging not only polluted waters but also industrial wastes which are difficult to eliminate on dry-land. In this context, it is very important to consider, mainly for the future, the discharge of wastes from nuclear industry;

j) other forms of utilization: scientific research, identification of zones of archeological interest, etc.

It is clear that the utilization of the sea-bed and the ocean floor and the subsoil thereof must take into consideration the numerous interests deriving from the already existing use of seas and oceans, and it is necessary therefore to negotiate appropriate regulations for the protection of such interests. The inland and marginal seas are of great importance in this connection, because of the existence of many of the above-mentioned interests in those areas.

1. In South Africa, this is a commercial undertaking, not an experiment.

Technologies and technical means for the exploitation of the sea-bed

4. The following are the main ways and means by which the sea-bed and ocean floor and the subsoil thereof can be exploited:

a) fixed or anchored drilling rigs on the surface of the water. This is the method used in present exploitation;

b) installations or submerged laboratories placed on the sea-bed ocean floor. This is an experimental system that can be widely employed in the future;

d) the explosion of peaceful nuclear devices. This is the technical means of the future; at present it is being experimented with only on dry-land but it will probably be used for extracting resources from the sea-bed and ocean floor, such as liquid and gaseous fuels, and solid minerals.

The use such means for the exploitation of the sea-bed and ocean floor must not hinder the other activities for the utilization of the sea. The code, which will be adopted, must provide for damages which could be caused to these activities. In this field there are special problems connected with inland and marginal seas, where more than elsewhere the exploitation of the sea-bed can disturb other activities. These are also special problems connected with the juridical nature of the public and private bodies exploiting the sea-bed and ocean floor, which should be closely examined.

Basic principles of a legal regime

5. A complete picture of the possible future legal regime concerning the sea-bed and ocean floor resources beyond national jurisdiction must also take into account the main "principles" of the utilization and exploitation of such resources which have been discussed at international meetings.

These principles have been examined in the memorandum prepared by the Government of Malta in September 1967; in the discussions which took place at the 22nd and 23rd General Assemblies of the United Nations; during the debates at the three Sessions in 1968 of the United Nations Ad Hoc Com-

mittee on the Peaceful Uses of the Sea-bed; and, in particular, in the discussions in Rio de Janeiro last August and, finally, by the Permanent Committee in New York.

In all these debates and discussions, the delegates of the various countries, and mainly those of the developing countries, particularly insisted on the adoption of the following principles:

a) the use and economic exploitation of the sea-bed and ocean floor and the subsoil thereof beyond national jurisdiction must be undertaken without discrimination, and for the benefit of all mankind;

b) the sea-bed and ocean floor and the subsoil thereof cannot be appropriated in any manner;

c) the sea-bed and ocean floor and the subsoil thereof beyond national jurisdiction must be used solely for peaceful purposes;

d) the exploitation of the sea-bed and ocean floor and the subsoil thereof beyond national jurisdiction must be in accordance with the United Nations Charter. Freedom of scientific research must be safeguarded.

6. The following four basic issues arise from the above-mentioned principles of the use and exploitation of the sea-bed and ocean floor and the subsoil thereof:

a) the specification of the limits between the zone within national jurisdictions and the zone outside national jurisdiction;

b) the definition of peaceful uses;

c) the definition of financial net gains;

d) the establishment of a legal regime concerning the sea-bed and ocean floor beyond national jurisdiction, jointly or apart from the creation of an "ad hoc" body for the enforcement of such a regime.

7. These principles and issues give rise to several collateral questions which must be mentioned because of their implications. These are the main ones:

a) once the concept of the definition of national jurisdiction has been defined, the boundaries of the sea-bed must

be fixed. Italy, for example, which on dry-land has a common frontier with France, Switzerland, Austria and Yugoslavia, on the sea-bed will also border upon Tunisia and Malta, and, according to the solution of the problem of the "delimitation of national jurisdictions", perhaps also upon Albania, Greece, Libya, Algeria and Spain;

b) the sea-bed and ocean floor beyond national jurisdiction must be open, under the same conditions, to all countries including those without coastlines. Europe is particularly interested in this problem as it includes the most numerous and compact group of countries without coastlines (Austria, Czechoslovakia, Luxemburg, Switzerland, Hungary, etc.);

c) there are particular problems regarding the exploration, utilization and exploitation of the sea-bed and ocean floor and the subsoil of the so-called inland and marginal seas, as well as regarding the activities undertaken, and of the safeguarding of the coastal countries' interests. For instance, it is clear that pollution caused by the outflow of oil from an oil well on the sea-bed can cause enormous damage in inland and marginal seas (destruction of the fauna, interruption of tourism activities, etc.). On the other hand, damage would be restricted should this occur in the ocean. Europe is greatly affected by this problem, since, in a strict geographical sense, it has a number of inland and marginal seas (the Mediterranean, the Baltic, the Black Sea, the Sea of Marmara, the North Sea, etc.). Almost all European countries are involved in these problems;

d) suitable mechanisms to facilitate the enforcement of an international juridical regulation. This subject (which will be mentioned later on) presents various alternatives. One is the possible utilization of national mechanisms and agencies with regard to the economic activities carried on in zones beyond national jurisdiction. The other is the possible creation of new mechanisms or agencies within the framework of the international regulations (for instance the establishment of international firms or enterprises governed by international law).

Areas of the sea-bed and ocean floor under national jurisdiction.

8. Though it is beyond the scope of this report, a brief resumé regarding the sea-bed and ocean floor and the subsoil thereof under national jurisdiction may be useful.

Some points of a general character emerged during the discussions within the United Nations, in particular:

a) there is general agreement on the existence of a continental shelf subject to the jurisdiction of the coastal states;

b) moreover, there is general agreement that this jurisdiction (with the exception of the sea-bed and ocean floor and of the subsoil thereof under territorial waters) does not imply sovereignty but only the exercise of specified rights and activities;

c) there is also general agreement that the exercise of such rights and activities does not extend to the superjacent water and that it is subject to certain servitudes — in particular, freedom of laying cables on the sea-bed and ocean floor, freedom of navigation and of fishing, etc.;

d) lastly it would appear that there is general agreement that there is a geographic limit to national jurisdiction; a limit which, however, must still be fixed.

These principles and criteria lead to the belief that some fundamental provisions of the Geneva Convention of 1958 concerning the continental shelf must be reconsidered. They, necessarily, will have to be subjected, directly or indirectly, to substantial modifications.

Legal Regulatory regime

Proposal in connection with the regulatory regime of the sea-bed resources.

9. The guiding principles of the regulatory regime for the exploitation of the sea-bed and ocean floor resources would appear to be the following: that the sea-bed and ocean floor are not subject to appropriation: that their exploitation should

be for the benefit of all mankind; that it should follow the aims of the United Nations Charter; and that the sea-bed and ocean floor should be devoted to peaceful uses.

The regulatory regime could be established in any of the following forms:

- a) non-institutionalized international legal regime;
- b) institutionalized international legal regime with a centralized organization;
- c) institutionalized legal regime with a decentralized organization.

A non-institutionalized international legal regime.

10. Such a regime could be established by adopting a number of agreed rules concerning the exploitation of the sea-bed and ocean floor and the subsoil thereof, without creating a specific Agency for their enforcement.

Problems relating to these rules and their enforcement could be discussed, amended or improved by the United Nations (General Assembly and the Permanent Committee on the Sea-bed). A board should be established in order to settle disputes between Parties without, however, changing the non-institutionalized character of this regime. Lastly, the United Nations Secretariat, without having authority to intervene or interfere, could perform specified activities to the best advantage of the system, such as: to take official note of developments, to record the areas of exploitation of a Government and administer them in conformity with the rules agreed upon or with the decisions of the General Assembly, and so forth.

In other words, while a non-institutionalized juridical regulatory regime cannot properly function without the activities of certain bodies or agencies, these bodies or agencies are external and not international to the regime, and undertake collateral, and not direct, activities.

An efficient non-institutionalized regime must be based upon a series of complete and precise rules. These rules, owing to the absence of an agency for their control and enforcement, should avoid uncertainties, omissions and difficulties of interpretation. This is the first problem of this type of regu-

latory regime. Very rarely can a juridical regime cover all the aspects of its activities without loop-holes; on the other hand a certain elasticity, especially as regards a new matter such as the sea-bed, is not only advisable but necessary.

Another problem derives from the fact that in such a regime no Party can be fully certain of its rights. In case of disputes, the procedure for obtaining a correct interpretation of the rules from the arbitral of judiciary bodies (in the absence of the institutionalized bodies) can take a very long time. Moreover, no rule can ever be considered as exclusive, due to the existence of a certain margin of uncertainties.

A third problem, related to the other two, arises from the fact that a non-institutionalized regime does not encourage private investments, does not favour the activities of the weaker countries, encourages the big trusts, and is not suitable to help the developing countries in undertaking activities connected with the exploitation of the sea-bed and ocean floor and the subsoil thereof.

Lastly, the establishment of a non-institutionalized regime would increase the risks that the exploitation of the sea-bed and ocean floor evades the control of the international community, in general, and of the United Nations, in particular, owing to the absence of a valid international organ. It could also be prejudicial to the interests of peace as the exploiting activities in the areas could give rise, because of the potential deficiencies of this system, to conflicts of power and to disputes among States.

An institutionalized legal regime with a centralized organization.

II. Such a regime, besides being provided with a set of rules on the exploitation of the sea-bed and ocean floor, would also provide for the establishment of an agency for their enforcement. It would be responsible for its tasks before the international community represented by the General Assembly of the United Nations.

Agencies in charge of the direct management of economic activities performed by private operators are known to international law. The most typical example is the International Bank for Reconstruction and Development. In this connection

we might also mention the existing river Commissions (Rhine, Danube) and some of the past ones (Oder, Elbe, Congo, etc.).

12. One Agency having world-wide responsibilities, concerned with the exploitation of the sea-bed and ocean floor and the subsoil thereof would have to be of enormous size, and would, therefore, present serious problems in carrying out its tasks. In order to avoid this drawback an *international legal regime with a decentralized organization* could be established. In such a regime the central agency could be sub-divided into as many regional bodies as there are areas under international exploitation, such as, for example, the North Atlantic, the South Atlantic, the Arctic Sea, the Indian Ocean, the South Pacific Ocean, etc.

A decentralized regime would provide for a better and more rational adaptation of the international regulations to the particular situations of each area. Furthermore, it could be employed as a means to begin exploitation activities in a specified area or region — in order to gain experience for future activities in other areas. In so doing, some possible initial mistakes, in the pilot area, which later on might have world-wide repercussions, could be avoided.

Functions of the international legal regime.

13. Whatever type of international regime is established there will be the problem of determining its functions.

For example, consideration could be given to the following functions, which appear to be the most important ones:

a) to set forth rules for the exploitation and exploration of the sea-bed and ocean floor, taking into account the following:

- i) freedom of navigation;
- ii) freedom of fishery;
- iii) freedom of scientific research;
- iv) servitudes deriving from the installation of cables, pipelines or canalizations;
- v) the necessity of avoiding pollution harmful to the sea and ocean flora and fauna, to the utilization of the water

for hydrological purposes (desalination) and to the exploitation of the shores for tourist purposes;

vi) the necessity of protecting the archeologic patrimony.

b) to facilitate the economic exploitation of the sea-bed and ocean floor, and in particular:

i) to encourage investments by creating suitable conditions;

ii) to promote international cooperation, bearing in mind the desirability of an adequate participation of the developing countries;

iii) to protect the interests of all States, and especially of the States bordering on the areas concerned, and the coastal States

iv) to safeguard the special interests of the inland and marginal seas.

c) to develop the exploration and exploitation of the sea-bed and ocean floor by:

i) establishing the areas where this activity will be permitted;

ii) granting and withdrawing exploration permits;

iii) granting and withdrawing exploitation permits;

iv) fixing the conditions of the above-mentioned permits;

v) keeping lists of permits granted for exploration and exploitation;

vi) keeping a cadastral map of the areas under exploration and exploitation;

d) to decide on disputes and violations and to create for this purpose appropriate jurisdictional bodies;

e) to assure that the benefits derived from the exploration and exploitation of the sea-bed and ocean floor be used for the good of mankind; for this purpose, to create an appropriate international taxation system;

f) to prevent and repress violations; to assure that the rules established by the United Nations Charter and its principles and aims, be respected.

14. The above-named functions are of an economico-juridical character.

However, one of the basic principles now being discussed in the international forum concerns the fact that the sea-bed and ocean floor must be utilized for peaceful purposes; this is a political aim.

The international regulatory regime and the institutionalized body could also have the political function of supervising the peaceful use of the sea-bed and ocean floor beyond the limits of national jurisdiction, according to rules agreed upon by the international community.

This supervising function might consist in informing the United Nations Security Council if and when the principle of peaceful use is not respected.

15. While a legal institutionalized regime could easily perform the above-mentioned functions, difficulties would arise with a non-institutionalized legal regime. In the latter case:

a) many of the proposed functions could not be carried out for lack of a body — or agency — charged with their implementation;

b) respect for international rules would depend on the goodwill of States;

c) the rights concerning the sea-bed and ocean floor would not be guaranteed. This uncertainty would, as already said, negatively affect the flow of investments, and the participation of the less technically developed States. Moreover it would also have a negative effect on the interest of the international community which should benefit from the exploration and exploitation of the sea-bed and ocean floor.

Therefore, a non-institutionalized juridical regime would not offer as many guarantees as an institutionalized one. This fact would also have a repercussion on the respect of the principles which should be the basis of the utilization of the sea-bed and ocean floor; principles whose implementation would almost entirely depend on the goodwill of States.

Ownership, management and law to be applied.

16. The *ownership* of the sea-bed and ocean floor beyond national jurisdiction is a problem whose solution should be found within the international juridical regime.

Excluding, as a matter of principle, that ownership of the exploited areas should belong to the states or to their nationals, there are the following alternatives;

a) ownership by the international community. This is a more abstract than concrete concept. Nevertheless, its application would be possible either in an institutionalized regime or in a non-institutionalized one;

b) ownership by the international body or Agency. This would be possible only with an institutionalized legal regime. In the case of a regime with a decentralized organization it must be decided whether ownership should belong to the world agency or to the regional bodies. The second possibility seems to be the more practicable.

17. *Management*, that is the practical fulfilment of the operations relating to exploration and exploitation of the sea-bed and ocean beyond national jurisdiction is another problem which must be duly faced by an international legal regime. There are the following possibilities in this respect:

a) direct management. It cannot be considered because — with the exception of limited and experimental operations — its execution is materially impossible owing to the magnitude of the task, the resources to be exploited and the financial and technical means needed;

b) indirect management, entrusted to the States to whom the world agency would allot the sea-bed and ocean floor. This is roughly what has been proposed by the Dutch, but there are some problems connected with it. First of all, there is a danger of a race among States in order to obtain the biggest "part" of the sea-bed and ocean floor, irrespective of the immediate possibility of effective exploitation. Each state would feel encouraged to ask for a larger share even if it could not exploit it for lack of means, for the absence of an immediate interest or of the will to do so. Furthermore, once a state had

definitively acquired an area, it would certainly extend to that area its own juridical system, at its own discretion, without bearing in mind the interests of mankind and those of the international community and of other countries. The sea-bed and ocean floor would be divided into several possessions and this fact would prejudice the effective exploitation activities and the benefits of other countries.

c) indirect management in an organic sense. The world or regional agency would receive documented requests for the exploration and exploitation of the sea-bed from enterprises or public and private bodies of any nationality. The agency would examine such requests and decide, in the case of requests for the same area, to whom priority should be granted. The grantee would receive permission for exploration and exploitation but on certain conditions, such as duration of the permit, the compulsory starting date of the operations within a short period of time (in order to avoid requests which have only the aim of securing potential benefits), and the amount to be paid to the granting body.

In the latter hypothesis, which seems the most workable, it would be possible to take into account the fact that the same area could be subjected to various methods of utilization: exploitation of the sea-bed (for instance, the metallic nodules, mainly of manganese, which are found on various parts of the ocean floor), exploitation in order to obtain liquid and gaseous fuels, exploitation of the ocean floor for solid minerals, etc. It is possible for an enterprise to be interested only in one of these activities. In this case the same area could be granted to other enterprises, according to the type of economic exploitation which they want to undertake.

18. Another problem to be solved within the framework of an international legal regime concerns the *law to be applied*.

In this connection it would be opportune to consider that:

a) according to one of the principles so far discussed without disagreement, the principles and aims of the United Nations Charter should find full implementation in an international legal regime;

b) with regard to economic activities, there already exists, in a narrow sense, an international practice and jurisprudence, of uniformly recognized character, different from the internal law of States; and it would be advisable to take it into consideration. In several branches of economic activity, mainly in the sector of oil, a valid international common law is developing. Moreover, in some specific sectors, the activities of UNCITRAL (United Nations Commission for International Trade Law) could be encouraged and speeded up. This Commission recently started to unify and harmonize international trade law, mainly in the sectors of international payments (international bills of exchange, documentary credits, etc.), international trade arbitration, international sale contracts on movables. It could also be possible to consider the enactment of a new set of rules within the framework of international law, dealing with the possibility of establishing international enterprises created, ruled and protected by international law, which should operate in areas beyond national jurisdiction (the sea-bed and ocean floor beyond national jurisdiction and outer space);

c) with regard to economic activities, the importance and the expansion of the matter is such that, through the regulations of the world agency of regional bodies (in the case of an institutionalized legal regime), one may expect the gradual development of an appropriate positive international law which at a certain moment, may reach the same completeness and integration as the present national laws.

d) the civil and penal laws applicable to the functions and personal acts of the people working in installations (sea-platforms, under-water laboratories), could be, as for ships and airplanes, the law of the flag of the agency or enterprise to which the concession has been granted, or that of the nationality of the owner of the installation, or that of the persons concerned, or that of the nearest coastal State, etc.

Enclosed and marginal seas.

19. In this paper the differences between enclosed and marginal seas and the great ocean basins have often been pointed

out in order to make clear that these differences require a specific and separate solution.

The practical results, however, which have been reached in certain cases by the Geneva Convention of 1958, suggest — for reasons of analogy, equity and rationality — the same solution for all coastal States of such seas.

The enclosed and marginal seas are those basins well delineated by borders of emerged lands, which allow some communication with the open seas and oceans. The most typical examples of enclosed and marginal seas are: the Mediterranean, the Black Sea, the Baltic, the Kattegat, the Skagerak, the Red Sea; however, the North Sea, the Arctic Sea, the Persian Gulf, the Yellow Sea, the Japanese Sea, the Gulf of Mexico, the Caribbean, the Hudson Bay, can also be considered as enclosed and marginal seas, even if they have wider communications with other basins.

20. The main differences between enclosed and marginal seas and sea and ocean basins which justify a different treatment of the former are the following:

a) delimitation of such a sea in relation to the surrounding emerged lands. An internal and marginal sea must not be confused with an inland sea (Dead Sea, Caspian Sea): the former has one or more openings which allow direct communication with other sea and ocean basins, the latter has absolutely no communication of the same kind. Moreover, the enclosed sea differs from the marginal sea, the latter being characterized by the fact that the delimitation of emerged lands lacks one or more sides (for instance Baffin Bay between Greenland and Canada, the Arabian Sea in the Indian Ocean) or it is only lightly marked (the Behring Sea, the Barents Sea, the North Sea, or the Coral Sea in the Pacific Ocean);

b) depth. Normally, but not necessarily, the average depth of an enclosed and marginal sea never exceeds 1,000-2,000 metres, with isolated extreme depths of around 3,000 metres;

c) geological structure of the bottom. It is nothing but the continuation of the crust of the emerged lands; consequently it seems to justify the fact that its resources should belong to the countries having jurisdiction over the continental areas;

d) nearness. Distances between emerged lands are generally relatively small;

e) the importance of certain problems. The enclosed and marginal seas have the following specific, important problems:

i) pollution. The exploitation of an enclosed and marginal sea may give rise to serious phenomena of pollution — aggravated by sea streams — which can destroy the flora and fauna and irreparably prejudice the utilization of the shores of the coastal countries (tourism);

ii) historic and archeologic patrimony. Some enclosed and marginal seas, above all the Mediterranean, contain the invaluable historic and archeologic treasures of ancient civilizations and therefore their exploration and exploitation must be undertaken with responsibility and great caution;

iii) thaw. Special caution — and even interdiction of exploitation — should be reserved to the Arctic Glacial Sea in order to avoid the thaw of the Arctic polar cap which could increase the water level throughout the globe, causing enormous damage to towns and coastal countries;

f) analogy. Some enclosed and marginal seas, owing to their shallow depths, are entirely within national jurisdictions and, therefore, are not included in the general international regulations, such as the Baltic Sea, the North Sea. The fact that other enclosed and marginal seas have a deeper bed does not appear to be a valid factor to justify a discrimination vis-à-vis the former.

21. In conclusion, it would seem desirable to reaffirm that enclosed and marginal seas need a solution different from that adopted for open seas and oceans. The solution could be that, for reasons of logic and equity, the sea-bed of all the enclosed and marginal seas, answering, more or less, to the aforesaid qualifications, should come under the national jurisdiction of the coastal States.

This solution should not affect the customary and written law governing the waters of such seas. In particular, the freedom of navigation and the freedom of fishery must remain unaltered.

Taxation system.

22. The principle of exploiting the sea-bed and ocean floor and the subsoil thereof for the benefit of mankind gives rise, first of all, to problems concerning its interpretation.

It can be stated that:

a) the interpretation cannot be in the sense that the profits derived from industrial enterprises exploiting the sea-bed and ocean floor should be allocated to the advantage of mankind, otherwise no enterprise would invest its capital and run risks for this exploitation. This concept must therefore be understood in the sense that the share of profits, which, in an internal juridical regime, is paid to the State by taxes, goes to the benefit of mankind when the enterprises carry out their work in areas beyond national jurisdiction;

b) the beneficiary is therefore mankind, that is the community of States, which is represented within the United Nations. The United Nations could employ these revenues in favour of all its members and mainly for the poorest countries (following the concept of the Maltese document of 1967).

23. By way of example, the taxes which could be levied for the benefit of mankind in the exploration and exploitation of the sea-bed and ocean floor and the subsoil thereof, could be the following:

a) registration taxes of the areas generally assigned to the States for a given period;

b) annual concession taxes for the carrying out, in the areas mentioned in paragraph *a)*, of general prospecting activities (for any kind of resources) or specific activities (oil, solid minerals, gaseous fuels, etc);

c) annual concession taxes for the carrying out of real economic activities of the exploitation of the sea-bed and ocean floor and the subsoil thereof;

d) "royalties" on the quantity of product actually extracted in the areas mentioned in paragraph *a)*;

e) international taxation levied on profits made by the enterprises working in the above-mentioned areas;

f) fines paid by the users of the aforesaid areas in case of violations of the law and rules in force in these areas.

Initially, the revenues deriving from these activities might be quite small, but they would gradually increase and reach considerable amounts.

24. Once these amounts become available, the international community could utilize these revenues from the exploration and exploitation of the sea-bed and ocean floor and the subsoil thereof, in order to:

a) meet institutional expenditures of the international legal regime of the sea-bed (world agency, regional bodies, court of arbitration, police and control authorities, possible pilot project, etc);

b) meet United Nations institutional expenditures; first reducing and then eliminating the regular contributions of members. The day this hypothesis becomes a reality, the smaller contributors, which represent the great majority, could avail themselves of the United Nations activities much more freely than now, since the major contributors keep a watchful eye on expenditures;

c) meet special expenditures of the United Nations, which now are financed by voluntary contributions, that is expenditures for the peacekeeping forces for technical assistance, etc. Within the family of the United Nations and the Specialized Agencies, there are several funds, financed by voluntary contributions going from the UNDP (about 200 million dollars per year) to the modest individual funds of some agencies (about 100,000 dollars each). With the replacement of individual and voluntary contributions of States by regular and independent receipts, it should be possible to give real autonomy to the United Nations, allowing it to carry out its activities unhampered by the final vigilance of the major contributors.

d) meet institutional and particular expenditures of the Specialized Agencies of the United Nations, which are roughly the large departments of the international community. Thus, the various agencies could have more leeway in developing their activities without depending upon the goodwill of contributing states;

e) add to the funds of the International Bank for Reconstruction and Development in order to increase investments in the developing countries, by means of long-term loans with low interest and other special conditions, in order to foster their economic and social programmes;

f) increase the funds at the disposal of the International Monetary Fund, to assure greater stability of the world currencies.

25. The problem of the utilization of natural resources which are to be found beyond the limits of national jurisdictions is not only that of the sea bed. In fact, very important resources can also be found in other areas beyond national jurisdiction, for example in outer space.

Indeed, space resources are already being partly exploited, from an economic point of view, in the field of telecommunications by means of satellites. INTELSAT, which created the first global telecommunications system by means of satellites, has been in existence for more than five years. This system, in which 60 countries participate, is showing a good profit.

Nevertheless, space resources have not yet been exploited for the benefit of mankind. None of the profits of Intelsat have been put at the disposal of the international community. It is logical, however, that some of the benefits from the exploitation of outer space, like those deriving from the sea-bed and ocean floor, should also be paid to the international community, according to what has been stated above, in order to facilitate the economic and social progress of all countries and mainly of the developing countries.

International enterprises.

26. In order to facilitate both the exploitation of resources beyond national jurisdictions (sea-bed, ocean floor and outer space) and the allotment of a portion of the profits for the benefit of mankind, it may be useful to consider the creation, within the framework of international law, of a new type of firm: the international enterprise.

International enterprises should be public or private organizations established in order to operate, for profit, in areas beyond national jurisdiction: the sea-bed, the ocean floor and outer space.

Since these enterprises operate beyond national jurisdiction, it is obvious that their establishment and regulation should be governed by a legal regime different from a national one, that is, an international regime.

As already said, the concept of international enterprises is not new in international law. The best example is the International Bank for Reconstruction and Development which performs, on a commercial basis, banking operations and follows, in its practice, principles and rules, mainly of international character, with no recourse normally to national regimes.

The establishment of international enterprises would also require an appropriate international regulation of the different legal aspects which this institute must take into consideration, such as bonds, managers' responsibilities, and so forth.

On the other hand, there already exists a kind of international "common law", mainly in the mineral field, which developed because of petroleum activities, to which it could be possible to have recourse.

The establishment of international enterprises will create the problem of the distinction between civil and penal laws. The international community could provide for the civil law while for the criminal law it could be possible to have recourse to one of several national juridical systems, as for example, to the national law of the defendant, the law of the nearest coastal state, the law of the concessionary State of the area of the sea-bed concerned, the nationality of the installation's owner and so on. There are, therefore, several alternatives.

27. The possibility of creating international enterprises ruled by international law should, in practice, present several advantages and in particular:

a) it would facilitate the enforcement of an international taxation system;

b) it would be, directly or indirectly, a stimulus to financing and to the development of investments;

c) it would encourage international cooperation in view of the fact that an international enterprise would be an efficient instrument for furthering international cooperation;

d) it would allow nationals and agencies belonging either to industrialized or developing countries, to join their industrial and technological experiences and capital;

e) it would simplify the problem of establishing the gigantic inter-continental enterprises which are necessary to handle successfully the complicated and expensive task of exploiting the sea-bed, ocean floor and outer space.

28. The establishment and the successful operation of international enterprises would allow consideration of further alternatives to the international legal regime.

Indeed, a regional international agency could be entrusted with the management of an area of the sea-bed and ocean floor (or of outer space).

Such an agency, instead of granting prospecting and exploiting rights to a Government, which in return would grant them to national enterprises, could directly grant them to international enterprises.

The establishment of an area administrated under this system would be, in any case, an interesting experiment which could coexist with other regimes in other areas.

Conclusion

29. The establishment of an international regulatory regime for the exploitation of the sea-bed and ocean floor and the subsoil thereof for the benefit of mankind, is conditioned by geographic, geologic, political and environmental factors.

Such a regime, moreover, must take into consideration some basic principles which have been widely accepted in national meetings at the United Nations.

However, the realization of an international regulatory regime depends upon the definition of the limits of national jurisdiction, which is of fundamental importance and which seems to imply either a modification of or some basic departure

from the provisions of the Geneva Convention of 1958 on the continental shelf.

As to the international regulatory regime regarding the sea-bed and ocean floor, and the subsoil thereof beyond the limits of national jurisdiction, there are several possibilities.

These are the main ones:

a) a non-institutionalized international regime. It seems to be the easiest to establish but, at the same time, the most complicated to be efficiently enforced, since no country will be certain of its rights and it will lack full protection of its activities;

b) an institutionalized international regime with a centralized organization. It may be realized by creating a large, world agency having authority over all areas of the sea-bed belonging to the international community;

c) an institutionalized international regime with a decentralized organization. Single regional bodies could control single parts of the sea-bed and ocean areas;

d) any of the above-mentioned possibilities would not preclude the coexistence of a system of national enterprises together with a system of international enterprises. The latter must of course be purposely created.

30. The establishment of an international legal regime cannot avoid appropriate consideration of certain aspects.

One of them is the particular situation of the enclosed and marginal seas, for which an "ad hoc" solution should be found. This "ad hoc" solution could consist in adopting for the sea-bed of such seas the same international system as for the continental shelf.

Another aspect is the creation of an appropriate taxation system of the international Community. This system, more than any other, would ensure the application of the principle that the exploitation of the sea-bed and oceans floor must be for the benefit of mankind. This benefit could consist in financing the needs — as profits increase — of the international Community, and in the first place, of the United Nations and of the Specialized Agencies.

The last aspect is the possibility of creating, within the framework of international law, a system of international enterprises.

Such a system would be an efficient instrument for stronger international cooperation and for a more active enforcement of an international taxation procedure.

FUTURE REGIME OF THE DEEP OCEAN FLOOR

BY

Dr. SHIGERU ODA

Professor of International Law, Tohoku University, Sendai

1. *Exclusive Reservation of the Sea-Bed for Peaceful Purposes*

At its 22nd session in 1967 as well as its 23rd session the following year, the UN General Assembly had before it for consideration "the question of the reservation exclusively for peaceful purposes of the sea-bed and the ocean floor, and the subsoil thereof, underlying the high seas beyond the limits of present national jurisdiction, and the use of their resources in the interests of mankind". The regime of the deep ocean floor and the peaceful uses of the sea-bed are matters which have generated discussion not only in the UN but also at non-governmental levels. Of special interest have been such discussions as Senator Pell's draft treaty, Danzig's proposed treaty Borgese's Ocean Regime and the Declaration of General Principles of the Commission to Study the Organization of Peace.

The attempt to lump problems of military versus non-military uses of the sea-bed with other aspects of the use of the sea-bed, for example, exploration or exploitation of the resources of the area, tends mainly to confusion. In terms of exclusive reservation "for peaceful purposes", the areas considered "beyond the limits of present national jurisdiction" are those under the high seas *beyond the territorial seas*. Moreover, the continental shelf is the area over which the coastal state has rights *only* for the purpose of exploration and exploitation of natural resources; the regime of the continental shelf is quite irrelevant to the military or non-military use of the sea-bed. On the other hand, the natural resources which should be utilized "in the interests of mankind" are clearly those contained

in the areas *beyond the continental shelf*, which generally extends far beyond the limits of the territorial sea.

It is thus plain that the areas "beyond the limits of present national jurisdiction" (UN General Assembly resolutions) are two different areas with two different connotations: namely, the areas *beyond the territorial sea for exclusive reservation for peaceful purposes* and the areas *beyond the continental shelf for the use of resources in the interests of mankind*. Despite the importance of the problem of peaceful uses of the sea-bed, it is essential to avoid confusing the two aspects of the uses of the sea-bed. In the course of deliberations at the UN Sea-Bed Committees in 1968 and 1969, the distinction between these two aspects, namely, exclusive reservation for peaceful purposes, on the one hand, and use of resources in the interests of mankind, on the other, was not always observed.

In this respect, the position taken by the USSR at the UN Sea-Bed Committee seems relevant. The USSR proposal reads:

The General Assembly ... 1. Solemnly calls upon all States to use the sea-bed and the ocean floor *beyond the limits of the territorial waters of coastal State* exclusively for peaceful purposes (emphasis added) ¹.

The Draft Treaty Banning Military Uses of the Sea-Bed, submitted by the USSR at the Disarmament Committee meeting in Geneva on March 18, 1969 states:

Article 3 - The use for military purposes of the sea-bed and the ocean floor, and the subsoil thereof, *beyond the 12-mile maritime zone* of coastal States, shall be prohibited ... (emphasis added).

The USSR apparently seeks to avoid the complicated issues of the extent of the territorial seas by referring simply to a "12-mile maritime zone".

I should like to point out again that the problem of exclusive reservation of the sea-bed for peaceful purposes should be discussed separately from *lex ferenda* of the deep ocean

1. United Nations, General Assembly, Official Records, Doc. A/AC/135/20.

floor. My treatment, therefore, will be concerned with *uses of the resources contained in the sea-bed beyond the limits of present national jurisdiction in the interests of mankind.*

2. *Areas Beyond the Continental Shelf*

The Convention on the Continental Shelf has been ratified or acceded to by 39 States, an insignificant figure in terms of the total number of nations now existing in the world. However, if those States which in their respective domestic measures have taken steps toward recognizing the continental shelf regime are to be added to this number, it may be accurately said that at least 70 nations have committed themselves to the regime of the continental shelf. It is submitted that, at the present time, the fundamental regime of the continental shelf is recognized under customary international law. In other words, each State, no matter whether it has ratified the Convention or acceded to it, is entitled to reserve its offshore subsoil areas as its own for the purpose of their exploration and exploitation. The area "beyond the limits of present national jurisdiction", where the natural resources should be exploited "in the interests of mankind", begins where the continental shelf ends.

The outer limit of the continental shelf is one of the most hotly debated aspects of Article 1 of the Convention; and the interpretation of that provision is closely related to the problem of the regime of the deep ocean floor. I had earlier expressed my views on the outer limit of the continental shelf as follows:

It can be inferred that, under this Convention, all the submarine areas of the world have been theoretically divided among the coastal states at the deepest trenches. This is the logical conclusion to be drawn from the provision approved at the Geneva Conference. ... By taking this stand, the author does not suggest that, as *lex ferenda*, the deep sea should be divided among the various coastal states. On the contrary, he is inclined to support the view that, as *lex ferenda*, the regime of the ocean floor of the deep sea should be distinct from that of the continental shelf, thus releasing deep sea areas from the exclusive control of the coastal states which they adjoin. In other words, coastal submarine areas should remain under the control of the coastal state as elements of the continental shelf,

but the deep sea areas beneath the ocean should be treated differently. In order to realize this policy for deep sea areas, it is essential that the Continental Shelf Convention be revised, thus leaving the way open to free the deep sea areas from the exclusive control of the coastal state².

There seems to be no opposition in principle to the suggestion that the continental shelf should not be extended without limit and that precise limits should be set to the continental shelf. The draft statement of principles agreed to by the countries in the Western Group at the UN ad Hoc Committee on the Sea-Bed in 1968 (Set B) proposes:

(1) There is an area of the sea-bed and ocean floor and the subsoil thereof, underlying the high seas, which lies beyond the limits of national jurisdiction;

(2) Taking into account relevant dispositions of international law there should be agreed a precise boundary for this area.

On the other hand, the draft resolution submitted by Malta, Mauritius and the United Republic of Tanzania at the 23rd session of the UN General Assembly contained a paragraph beginning:

Recognizing that there exists an area of the sea-bed and ocean floor and the subsoil thereof which lies beyond the limits of national jurisdiction and which requires further definition, ...³.

The draft prepared by the Afro-Asian Group of the Committee on the Sea-Bed meeting in May, 1969, contains a statement identical with paragraph (1) of Set B above; but it does not propose anything similar to paragraph (2) of Set B above, probably because, in the view of the Afro-Asian Group, this concept would undoubtedly meet with objections from those Latin American countries which have provided for 200-mile territorial seas in their respective Constitutions.

Apart from interpretations of the provision of the Convention relevant to the definition of the continental shelf, suggestions have been made on various occasions with respect to the outer

2. Oda, *Proposals for Revising the Continental Shelf Convention*, 7 *Columbia Journal of Transnational Law* (1968), pp. 1-31.

3. United Nations, General Assembly, Official Records, Doc. A/C.1/L. 433, November 5, 1968.

limit of the continental shelf, in other words, the inner limit of the deep-ocean floor.

At the 1958 Geneva Conference, where the Convention on the Continental Shelf was adopted, the delegate from the Netherlands felt it might be preferable to specify a depth line of 550 metres as being more in line with the deepest part of the continental shelf; and the delegates from Norway and the United Arab Republic proposed that the limitation of the continental shelf be based upon distance from the coast. At the UN Ad Hoc Committee on the Sea-Bed in 1968, the delegate from Norway suggested a combination of criteria of either 500 or 600 metres depth of superjacent waters and the 200-mile distance from the coast. The idea of delimiting the continental shelf in terms of distance from the coast, or at least of granting to each State the right to choose the more advantageous criterion of either depth of superjacent waters or distance from the coast was voiced often by delegates from many States to the UN Ad Hoc Committee of 1968 and the UN Committee of 1969. As for distance from the coast, ranges between 40 and 60 miles are normally suggested. On the other hand, certain Latin American States strongly oppose this, since, according to them, the 200-mile distance from the coast has already been adopted in their Constitutions, and the outer limit of the continental shelf should not be prejudiced by any consideration which might contradict these constitutional provisions.

The various drafts prepared by non-governmental bodies put forward a great variety of suggestions on the outer limit of the continental shelf. They may be grouped as follows:

- i) retention of the 200-metre depth approach;
- ii) combination of the 200-metre depth theory and a criterion of a fixed distance from the coast;
- iii) delimitation in terms of greater depth of the superjacent waters, such as 600 metres, or even 3,000 metres.

It is interesting to note that the oil industry in the US seems to be inclined to favour the extension of continental shelf jurisdiction seaward to the limit of the continental land mass, which falls generally to a depth of 2,500 metres.

Each State naturally favours a wider extension of its own continental shelf. Even the developing countries, which themselves are not vested with advanced skills or capital, are still free to grant concessions to more sophisticated enterprises and thus realize great benefits from their own widely-extended continental shelf areas.

Opposition to any wider extension of the continental shelf exists mainly for two reasons. Certain geographically handicapped nations, such as land-locked countries or countries with only small coastlines or a narrower geological continental shelf, cannot expect much benefit from any widening of the continental shelf, and they therefore oppose such an extension. They would naturally prefer wider areas of the sea-bed to be free from the monopolistic control of the coastal State and placed under some kinds of international arrangement. This would bring to them increased profits obtained thereby from the exploitation of the areas. Opposition to a wider extension of the continental shelf also comes from some of the more advanced States, which would stand to lose potential benefits existing off the coasts of other nations, should such other nations claim a wider region to be under their own jurisdiction. In any case, a State should make known its preference with respect to the outer limits of the continental shelf only after it has fully examined the regime which is applicable to the area beyond, that is, to the deep ocean floor.

In this respect, I note as of great interest the idea of a buffer zone suggested by some non-governmental organizations in the US. The idea is traceable to the American Assembly of 1968 and is fully explicated in the Report of the Commission on Marine Science, Engineering and Resources of 1969. The Commission recommends that:

... intermediate zones be created ... only to the 2,500-meter isobath, or 100 nautical miles, ... whichever alternative gives the coastal nation the greater area ... Only the coastal nation or its licensees, which may or may not be its nationals, should be authorized to explore or exploit the mineral resources of the intermediate zone. In all other respects, exploration and exploitation in the intermediate zone should be governed by the framework recommended above for the areas of the deep seas beyond the intermediate zone.

Thus, a compromise lying between the exclusive interest of each coastal State and the community interest for the benefit of all finds proper expression in a concept of an intermediate or buffer zone.

3. *Use of the Deep Ocean Floor for the Benefit of All Mankind*

The concept of *of the deep ocean floor for the benefit of all mankind* has been generally agreed upon both in the UN and at the non-governmental level. The UN General Assembly resolution of 1967 refers to the exploration and use of the deep ocean floor "for the benefit of all mankind"⁴, and the resolution of 1968 favours the exploitation of the resources of this area

for the benefit of mankind as a whole, irrespective of the geographical location of States, taking into account the special interests and needs of the developing countries⁵.

No nation challenged this concept in the forum of the UN.

Former U.S. President Johnson declared that "we must ensure that the deep seas and the ocean bottoms are, and remain, the legacy of all human beings.

The common heritage of mankind in ocean space and *the common interest of all mankind* in the exploration of ocean space are recognized in the Senator Pell's draft. A similar idea has been repeatedly advanced in various private drafts on the use of the deep ocean floor. The terms *common heritage of mankind* (Commission to Study the Organization of Peace, Borgese's draft), *for the benefit and in the interest of all mankind* (Commission), *for the benefit and in the interest of all countries* (Danzig's draft), *for the benefit of all mankind* (Borgese's draft), *for the benefit of all peoples* (Danzig's draft), etc. are used in designating the general status of the deep ocean floor or in qualifying the exploitation of its resources.

4. Resolution 2340 (XXII).

5. Resolution 2467 (XXIII).

These concepts, however, are so vague that it is extremely difficult to derive from them any precise regime for the deep ocean floor. *The principle of non-appropriation* of any part of the deep ocean floor by any State seems to be the only unchallengeable outflow of these concepts. The principles supported by the States of the Western Group (Set B) at the UN Ad Hoc Committee in 1968 contain the following paragraph:

(4) No State may claim or exercise sovereign rights over any part of this area, and no part of it is subject to national appropriation by claim of sovereignty, by use or occupation, or by any other means.

The principles advanced by the developing countries (Set A) on the same occasion read, *inter alia* :

(1) ... no State may claim or exercise sovereignty over any part of the area ...

The draft prepared by the Afro-Asian Group of the UN Committee in May, 1969 contains a similar paragraph:

(2) This area is not subject to national appropriation by any means, no State may claim or exercise sovereignty or jurisdiction on any part of the area, by use or occupation or by any other means whatsoever, (the term "jurisdiction" seems to be misunderstood in this draft - Oda).

To provide points of reference, it is appropriate to quote from some of the private drafts on the subject. Commission to Study the Organization of Peace:

(4) No State should be permitted to claim or exercise sovereignty, jurisdiction or any exclusive rights over this area, and no part of this area should be subject to national appropriation by any means whatsoever.

Danzig's draft:

Art. III - No portion of the ocean bed or any resources thereof are subject to national or private appropriation or any exclusive use, by claim of sovereignty, use, occupation, or any other means ...

Borgese's draft:

Art. II, A, 2- ... (the deep ocean floor is) not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

American Assembly:

— the bed of the deep sea should not be subject to national appropriation by claim of sovereignty.

Senator Pell's draft:

Art. 2 - Ocean space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

Whatever expression may be used, it is quite clear that no State is allowed to lay claim to any part of the deep ocean floor.

4. *Who Is Entitled to Exploit the Resources of the Deep Ocean Floor?*

The principle of non-appropriation of the deep ocean floor does not lead us to conclude that the exploration or the exploitation of this area should be suspended. On the contrary, the most effective exploitation of the resources should be encouraged, and the incentives for this should not be removed. Free access to the resources of the deep ocean floor should be the right of all nations, not merely those possessing advanced technologies.

Danzig's draft suggests that "there shall be free access to all areas of the ocean bed", and Senator Pell's draft contains the following paragraph:

Ocean Space and the resources in ocean space shall be free for exploration and exploitation by all nations without discrimination of any kind, on a basis of equality of opportunity, ... and there shall be free access to all areas of ocean space.

While free access to the deep ocean floor is guaranteed to all nations, *lex ferenda* provides two alternatives: free exploitation without any restrictions except those imposed by the flag State (flag nations system); and exploitation under some kind of international control (international control system). In other words, it should be asked whether, as in the case of high seas fishing, any entrepreneur would be free to undertake exploration or exploitation of the deep ocean floor merely under the aegis of the nation of his flag, or whether there should be any

international arrangement which would guarantee the orderly development of the resources of the deep ocean floor.

Unlike high seas fishing, the exploitation of the resources of the deep ocean floor requires an enormous amount of capital investment. This in turn requires a certain stability or guarantee against uncertainties. Under the laissez-faire principle, the discovery of any promising deposits of mineral resources by any specific enterprise inevitably attracts the interest of other enterprises and thus gives rise to unnecessary competition among them.

Mention is often made of the necessity to create an international registry with which any project of exploration of the deep ocean floor or its exploitation would be registered, so that all the world might be informed of what is happening in connection with the exploration and exploitation of the deep ocean floor. This agency would have no regulatory power but would be only a clearing-house for registration of the claims of a nation or enterprise to exploration and exploitation rights. The idea of registration of claims is suggested in the recommendations prepared by the SIPRI; and the Commission on Marine Science, Engineering and Resources proposes the establishment of an International Registry Authority. In answer to the question of who is authorized to register with the international registry its claim to exploration or exploitation, the Commission suggests that "only a nation, or association of nations, should be eligible to register a claim". It states further that whether the entity undertaking exploration or exploitation may or may not be a national of the registering nation should be a matter for each nation to decide for itself. It is nowhere made clear why only a nation and not an enterprise, is eligible to register. A further question is raised in connection with the effect of the registration of a claim. If the international registry authority functions simply as a clearing-house, competition among the enterprises is not avoided by the mere act of registering. It seems that registration of a claim to exploit the resources in a specified area of the deep ocean floor should confer upon the registering body, either a nation or an individual, the exclusive right of exploitation in that area for a specified period of time. Without securing such a guarantee of exclusiveness, registration of a claim would be all but meaningless.

Under this registration system, the principle of "first-come, first-registered" should be maintained, subject only to some technical competence of the claimant to carry out the exploitation for which registration is made. The international registry authority shall not be an organization, granting permission or concession for exploration or exploitation but should remain simply a body with which a claim is registered. Again, claimants should not be confined to nations. The exclusive right of exploitation granted to claimants through registration should not be considered tantamount to sovereign rights over any specified area of the deep ocean floor. Therefore, since the claimant which registers with the international authority is not considered to exercise sovereign rights over an area, there is no reason why the claimant should not be an individual or a private enterprise. The state of the flag of the claimant is undoubtedly competent to exercise its jurisdiction over the registered claimant which carried out exploration or exploitation. Such exercise of jurisdiction is no different from that exercised by a State over its vessels engaged in fishing on the high seas.

The registration system benefits most those States which have advanced technologies and sufficient capital to enable them to undertake exploration or exploitation of the resources of the deep ocean floor, since, once their claim is secured by registration, unreasonable competition and conflict among these advanced entrepreneurs will be avoided. While this approach is in conformity with the concept of the resources of the deep ocean floor being the common heritage of all mankind, in the sense that everyone is free to register his claim once he has satisfied certain technical conditions, it is extremely difficult for the developing nations to benefit from this approach, since the right to register a claim with an international registry authority does not at the same time guarantee that they will be able to explore or to exploit the deep ocean floor.

Various private organizations have advanced the idea of a licensing authority which would control and regulate all exploration and exploitation of the deep ocean floor. Licenses or concessions would be granted to States making application on behalf of enterprises within their jurisdiction or directly to the enterprises themselves. The licensing body would be vested with extensive powers to control use of the deep sea bed, since

it would have sole authority to determine who should receive licenses or concessions to initiate or to carry out exploration and exploitation. Senator Pell's draft proposes "a licensing authority to be designated by the UN, with approval by the Security Council in the manner provided by para. 3 of Art. 27 of the UN Charter".

Danzig's draft provides:

Art. III - ... The Ocean Agency shall have sole authority to grant licenses or authority for the exclusive exploration or exploitation of the ocean bed.

The Commission to Study the Organization of Peace has come out for an

International Authority for the Sea ... authorized by the UN General Assembly to manage the leasing of the deep ocean floor.

Borghese, on the other hand, recommends an

Ocean Regime ... authorized ... to issue licenses to Member States and to governmental or non-governmental international organisations and corporations for the peaceful and orderly exploration and exploitation ...

Such an authority as suggested in some of the private drafts would be vested with competence to grant or to suspend licenses. How would this authority be created? What would be its composition? These are very difficult and delicate questions yet to be solved. Generally speaking, the developing nations strongly favour this idea, while the advanced nations have shown considerable reluctance, because, as past experience in some other fields has shown, international authorities are inevitably subjected to strong pressures by the developing nations, and the number of these nations has been rapidly increasing. If, however, any international authority is to be established to regulate the granting of licenses or concessions, a real and difficult problem will inevitably be raised as to the criteria which should be utilized in determining whether to grant or to withhold a license or concession.

Should the principle of "first come, first served" be the touchstone? But, this is not a valid test if we are talking about more than the simple mechanics of international licensing.

Yet, to say that the resources of the deep ocean floor should be developed for the benefit and in the interest of all mankind, provides no criteria for the granting of concessions or licenses. Danzig's draft gives us little to go on in formulating criteria for granting licenses:

All such licenses shall be awarded on the basis of highest bid, having due regard, however, to the competency of the bidder ... Notwithstanding that a bid for a specific license may not be the highest, the Agency in its discretion may disregard such requirement if the granting of a license will assist a developing State to improve the technological capability of such State or its nationals to explore or exploit ocean bed resources.

The criterion of the highest bid is certainly worth considering. However, the licensing system is closely connected with another problem, which I shall deal with next.

5. *Problems of Sharing the Profits Derived from the Exploitation*

Whether under the simpler registration system or under the more effective licensing system, the reality is that only the most advanced nations stand to benefit, since the less developed countries will be hard put to it to undertake any significant exploration, let alone exploitation, of the deep ocean floor. It is natural, at least on the part of the latter, to claim a share of the profits derived from the exploitation undertaken by advanced nations or well-capitalized enterprises. In the view of the developing nations, their claims are justifiable under the concept that resources are the common heritage of mankind and should be utilized for the benefit and in the interest of all mankind. As I said before, it could be argued that the term "common heritage of mankind, benefit of all mankind", etc. means only the guarantee to all nations of free access to resources. According to this view, the developing nations, which contribute little to the development of the resources of the deep ocean floor, can hardly expect to claim a share of benefits brought about by the costly undertakings of the advanced nations and enterprises simply because the area in question is situated beyond national jurisdictions.

The "free access" concept seems to have grown out of some preliminary thinking by certain advanced nations at an early stage of the deliberations on the status of the deep ocean floor. It has become obvious that it is impractical — and impracticable — for the advanced nations to ignore the growing claims of the developing countries to at least some of the benefits to be derived from this area. So long as the incentive to the investment necessary for exploration and exploitation is not destroyed, the advanced States must realize the necessity of offering some benefits to developing countries without obtaining any direct benefits in return. The following thought has already been suggested by the US at the second session of the UN Ad Hoc Committee in June, 1968:

(2) ... (c) Dedication as feasible and practicable of a portion of the value of the resources recovered from the deep ocean floor to international community purposes, ...⁶.

It would be only prudent for the advanced nations to secure for themselves the benefits of exploration and exploitation of the resources of the deep ocean floor and to offer to the developing nations in exchange a portion of these benefits.

An international regulatory authority would have the additional function of collecting royalties and fees for concessions or licenses for granting the right of exclusive exploration and exploitation which I mentioned in the preceding section. Claimants would undoubtedly be prepared to dedicate a portion of the value of the fruits of their exploration and exploitation if their right of exploration and exploitation were to be protected through concessions or licenses. This relinquishment would not be likely to impede any incentive on their part to make sizeable capital investments.

A further question is raised as to how the revenues collected by the international regulatory authority through the grant of concessions or licenses should be distributed. It has been suggested that these revenues should be spent to solve the financial crisis of the UN. This suggestion, however, failed to secure majority support; and the use of these revenues for

6. United Nations, General Assembly, Official Records, Doc. A/AC. 135/25.

the benefit mainly of the developing nations is now being strongly advocated.

The Principle advanced by the States of the Western Group (Set B) at the UN Ad Hoc Committee are focused in the following paragraph:

(5) Exploration and use of this area shall be carried on for the benefit and in the interests of all mankind, taking into account the special needs of the developing countries.

That supported by the developing countries (Set A) finds the following expression:

(5) The international regime to be established shall also consider the way for the most appropriate and equitable application of benefits obtained from the exploration, use and exploitation ... through a suitable international machinery, for the economic, social, scientific and technological progress of the developing countries.

The concept of special interests of developing nations in this respect is no longer being challenged. In addition, the interests of land-locked countries are also being given special consideration. The draft by the Afro-Asian Group of the UN Committee of May, 1969 seems to represent part of the approach towards the distribution of the benefits:

4. Exploration, use and exploitation of this area shall be carried on for the benefit and in the interests of mankind as a whole irrespective of the geographical location of States whether coastal or *land locked*, and for the promotion of economic development taking into consideration *the needs and interests of the developing countries* (emphasis added).

In spite of such general concepts as "special interests or needs of the developing nations", "special interests of land-locked countries", etc., it is most difficult to devise a generally acceptable formula for the distribution of benefits. In any event, it might well be that the UNPD, the World Bank, etc. could function as an international authority competent to distribute the profits realized from this ocean floor development.

6. *Use of the Deep Ocean Floor and the Freedom of the High Seas*

Besides the questions of who is entitled to exploration and exploitation of the deep ocean floor and how the profits obtained therefrom should be distributed, there exists another problem of a completely different nature. No matter who undertakes exploration or exploitation, these activities should be in conformity with the rules governing the use of the high seas over the deep ocean floor.

A simple analogy between the regime or rules now applicable to outer space and the use of the deep ocean floor does not seem relevant. Some of the private drafts on the regime of the deep ocean floor have mistakenly introduced into this area of law various rules concerning the peaceful use of outer space.

The duty to render assistance to any person, vessel, etc. in danger of being lost or otherwise in distress, and to inform of any phenomena which could constitute a danger to the life or health of persons exploring or working in the waters above the deep ocean floor (Senator Pell's draft, Danzig's draft, and Borghese's draft) seem to be concepts borrowed from the Outer Space Treaty.

So far as outer space was concerned, however, at least up to the time of the Outer Space Treaty, there existed no applicable regime or rule and hence the Treaty introduced many new laws and rules. But when exploration and exploitation of the deep ocean floor are concerned, the time-honoured and well-established principles of law relating to the high seas should be applied. In this respect, exploration and exploitation of the continental shelf, on the one hand, and of the areas beyond, namely the deep ocean floor, on the other, are identical in respect of the application of the principles of freedom of the high seas to the activities carried on in the superjacent waters of the respective sea-bed areas. This point is often overlooked. I should like to emphasize again that there is no reason why the same rules should not be applicable to the effect on the superjacent high seas waters of exploration and exploitation of the deep ocean floor as well as to the waters over the continental shelf. In this respect, articles 3, 4 and 5 of the Convention

on the Continental Shelf seem to be quite relevant. Especially noteworthy is Art. 5, para. 1 of the Convention:

The exploration of the continental shelf and the exploitation of its natural resources must not result in any unjustifiable interference with navigation, fishing or the conservation of the living resources of the sea, nor result in any interference with fundamental oceanographic or other scientific research carried out with the intention of open publication.

The questions as to who is entitled to exploration and exploitation and which parts of the sea-bed may be so explored and exploited are quite irrelevant to the application of the principles of freedom of the high seas to such activities. Principles (Set B) of the UN Ad Hoc Committee state, i.a.:

(7) Activities in this area shall be conducted in accordance with international law, including the Charter of the UN. Activities in this area shall not infringe upon the freedoms of the high seas.

Principles (Set A) read, as follows:

(6) All activities in the sea-bed and ocean floor and the subsoil thereof, ... shall conform to the following guidelines, aimed at protecting the rightful interests of other States:

(a) No impediment shall be created to navigation and fishing nor shall there be undue interference with the laying and the maintenance of submarine cables and pipelines; ...

(f) No damage shall be caused to animal and plant life in the marine environment;

(g) Damages caused by any such activities entail liability.

The draft prepared by the Afro-Asian Group in May, 1969 reads:

(7) This area should be considered separately from the superjacent waters of the high seas, activity in this area should not affect the legal status of the superjacent waters or that of the airspace above those activities shall not infringe upon the freedom of the high seas ...

(9) All activities in this area, shall conform to the following guidelines: ...

(c) Pollution and other hazards of the marine environment, especially radioactive contamination, shall be avoided by means of appropriate national and international measures;

(d) Appropriate safeguards shall be adopted so as to conserve and protect the living resources of the marine environment.

(e) Damages caused by any such activities entail liability.

In this regard, it is most appropriate to refer to UN General Assembly Resolution 2467-B concerning prevention and control of pollution and other hazardous and harmful effects which might result from the exploration and exploitation of the deep ocean floor. Moreover, careful consideration should be given to the question of liability resulting from exploration and exploitation. The Outer Space Treaty provides for *state responsibility*, as follows:

States Parties ... shall bear international responsibility for national activities in outer space ... whether such activities are carried on by governmental agencies or by non-governmental entities ...

However, this construction cannot be applied to activities conducted in sea waters relating to exploration or exploitation of the sea-bed. Both qualitatively and quantitatively, the damage caused by these activities differs from that resulting from activities in outer space. In addition, as earlier noted, there is nothing to prevent application of the general rules on freedom of the high seas to any activities in high-sea waters. Collision with equipment used in the exploration or exploitation of the continental shelf or the deep ocean floor, pollution of sea waters or other hazards resulting from such exploration or exploitation, etc. are matters which clearly fall within existing rules of international law.

7. *Conclusions*

First, the regime of the deep ocean floor should be considered independently of the problem of peaceful uses of the sea bed, since the latter problem involves questions beyond the regime of the deep ocean floor.

Second, the outer limit of the continental shelf, which is at the same time the inner limit of the deep ocean floor, has already come under discussion. Although various policy consi-

derations arise in delimiting the continental shelf, the concept of a buffer zone or intermediate zone merits close examination.

Third, there is no opposition to the concept of non-appropriation of the deep ocean floor; but non-appropriation of the deep ocean floor does not necessarily lead to the principle of non-exploitation of the resources of this area. On the contrary, free access to this area and to its resources should be guaranteed to all nations.

Fourth, the question has been raised of whether free competition should be permitted or some kind of international supervision imposed. The idea of an international registry authority and of an international license-issuing authority were examined. To the developing nations, the question who is entitled to explore and exploit is a matter of indifference, it not entirely academic. The real question, so far as they are concerned, is how developing countries can participate in sharing the profits obtained from actual exploitation.

Finally, I stressed how important it is to distinguish the problem of how exploration and exploitation of the deep ocean floor are conducted under the regime of the freedom of the high seas from the question of who is entitled to explore and to exploit this area. Insofar as the former problem is concerned, it was suggested that it might be relevant to advert to discussions already held on the regime of the continental shelf. It was also emphasized that, as differentiated from the case of outer space, all activities for exploration and exploitation of the deep ocean floor are conducted in high seas areas and, hence, should be subject to the existing rules of the regime of the high seas.

SOME GENERAL CONSIDERATIONS ON THE NEED
FOR AND THE REQUIREMENTS
OF AN INTERNATIONAL REGIME FOR THE SEA-BED
AND THE OCEAN FLOOR

BY

ARVID PARDO

*Ambassador, Permanent Representative of Malta
to the United Nations*

Background

1. We are the inhabitants of a spaceship; the spaceship — Earth. The resources of our spaceship are vast but not unlimited. We are in the main using, not always efficiently, resources from approximately one third of our spaceship i.e. from the land area of our planet.

2. Pressure on land-based resources must grow at an accelerated rate, inter alia because of:

a) rapidly increasing population (expected to double within the next thirty years);

b) rising expectations and improved standards of living;

c) increasing industrialization.

3. Reliable estimates indicate that energy requirements in the next twenty years will be more than three times those of the past hundred years. Consumption of metals in the next thirty five years will equal that of the past two thousand years. Demand for key minerals will double by 1985 and treble by the year 2000. There is little hope of satisfying these requirements at acceptable cost from land resources alone, hence increasingly massive utilization by man of the ocean environment at increasing depths and distances from the coast is inevitable; the only question is the conditions under which such utilization will take place.

*Some generally agreed facts with regard to the sea-bed
and ocean floor beyond the geophysical shelf*

1. *Our knowledge is limited.* Some 95 per cent of the ocean floor beyond the geophysical shelf is virtually unknown.
2. *What knowledge we possess indicates that valuable mineral resources exist beyond the geophysical shelf.* These include sub-bottom resources (petroleum, gas sulphur) and on-bottom resources (calcareous and siliceous oozes, pelagic clays, phospherite and manganese nodules, the latter containing a variety of minerals in varying concentrations).¹ In addition there exist the "hot brines" discovered in the Red Sea, which contain a variety of metals in high concentrations.
3. *Rapidly developing technology is making possible the effective exploration of the greater part of the ocean floor beyond the geophysical shelf and the exploitation and even occupation by man of areas at relatively modest but increasing depths.*

In addition to underwater photography and television, a wide variety of sophisticated sound and seismic devices have been developed for sea-bed exploration. Deep sea investigation is also facilitated by the construction of specialized deep submergence vessels. Manned vehicles are being built with operating depths of 1,500 metres for rescue purposes, 2,000 metres for research purposes and nearly 7,000 metres for search purposes. It is believed that over 1,000 deep submergence vessels of various types will be operating in the seas within a decade.

There has also been a rapid advance in underwater exploitation technology, both military and civilian. As an example I would cite the petroleum industry, where several methods to operate by remote control underwater wells and production facilities have been developed and tested; among recent developments are robots, specialized submersibles and underwater chambers at subhydrostatic pressures in which production faci-

1. Strictly speaking calcareous and siliceous oozes and pelagic clays are only a potential resource at the present time. On the other hand I consider phosphorite and manganese nodules to be a resource, since their existence can set a ceiling, albeit vague, to prices of certain minerals.

lities can be enclosed and in which man can operate. It is predicted that by 1972 petroleum exploitation capability will be available in depths of approximately 400 metres.

Once these depths have been reached progressive movement seaward ... should be less sensitive to water depths and more sensitive to distances from shore ².

With regard to on-bottom hard minerals, it is understood that technology is already available for their recovery; absence of significant exploitation is due, not to lack of technology, but to factors such as capital investment required, prices of equivalent land based minerals, technical difficulties in the beneficiation process and uncertain legal status of the sea-bed beyond the geophysical shelf.

One of the most remarkable developments in the past decade is the progressive improvement in the adaptation of the physiology of man to permit him to operate freely in the ocean at moderate depths. Prototype manned habitats have been developed. Sealab and other experiments have proved man's ability to live efficiently for long periods at a depth of 150 metres with limited excursions to 220 metres. According to the National Petroleum Council "man can work effectively down to 213 metres and depths as great as 305 metres are contemplated". ³ The limit of present saturation diving techniques is believed to be between 500 and 600 metres. There is little doubt that some of the summits of the great submarine mountain ranges and some of the other features (banks, etc) of the seabed beyond the geophysical shelf are now accessible to occupation by man.

4. *Despite the progress of technology the deep seas and the sea-bed remain a hostile environment.* Few, in the foreseeable future, will possess either the financial means or the very sophisticated technology required to exploit effectively the deep seas and the sea-bed beyond the geophysical continental shelf.

2. National Petroleum Council, Resources under the ocean floor, p. 59.

3. Ibid., p. 58.

5. *Areas of the sea-bed beyond the geophysical shelf vary considerably in value; the value will increase as these areas become more easily accessible and exploitable. The value is likely to vary according to the purpose for which these areas are desirable and in relation to general political and economic considerations.*

Areas that are desirable for a defence or defence related purpose may have no economic value, nevertheless control of such areas may be of compelling importance or of little interest according to the world political situation.

The considerations governing the value of areas containing hard minerals differ from those containing petroleum.

6. *Intensified use of the oceans and ocean floor raises problems of accommodation between different uses.*
7. *Use of the sea-bed inevitably affects the superjacent water column⁴; intensive use, and more so exploitation, requires a measure of control over superjacent and, in some cases, adjacent waters.*

Pollution caused by exploitation of the sea-bed affects the sea and the consequences could be felt at great distances. It is impossible therefore neatly to separate the sea-bed from the superjacent waters; ocean space forms an organic whole. This, however, does not necessarily imply that all its parts should be legally regulated in the same manner.

8. *There exist no international norms that clearly define the limits of the area of the sea-bed over which States have sovereign rights for the purpose of exploration or resource exploitation or which provide an adequate legal framework to govern the conduct of State in the exploration, exploitation and use of the sea-bed beyond national jurisdiction.*

The cumulative weight and inter-action of these known facts alone point towards a developing situation of extreme gravity which could lead to the erosion of established law with regard to the high seas, to escalating political tensions and to the serious impairment of large areas of the marine environment through pollution.

4. Except when shafts or tunnels are dug from adjacent land.

Present legal situation

The present situation of international law with regard to the sea-bed is embodied in a limited number of generally accepted principles of customary law the interpretation of which is not always entirely clear in concrete cases; in the provisions of the 1958 Geneva Convention on the Continental Shelf and in a few fragmentary and scattered provisions in some other multilateral or bilateral international agreements. Almost every international legal question with regard to the sea-bed is controverted: there is controversy on the limits of national jurisdiction over the sea-bed on the extent of the powers of the coastal State over the sea-bed beyond territorial waters, over the legal status of the sea-bed beyond national jurisdiction (whether any part of the sea-bed is beyond national jurisdiction and if so whether it is *res nullius*, *res communis* or has some other status), etc. Substantive norms of international law contained in the 1958 Geneva Convention on the Continental Shelf and in other multilateral agreements are fragmentary not always observed in practice and sometimes ambiguous. There is no generally recognized limit to the extension of national claims over the sea-bed.

Whatever is not explicitly prohibited in international law, is permitted. The lack of a clear definition of the limits of the jurisdiction of the coastal State over the seabed has led to the extension of national jurisdiction in recent years over areas that few people ten years ago would have imagined could be subject to national control, and there is a clear trend towards more expansive claims. At the end of 1967, fifteen States had issued without challenge exclusive petroleum exploration permits — action widely regarded as claim to jurisdiction — over areas beyond the 100 metre isobath; at the end of 1968 the number of such States was 29. The areas covered by these permits did not extend beyond some 200 miles from the nearest coast in 1967; in 1968 they extended up to 350 miles from the nearest coast.

Despite the trend to ever more expansive claims it is unlikely that events will be permitted to result in a division of the entire ocean floor among coastal States; at the United Nations there is virtual unanimity that such a development would be

unacceptable. Furthermore a division of the world's sea-bed among coastal States would not be tolerated by major maritime Powers.

For the few countries that possess the financial and human resources and the advanced technological capability required, it would appear highly desirable to confine exclusive national jurisdiction to a yet undetermined, but certainly relatively short, distance from the coast and to ensure unrestricted access to the sea-bed beyond, leaving accommodation between the various uses of the sea-bed and adjustment of conflicts to be resolved on an 'ad hoc' basis as controversy arises, in accordance with available principles of international law and with such further principles which it may be found necessary to elaborate in due course. Exploration would take place under the protection of the flag of the State concerned, which would claim not sovereignty, but *exclusive rights*, over those areas of the sea-bed that are found to be of economic or military interest.

Such a regime would be analogous to the present regime with regard to fisheries and is certainly not contrary to existing international law. Nevertheless it is questionable whether the regime described would be viable or in the interests of the world community.

The reservation in practice of the plurality of the world's resources for the benefit of a few wealthy and technologically advanced countries would be deeply and increasingly resented by the overwhelming majority of the international community. Thus, although a regime of unrestricted access to, and exploitation of, the sea-bed beyond a narrow coastal belt can be imposed and maintained through the exercise of power, the political cost of this exercise of power would grow and is likely in the long run to become intolerable. In the meantime, however, a situation would have been created seriously prejudicial to all, and which it would be difficult to correct.

From a more general point of view, it must be observed that the regime described: (a) makes accommodation between alternative uses of the sea-bed increasingly difficult; (b) complicates effective control of ocean pollution; (c) leads to gross physical and economic waste; (d) is likely to result in conflict, since multiple claims to the same resource area could be put forward and could only be resolved through laborious bilateral

negotiations; (e) occupation of segments of the ocean floor for military purposes is likely to lead to an escalation of military measures in this new environment; (f) unadvertised occupation of segments of the sea-bed for the installation of weapons of mass destruction or for the establishment of military bases would certainly lead to sharply increased tensions and to countermeasures.

Although some of the undesirable consequences of a flag-nation approach described in the preceding paragraph could be controlled through appropriate international agreements on matters such as pollution of the seas, peaceful uses, etc., there can be little question that the control achievable would be far from perfect and that exploitation of the sea-bed would take place in a legal atmosphere favorable to international rivalry and wasteful exploitation.

It has been argued that establishment of a comprehensive and more adequate legal framework for the exploitation and use of the sea-bed should await the full exploration of the sea-bed and the acquisition of more complete knowledge of its resources.

The objection to such a course of action is that irreversible situations are likely to be created which will make it very difficult, if not impossible, to create an efficient regime based upon the interests of all countries.

Others have contended either that the United Nations should proclaim a freeze upon exploitation of sea-bed resources situated at more than an agreed distance from the coast until such a time as agreement can be reached on a precise definition of the continental shelf and on a regime for the sea-bed beyond; or that the legal continental shelf be extended in such a manner as to comprise areas likely to be exploited in the foreseeable future. Both these suggestions are impractical. It is impossible to freeze the application of rapidly developing technology, while the extension of the legal continental shelf to comprise areas likely to be exploited within the next decade would imply a very considerable and probably unacceptable extension of national jurisdiction over the sea-bed.

Conclusions

A division of the ocean floor of the world among coastal States is unacceptable to the international community.

A flag nation situation beyond a narrowly defined legal continental shelf would establish a regime for the sea-bed analogous to the existing regime of the high seas. Such a regime might be in the interests of a few major maritime Powers, but would be unacceptable to the majority of the international community and would have dangerous implications for world peace and order.

A freeze upon sea-bed exploitation beyond agreed limits is impractical.

Present international law is ambiguous and controverted with regard to the limits of coastal State jurisdiction and is grossly inadequate to cope with the problems that will be posed by the increasingly intensive exploitation of the sea-bed. Such problems are already appearing and will rapidly become more serious and complex. No time should accordingly be lost in defining the limits and extent of national sovereignty with regard to the sea-bed beyond territorial waters and a regime for the sea-bed beyond national jurisdiction, if international friction, destructive competition and gross waste of resources are to be avoided.

Some general requirements for the establishment of a regime for the sea-bed.

1. The regime must be acceptable to the great majority of the international community and to all significant maritime States.

2. To be acceptable the regime must be generally equitable, that is — must offer a balance of advantage to all States, including land-locked States. A flag nation regime is not equitable.

3. To be acceptable the regime for the sea-bed should affect as little as possible the legal status of the superjacent waters as high seas or that of the air space above.

4. To be acceptable the regime must be enforceable through an impartial machinery.

All these requirements point to the need for some form of international regime.

Some essential objectives of a regime for the sea-bed.

1. To provide a favorable framework for international peace and security and the limitation and peaceful settlement of conflict.

2. To ensure the economically most efficient use of vast, but not unlimited, resources.

3. To establish a framework for the control of the ocean environment for human benefit, with particular reference to the use of the sea-bed, the exploitation of its resources, and the limitation of ocean pollution.

4. To provide a framework that will encourage scientific research and exploration of the oceans and the wide dissemination of the results of these activities.

5. To provide a framework that will enable all countries to participate in the benefits derived from the exploitation of the sea-bed.

These objectives can only be achieved through the establishment of an international regime provided with appropriate implementation machinery.

Some Objections to an international regime.

It has been argued that: (a) the concept of an international regime is utopian in the light of contemporary political realities; (b) it would require the establishment of an international machinery with wide powers to cope with the complex problems of marine resource management, but States would be unwilling to entrust the required powers to an international machinery and, even if they were willing, experience to date with international organizations has demonstrated their administrative ineffectiveness.

A reply to these objections could be as follows: there is no viable alternative to some form of international regime for the sea-bed beyond national jurisdiction. The development of technology and communications have resulted in rapidly increa-

sed context and interaction between peoples. Increasing populations and increasing industrialization require increased food production and increased availability of resources at reasonable prices and available without discrimination. It is imperative that a legal structure be devised for these needs. If an international regime is utopian, there is no hope for a more efficient use of global resources, for world peace, for the avoidance of massive ocean pollution, or for the development of more equitable international law between states. Any international regime may be difficult to formulate, but it will be established if States see in such a regime a balance of advantage.

An international machinery is undoubtedly required to administer an international regime but the powers entrusted to such a machinery need only be for purposes recognized as essential by the international community. Nor need any future international machinery with regard to the sea-bed be necessarily organized in the same way as the United Nations or the specialized agencies within the United Nations system.

This is not to say that difficult and complex problems must not be solved in a manner acceptable to the international community, if an effective international regime is to be established.

Basic problems requiring solution.

Three basic but inter-related problems must be answered if an international regime based upon the balance of advantage of all States i.e. the common interests of mankind, is to be established.

These questions are: what are the outer limits of the legal continental shelf subject to the sovereignty of the coastal State for the purpose of exploration and resource exploitation? Secondly, what legal theory and principles should be applied to the area of the sea-bed beyond the legal continental shelf? Thirdly, what is the precise nature of the legal regime that should be established, in application of the principles adopted, for the sea-bed beyond national jurisdiction and what are its implications for States?

In replying to these questions it should be borne in mind that a general goal, however desirable in theory, is not likely

to obtain the support of States in practice, unless it can be convincingly shown that interests which they consider vital are not seriously endangered.

I shall only very briefly examine the parameters of each of the questions posed.

Little progress can be made unless the area of the sea-bed beyond national jurisdiction is defined with sufficient approximation. At the same time general acceptability of any definition proposed — and general, although not necessarily unanimous, acceptance is essential — depends largely upon agreement on the type of regime which it is proposed to establish for this area. It is clear that, if, for instance, it were proposed to establish, for the area beyond national jurisdiction, a legal regime solely upon the principle of free and unrestricted access for the purpose of exploitation, States without near term exploitation capability are likely to maximize their claims in the hope of reserving for themselves as large as possible a share of eventual benefits. On the other hand, it does not appear entirely unrealistic to hope that these same States might be disposed to moderate somewhat their potential claims, if others were to agree to a regime effectively protecting the common heritage of the sea-bed and enabling all equitably to benefit from the exploitation of its resources.

However, in determining how to proceed, we are immediately confronted by the fact that the General Assembly of the United Nations is not empowered to define the legal continental shelf. Even if a definition were attempted, such a definition, at best, could have a persuasive moral value. A definition of the legal shelf must, therefore, be discussed and adopted in an appropriate forum, which can only be an international conference convened for the specific purpose of revising the 1958 Geneva Convention on the Continental Shelf, in accordance with the procedure indicated in article 13. There can be no doubt that such a revision is urgent, but it is also likely to be a complex process that is unlikely to be successful unless carefully prepared.

Preparation must necessarily include consultations between States and this is likely to be a lengthy process. Nor would there be much purpose in convening an international conference on the revision of the 1958 Continental Shelf Convention

unless there existed some assurance that a more precise definition of the legal continental shelf were acceptable to the overwhelming majority of coastal States. Such assurance is unlikely to be forthcoming, as we have indicated above, unless there is some agreement also on the outlines of an acceptable regime for the area of the sea-bed which is to remain beyond national jurisdiction. Nor can we afford unlimited time to be consumed in inconclusive consultations and negotiations in view of the rapid development of technology and the steadily rising claims of coastal States to jurisdiction over ever wider areas of the sea-bed.

In seeking to deal with this problem effectively and expeditiously, we suggested last March in the United Nations Committee on the peaceful uses of the sea-bed that United Nations might attempt to identify through a General Assembly resolution a minimum area of the sea-bed which is without doubt beyond national jurisdiction. This would not prejudice the solution of the legal question of where precisely the legal continental shelf ends and would facilitate a cooperative solution of the political problems that impede progress on the question of a regime. At the same time, such a resolution, interpreting in effect the maximum extension of the concept of adjacency contained in article 1 supported by a sufficient majority, would carry sufficient moral weight to constitute an effective limitation to excessively expansive claims of sovereign rights over the sea-bed.

What could be the criteria for determining such a minimum area which is unquestionably beyond national jurisdiction?

There have been many suggestions with regard to the criteria that should be used in determining the outer limits of the continental shelf, but none, as far as I am aware, have been proposed for determining a minimum area beyond national jurisdiction. Nevertheless, an analysis of the former can be of assistance in narrowing the choice of acceptable options.

Some suggest that the outer limits of the shelf should be determined by geomorphological criteria and that since "one of the most fundamental natural boundaries in the earth's crust is that which separates the continents from the ocean", the demarcation line should be placed where continental formations are replaced by oceanic ones. This approach would

place not only the geological shelf and the continental slope but also, according to Hedberg, "a zone just beyond the base of the slope" within the scope of the continental shelf doctrine. It is claimed that the main advantage of this approach would be that a solution of the continental shelf limits would be adopted corresponding to basic geological fact, and that most legal problems with regard to resource exploitation would find an immediate solution, while the future legal status of the area beyond the geological continental block could be considered at leisure. Despite its claimed advantages, a definition of the continental shelf based upon geological criteria alone is both impractical and unrealistic. Not only would the precise determination of the geological and legal boundary remain uncertain, since in many places it is irregular or gradational, but also the boundary would occur at sharply differing depths of water and distances from the coast: thus some States would gain much, others very little. This is unlikely to be widely acceptable. More importantly, proponents of this approach ignore the fact that boundaries whether on land, in the ocean or in space are only incidentally determined by geomorphological criteria. The establishment of a limit to the area subject to national jurisdiction is a political act and, as such, is the result of political events, and multiple political pressures and needs.

Apart from geologic criteria, three methods for determining the legal shelf have been suggested: by reference to a specified depth, by reference to a specified distance from the coast or by a combination of both.

A boundary fixed by depth alone is unsatisfactory because it is difficult to define the area subject to national jurisdiction on the basis of the complex and imprecisely known sinuosities of the broken topography of the sea bottom and also because the depth criterion would almost certainly be politically unacceptable since it would produce very sharply differing results in different parts of the world. There is also the troublesome problem of marine troughs.

Definition of the shelf in terms of a precisely determined distance from the coast has the advantage of establishing an easily ascertainable demarcation line, particularly if drawn from base-lines. It may, however, appear advisable to sup-

plement this criterion by a depth criterion to avoid giving the impression of attempting to deprive States with very wide geophysical shelves of rights that they believe that they have acquired under the 1958 Geneva Convention, particularly in view of the recent comments of the International Court of Justice on the interpretation of the principle of adjacency.

Thus it would appear that a combination of distance and depth criteria is the most suitable way of defining the outer limits of the continental shelf subject to national jurisdiction and, by implication the minimum limits of the area beyond national jurisdiction. This combination would also materially assist in identifying a demarcation line in the water.

The crucial question, however, is where should the line demarcating these minimum limits be drawn?

Initially, it seems clear that determination of the minimum limits of the area beyond national jurisdiction cannot directly contravene the provisions of the 1958 Geneva Convention on which the legitimate expectations of many States are based, nor can we ignore the confirmed state of contemporary exploitation technology, or the national legislation, or claims to exclusive jurisdiction (particularly if exercised by some clear act indicative of technological competence in exploitation) of significant groups of States.

In the second place, identification of the minimum limits of the area beyond national jurisdiction must produce reasonably equitable, that is approximately similar, results for all oceanic coastal States despite the varied topography of the ocean bottom.

Finally the security interests of States must be taken into account.

If these considerations are accepted as relevant, it is obvious that the minimum area beyond national jurisdiction cannot include a wide belt of the sea-bed adjacent to the coasts of States. Although we are as anxious as anybody to see the reservation of as large an area as possible beyond national jurisdiction, we do not consider realistic the opinion of some that the belt of the sea-bed adjacent to coastal States not included in the minimum area beyond national jurisdiction, be limited to 40 to 50 miles, corresponding to the average width of the world's geophysical continental shelves. We feel, although we

would be happy to be proved wrong, that the global criterion of the average of the world's geophysical shelves is not particularly relevant to the actual situation of each country and, if a depth criterion, for instance 200 metres, is also used, would not be sufficiently equitable to gain wide acceptance. Some States would have a 50 mile wide continental shelf, others a 400 mile or more wide shelf. The present state of fact, that is: proved technological capability, national legislation and claims of States — all appear to indicate that any attempt to identify a minimum area of the sea-bed beyond national jurisdiction less than 100 miles from the coast is doomed to failure. Indeed, it may be necessary to provide for double such a distance from the coast if a sufficiently wide agreement on a minimum area beyond national jurisdiction is to be rapidly reached.

Another question that requires careful consideration is the position of rocks and islands in the continental shelf doctrine. According to the 1958 Convention on the Continental Shelf all islands without distinction have the same rights as coastal States with regard to the legal continental shelf. The reasons for this provision are clear; but the problem is complex. The existence of remote islands and rocks with potentially extremely valuable rights to vast areas of the sea-bed immeasurably complicates a solution of the problem of the definition of the limits of the continental shelf subject to national jurisdiction. In March 1969 we suggested in the United Nations that rocks and islands without a permanent settled population should be disregarded for the purpose of identifying a minimum area of the sea-bed beyond national jurisdiction. The suggestion was founded on the test of equity and reasonableness to which all international law is subject; it is just and reasonable that a coastal State should exercise sovereign rights over the sea-bed adjacent to its coast; it is just and reasonable that the international community should reserve the rights of islands that one day may emerge as independent States. But where not only no State but no population exists and where often no resources exist to support a future population, the basis for application of the continental shelf doctrine is lacking. It is entirely unacceptable that a remote rock or a sandbar should be considered to enjoy the same rights as populous States for the purpose of the continental shelf doctrine. This does not mean, however,

that I question in any way the sovereignty of the administering powers over the sea-bed underlying the territorial waters of the uninhabited islands and rocks which the accidents of history have placed under their administration.

The second problem on which it is necessary to reach agreement before it is possible to establish an international regime for the sea-bed beyond national jurisdiction, is the general legal theory or concept applicable to this vast area. There are two basic approaches. The first, based on the overriding priority of national interests of States, emphasizes that international law applicable to the high seas is also applicable by analogy to the sea-bed beyond national jurisdiction. This approach inevitably leads to a flag nation situation which is inefficient, highly wasteful of resources and dangerous to world peace and which, if imposed, would be intolerably inequitable. The second approach questions the relevance or the applicability of international law relating to the high seas to the sea-bed beyond national jurisdiction. It stresses that apart from certain general principles of international law and a few isolated norms, such as those relating to submarine cables and pipelines, a legal vacuum exists which must be filled through the development of a legal structure based upon the long-term common interests of the international community as a whole. The concept underlying this second approach has been expressed in the sentence: "The sea-bed and ocean floor beyond the limits of national jurisdiction are a common heritage of mankind".

The concept, which is already accepted in germ in international law in the field of surface transportation, implies a concern for objectives that are not necessarily always prominent in immediate national priorities, and an international regime for the sea-bed administered in the interests of all States by a body representative of the international community. The Government of Malta has formulated the objectives of such a regime as follows:

"The preservation of the international character of the sea-bed... beyond the limits of present national jurisdiction, not as a *res omnium communis* usable for any convenient purpose, and the resources of which are indiscriminately and competitively exploitable, but through the acceptance by the international community that these vast areas of our planet have a

special status as a common heritage of mankind and, *as such*, (that is as a common heritage) should be reserved exclusively for peaceful purposes and administered by an international agency in the name and for the benefit of all peoples and of present and future generations".⁵

From the concept of common heritage a number of principles can be derived such as the principles of peaceful use of the sea-bed, exploitation, management and conservation of sea-bed resources by an international body in the common interests of the international community, international control of marine pollution and others.

In the United Nations considerable discussion has taken place on the question of what principles should be proclaimed by the international community with regard to the sea-bed. Two main sets of principles have been proposed, the one by the majority of Afro-Asian and Latin American States, the other by an influential group of technologically advanced countries and it is hoped to reconcile the two sets of principles at the next session of the United Nations sea-bed committee in August this year in order to make possible the adoption of a virtually unanimous resolution at the next session of the General Assembly. Malta has not associated itself with either set of principles. My country has expressed the view that any balanced set of principles not incompatible with the common heritage concept is acceptable. My country believes that at the present time, since we are dealing with an undefined area which is virtually unknown, and all the possible uses of which cannot yet be foreseen, it is important that principles be broad, few and flexible. We do not think that it is necessary, or even useful, that all the implications of the common heritage concept be formulated in terms of principles until the need arises and public opinion matures.

Alternative international regimes for the sea-bed.

It is certainly premature to discuss the details of an international regime for the sea-bed beyond national jurisdiction until a decision has been taken at the United Nations on the

5. United Nations document A/AC 135/1, p. 27.

maximum extent of the area subject to national jurisdiction (or the minimum extent of the area beyond national jurisdiction) and the general legal concept applicable to it. Nevertheless it may be useful to sketch the outlines and implications of some international regimes that are sometimes mentioned.

To have legal validity any regime envisaged must be based upon one or more international conventions adhered to by all significant maritime powers and by the great majority of other States. Several different types of regime are conceivable.

At one extreme it is possible to conceive of an international regime guaranteeing the unrestricted access to living and non living sea-bed resources modified only by such conventional provisions as may appear desirable to control ocean pollution or to achieve purposes generally recognized as useful by the international community as a whole. Such a regime, which would be only a slight modification of the flag nation approach, does not require implementation machinery, would be comparatively easy to implement and would be the natural development of an influential interpretation of existing international law. Nevertheless such a regime would suffer from most of the disadvantages of the flag nation approach and in particular would not be acceptable to the majority of the international community that has no immediate prospects of participating directly in the exploitation of the sea-bed.

To meet these objections certain additional modifications have been proposed to the flag nation approach.

It has been proposed, for instance, that an international registry office be established to register and give publicity to claims of exclusive rights to explore or exploit particular mineral resources in defined segments of the sea-bed beyond national jurisdiction. A fixed fee would be charged for registration; the fees would be used to meet the expenses of the registry office and any surplus could be used for marine research, or could be contributed to the United Nations Development Programme, or other appropriate programme of assistance to developing countries. The powers of the registry office can be conceived in a variety of ways: from automatic registration of all claims in the order submitted, — the purpose of registration being merely to give publicity to a claim — to an authority empowered to accept or refuse registration of claims; to esta-

blish conditions of licenses and amounts of fees; to deliver internationally recognized exclusive title and to allocate part of the funds received to acceptable international purposes. In this connection the United States Commission on Marine Science, Engineering and Resources has recommended the establishment of an International Registry Authority with the following characteristics: ⁶

a) all mineral exploration and exploitation claims to be registered with an International Registry Authority established by international agreement under which States bind themselves not to engage in or authorize exploitation except under registered claim;

b) only nations or associations of nations are eligible to register claims; the claims are transferable. Registered claims confer exclusive exploration or exploitation rights to the area and minerals mentioned therein;

c) the International Registry Authority is required to register mineral exploitation claims satisfying a small number of conditions. A registered exploration claim must be converted to an exploitation claim upon demand;

d) the International Registry Authority grants registration of exclusive rights for limited periods: there is no vested right to claim renewal of registration;

e) membership of the International Registry Authority and method of choosing its governing body should be specified by international agreement; the Authority should be an autonomous member of the United Nations family;

f) Every State member of the Authority should be required to pay a fee for registration of exploration claims and an additional fee for the registration of exploitation claims; the amount of the fees should be fixed by the Authority. The funds received should be applied to cover the costs of the International Registry Authority;

g) Every nation registering exploitation claims should be required to pay a portion of the value of production, if any,

6. Our Nation and the Sea, Report of the Commission on Marine Science, Engineering and Resources, 1969, pp. 147-149.

to the Authority; funds received in this connexion would be used to finance marine scientific activity or placed in an international fund to aid developing countries.

An International Registry Authority with the powers suggested by the United States Commission on Marine Science would usefully meet an obvious need: by delivering internationally recognized exclusive rights, the Registry Authority would provide security of tenure for the exploitation of specific minerals in defined areas for specified periods of time; waste of time and financial resources would be avoided and potential friction would be diminished. The allocation of part of the value of production to the assistance of developing countries makes it possible to envisage the international acceptability of the proposal with a measure of confidence.

Nevertheless the proposal, while useful, does not meet all clearly foreseeable needs for legal regulation of the sea-bed beyond national jurisdiction since it deals only with the exploration and exploitation of the mineral resources of the sea-bed. The requirement to register claims to exploitation on a first come-first served" basis may be excessively rigid: in some cases at least it might appear desirable to see exploitation claims allocated by auction. More importantly, the powers of the International Registry Authority and the discretion which it can exercise are too circumscribed. Finally, since exploration, and particularly exploitation, of sea-bed mineral resources inevitably have an impact on other uses of the sea-bed and of the superjacent waters, it would appear highly desirable to establish an organization with sufficiently comprehensive competence to regulate competing uses and to take action to avoid possible undesirable consequences of sea-bed exploitation, such as avoidable pollution of the seas. This does not mean of course that a Registry Authority could not form an important part of any such wider organization.

An international regime could also take the form of a consortium composed either of States or of public and private groups to explore and exploit either specified minerals or all minerals or all living and non-living resources of the sea-bed beyond national jurisdiction, somewhat on the lines of Intelsat.

This concept is interesting but it is unlikely to be widely acceptable since it would probably meet objections on the part of socialist countries and is unlikely to gain the acceptance of the majority of developing countries which would have little influence in such a body.

At the other extreme some have suggested that mineral resource development of the sea-bed beyond national jurisdiction be undertaken directly either by the United Nations or by an agency in the same relationship to the United Nations as one of the present specialized agencies under some title approximating sovereignty. I consider these suggestions to be impractical and politically unrealistic, for a number of reasons. Neither the United Nations nor any of the existing specialized agencies are in a position directly to undertake the exploitation of the sea-bed since they lack both relevant management experience and the necessary financial resources, and their decision-making process is not such as to give credible guarantee that the sea-bed will be administered in an orderly and efficient manner. In the second place, the sea-bed beyond present national jurisdiction contains resources potentially vital to the economies of many countries; major powers are unlikely to consent to vest complete control of these resources in the hands of an international agency administered on the one nation-one vote principle. Although, I do not think that it is possible for an international regime to be administered directly either by the United Nations or by an existing specialized agency, it would nevertheless be useful from many points of view, could an international regime be administered by a body having some constitutional link with the United Nations system.

Some basic considerations governing the functions and management of an organization administering an international regime for the sea-bed.

No viable international regime administered by an international machinery can be established without taking into full account political realities, basic facts with regard to the sea-bed and clearly foreseeable needs.

Ocean space as a whole constitutes one global and interrelated ecological system of which the sea-bed is one part. Acti-

vities on the ocean floor inevitably affect to a greater or lesser extent the superjacent waters.

Intensive exploitation of the sea-bed inevitably affects in greater or lesser measure other uses of this area.

A basic political reality is that *the sea-bed is of vital importance for many states*: For some states the sea-bed is important essentially for economic reasons, for others the reasons are both of an economic and of a defence character. The importance of the sea-bed both from an economic and defence point of view is certain to increase with technological progress.

Among clearly foreseeable needs resulting from more intensive use of the sea-bed are *the need to avoid conflict, the need to avoid dangerous consequences that could derive from intensive use*, such as marine pollution, and *the need to provide for accommodation between different uses of the sea-bed and between these and the uses of the superjacent waters.*

From the fact that the sea-bed is of vital importance to States it can be deduced that, if conflict and the heightening of tensions are to be avoided, an international legal structure must be established that will insulate the sea-bed as much as possible, particularly in the defence and economic fields, from the continuing competition for power and influence in the world; this can only be done through an international machinery that can give credible assurance of impartiality and equity.

With regard to defence, insulating the sea-bed from power rivalries means prohibiting its use beyond agreed limits for the widest possible range of military purposes compatible with the possibilities of effective verification of any violations. This objective is achievable either through an international convention adhered to by all significant maritime powers without any implementation machinery or, and more credibly for the international community, through an international convention adhered to by all significant maritime powers which provides for the verifications of its provisions by an impartial international mechanism which could well form part of an international organization.

Again in the economic field, avoidance of conflict, the need to avoid pollution and the need deeply felt by many countries to provide for an equitable distribution of benefits, and, finally, the need to provide for accommodation between different uses

of the sea-bed all point to the necessity of establishing an international agency or authority, to manage the area as a whole, and not only its resources, in the name of the international community.

Any international agency or authority established to manage the sea-bed beyond national jurisdiction must, to be viable, give credible guarantee of efficiency and impartiality. This requires the creation of special mechanisms to assure both efficiency and a balance of interests. In the field of exploration and economic exploitation of the sea-bed both efficiency and balance could perhaps be attained by separating the functions of management of the sea-bed from those relating to the distribution of benefits derived from the exploitation of its resources. With regard to the former function it would not be impossible to conceive that those States whose special position and responsibilities are recognized under the United Nations Charter and three or four others should enjoy a voice commensurate with their outstanding financial and technological-marine capabilities, while in the distribution of benefits derived from exploitation all States should have an equal voice. Such a distribution of weight within an international organization would appear to correspond to the predominant interests of different groups of States.

Since ocean space constitutes one global and inter-related ecological system of which the sea-bed is only one part, it is clearly desirable that, if the necessity is recognized for an international body to administer the sea-bed beyond national jurisdiction in the name of the international community, the competence of such a body be extended to comprise ocean space as a whole. This would provide direction and focus to international cooperation in ocean space and bring together the fragmented and insufficiently coordinated activities now undertaken by the United Nations and half a dozen agencies within the United Nations system. It would undoubtedly be useful could "a single home be provided for the various marine scientific and technological activities now lodged in several United Nations Specialized Agencies", as the Oceanographic Committee of the United States National Academy of Sciences has recommended.

What is suggested does not mean that any future agency should, or can, have the same functions in all parts of ocean space disregarding the juridical status of its various parts. In waters

within the territorial sovereignty of a State, the competence of an international agency can at best be of an advisory nature and exercised only at the request of the State concerned. Established interests of States and a considerable body of international law exist with regard to the high seas, thus the functions of an international authority with regard to this part of the ocean environment must be confined to facilitating and harmonizing national activities with functions substantially similar to those of existing United Nations Specialized Agencies. With regard to the sea-bed on the other hand whatever international machinery may be established should provide not only for the registration and allocation of internationally recognized exclusive rights over the non-living resources of the sea-bed, but also for the conservation and management of both living and non-living resources and the distribution of a substantial part of the financial benefits deriving from exploitation of non-living sea-bed resources to developing countries.

Thus the outlines of the competence, powers and functions of a future international organization are derivable from known facts and clearly foreseeable needs. The outlines will become clearer as technological and political developments prove to States the historical inevitability of an international regime furnished with appropriate machinery, if the rich resources of the sea-bed are to be of any lasting advantage to anybody.

POSSIBLE FUTURE REGIMES
OF THE SEA-BED RESOURCES: INTERNATIONAL
REGULATORY AGENCY

BY

Dr. LOUIS B. SOHN

*Bemis Professor of International Law, Harvard Law School, Harvard University;
Senior Fellow, Center for International Studies, New York University*

Introduction

The purpose of this paper is to explore only one of the possible future regimes for the control of the resources of the sea-bed — an international regulatory agency.¹ The main assumptions are: that these resources which constitute the

1. The other options here would be: an agency limited to the registration of national claims to specified areas of the sea-bed; or an agency which, in addition to the registration of claims, would try to reconcile or to adjudicate conflicting claims. For proposals emphasizing registration, see L.F.E. Goldie, "The Contents of Davy Jones's Locker — A Proposed Regime for the Seabed and Subsoil", 22 *Rutgers Law Review* (1968), p. 1, at 38-54; *idem*, "The Exploitability Test — Interpretation and Potentialities", 8 *Natural Resources Journal* (1968), p. 434, at 455-61; United States, Commission on Marine Science, Engineering and Resources, *Our Nation and the Sea: A Plan for National Action* (Washington, D.C., 1969), pp. 147-51.

For a more general exploration of various options, see Victor Basiuk, "Marine Resources Development, Foreign Policy and the Spectrum of Choice", 12 *Orbis* (1968), pp. 39-72; Louis Henkin, *Law for the Sea's Mineral Resources* (New York, 1968), pp. 64-68; Francis T. Christy, Jr., "Economic Criteria for Rules Governing Exploitation of Deep Sea Minerals", 2 *International Lawyer* (1968), p. 224, at 232-42; *idem*, "Alternative Regimes for Marine Resources Underlying the High Seas", 1 *Natural Resources Lawyer* (1968), p. 63, at 74-77; Richard Young, "The Legal Regime of the Deep-Sea Floor", 62 *American Journal of International Law* (1968), p. 641, at 647-51. See also United Nations Secretariat, *Legal Aspects of the Question of the Reservation Exclusively for Peaceful Purposes of the Sea-Bed and the Ocean Floor ...: Part III, Alternative Legal Regimes Which Might Be Applied in the Future to the Sea-Bed and the Ocean Floor ...* (U.N. Doc. A/AC.135/19/Add.2, 25 June 1968), pp. 13-20. For a list of comments by Governments on the question of an international regime, see U.N. Docs. A/AC.135/12 (7 June 1968), pp. 18-25; and A/AC.138/7 (6 March 1969), pp. 32-36.

common heritage of mankind will become subject to an international regime; and that one of the main features of that international regime will be an "appropriate international machinery for the promotion of the exploration and exploitation of the resources of this area, and the use of these resources in the interests of mankind, irrespective of the geographical location of States, and taking into special consideration the interests and needs of the developing countries."²

The following problems will be explored in this paper:³

1. *Relationship to the United Nations*: should the new agency (or authority) be established within the United Nations framework or should it be a completely separate organization? If the decision should favor the United Nations, should the new institution be established as a specialized agency or should it be more closely connected to the United Nations? Should there be a universal agency or should there be instead several regional agencies?

2. U.N. General Assembly, Resolution 2467 (XXIII), Section C, para. 1. This resolution was the result of an initiative, and persistent advocacy of an international solution, by Ambassador Arvid Pardo of Malta. For the original Maltese proposal, see U.N. Doc. A/6695 (18 August 1967); for Ambassador Pardo's basic speech, see U.N. Docs. A/C.1/PV. 1515 and 1516 (1 November 1967). See also his article, "Who Will Control the Seabed?" *47 Foreign Affairs* (1968), pp. 123-37. As was pointed out by Roger Revelle: "If the less-developed countries are to gain much real benefit from these resources, it may be necessary to place them under the jurisdiction of an international agency which could grant exclusive licenses for exploration and exploitation in return for a share of the proceeds". R. Revelle, "Man and the Sea in the 21st Century", reprint by the Commission to Study the Organization of Peace (New York, 1968) from Foreign Policy Association, *Toward the Year 2018*, p. 6. For blueprints of such an agency, see Elizabeth Mann Borgese, *The Ocean Regime: A Suggested Statute for the Peaceful Uses of the High Seas and the Sea-Bed Beyond the Limits of National Jurisdiction* (Santa Barbara, Cal., 1968), pp. 9-39; Commission to Study the Organization of Peace, *The United Nations and the Bed of the Sea* (New York, 1969), pp. 27-29; (Aaron L. Danzig and others), *Treaty Governing the Exploration and Use of the Ocean Bed* (United Nations Committee of the World Peace Through Law Center, Geneva, 1968), pp. 20-26; Claiborne Pell, *Treaty on Principles Governing the Activities of States in the Exploration and Exploitation of Ocean Space* (U.S. Congress, 91st 1st session, S. Res. 92), pp. 8-17.

3. For similar lists of issues, see E.D. BROWN, *Report on the Legal Regime of Deep-Sea Mining* (British Branch Committee on Deep-Sea Mining, report presented to International Law Association, Buenos Aires Conference, 1968), pp. 52-53; R.R. Neild, "Alternative Forms of International Regime for the Oceans", in International Institute for Peace and Conflict Research (SIPRI), *Towards a Better Use of the Oceans: A Study and Prognosis* (Stockholm, 1968), p. 279, at 291-92; U.N. Secretariat, *op. cit. supra note 1*, at 18-20.

2. *Membership*: should the agency be limited to the Members of the United Nations or should non-members be allowed to participate? should some arrangements be made enabling the divided countries to participate? should a special category of membership be provided for microstates? should associate membership be granted to non-self-governing territories?

3. *Principal organs*: should the General Assembly of the United Nations be the main organ of the new institution or should there be a separate General Conference, composed of representatives of all Members? is a separate Governing Body needed, and if so, how should it be composed? what should be the voting procedures in the principal organs?

4. *Executive organs*: should there be merely a Secretary-General (or a Managing Director) or should there be an Executive Commission (as in the European Communities)? what kind of secretariat (and staff) is needed? what should be the status of the staff? where should the headquarters be located?

5. *Powers*: should the agency be allowed to enact binding regulations? how and on what basis should licensing decisions be made? how should the performance of the licensee be policed? how should the rights of the licensee be protected? how should the economic interests of the developing countries, including the landlocked countries, be promoted and safeguarded? should technical assistance be provided to the developing countries to increase their capability to participate in the exploration and exploitation of the resources of the sea-bed? should the agency limit itself to the promotion of scientific research by others or should it engage directly in such research? what role should the agency play in the enforcement of disarmament provisions relating to the sea-bed?

6. *Financial questions*: should the agency collect only such license fees and royalties as might be needed to pay for its costs, or should it try to collect additional revenue for the benefit of mankind? if special funds are thus made available, how should they be distributed and by whom? should all such additional funds be divided among the developing countries or should some revenue be reserved for the United Nations itself?

1. Relationship to the United Nations

A new international agency or authority for the promotion of the exploration and exploitation of the resources of the sea-bed might be established by the United Nations itself or by a special international conference similar to the Geneva Conferences on the Law of the Sea of 1958 and 1960. Such a conference would be necessary if it should be decided that the new institution should function outside the framework of the United Nations. Even if a close link with the United Nations is contemplated, the General Assembly might decide that a special conference is needed to resolve the complex issues relating to the regime of the sea-bed and to draft a detailed treaty on the subject.

One of the reasons for convoking a special conference is closely connected to the issue whether the new institution should be within the framework of the United Nations. It might be argued that both the conference and the new agency established by it should include all States of the world, even those which are not Members of the United Nations or of one of its specialized agencies. In order to be truly universal, the argument runs, the new organization should from the beginning include the People's Republic of China, East Germany, North Korea and North Vietnam, and they should be invited to the conference creating that organization. This might not be possible if the conference should be held under the auspices of the United Nations or if the new organization should be closely linked to the United Nations.

The other possible reason for opposition to the establishment of the new agency under the auspices of the United Nations is the dissatisfaction among some Members of the United Nations with the procedures and the voting patterns of the United Nations and the resultant desire of these Members to isolate the new organization from the influence of the principal United Nations organs. It may be noted that several of the States which are concerned with this problem are at the same time opposed to the rule of absolute universality and would want to keep some countries out of the new organization. As far as these States are concerned, the two sets of reasons militate against each other and might be a contributory factor to the

reluctance of this group of States to face the issue of the regime for the sea-bed and to their desire to postpone this question as long as possible. On the other hand, this very split of interests might prevent them from opposing firmly a decision on the subject approved by a preponderant majority of other States.

It seems likely, therefore, that the opposition to a link with the United Nations will be overcome, and it is necessary to explore the various forms which such a link might take. The new institution for the sea-bed might be a specialized agency, or an international organization not having the status of a specialized agency but nevertheless linked to the United Nations, or a subsidiary organ of the United Nations.⁴ Some of the specialized agencies of the United Nations are less closely linked to the United Nations than others, and a few of them insist on a large measure of independence. All of them have separate organs, not only small councils or executive committees, but also plenary assemblies or conferences in which all members are represented, as well as separate secretariats and budgets. They report to the United Nations through the Economic and Social Council, and though they are not bound by the recommendations of the United Nations they are expected to consider them and to consult with the United Nations about the modalities of their execution and the reasons for non-compliance.

The main example of an organization which is not a specialized agency but is closely linked to the United Nations is the International Atomic Energy Agency (IAEA). It reports directly to the General Assembly and the Security Council of the United Nations and not to the Economic and Social Council, though it participates also in various programs which are under the supervision of the Economic and Social Council. Additional functions have been conferred upon the IAEA by various agreements on the control of nuclear energy, including the Nuclear Non-Proliferation Treaty, in which the United Nations is greatly interested.

Some of the subsidiary organs of the United Nations have a large degree of autonomy. In addition to such older separate

4. See International Law Association, *Report of the Deep-Sea Mining Committee on the Exploration and Exploitation of Minerals on the Ocean Bed and in Its Subsoil* (Buenos Aires Conference, 1968), pp. 6-7.

entities as the United Nations Children's Fund (UNICEF) and the recently re-organized United Nations Development Program (UNDP), the General Assembly created directly, through resolutions and without international agreements, two full-bodied international organizations — the United Nations Conference on Trade and Development (UNCTAD) and the United Nations Industrial Development Organization (UNIDO) — as (subsidiary) organs of the General Assembly. All these organizations have separate executive boards or councils, and semi-independent secretariats and, to some extent, budgets.⁵

The new agency for the development of the resources of the sea-bed might assume any one of these forms. It could be as independent as IAEA or a specialized agency or it might be a subsidiary organ of the United Nations. It might be established by a treaty, drafted inside or outside the United Nations or even by a resolution of the General Assembly. It might report directly to the General Assembly or to the Economic and Social Council. Its staff might be completely independent, or semi-independent, or it might even be an integral part of the United Nations Secretariat. It might have a whole panoply of separate organs or it might have no separate assembly or conference, using the General Assembly of the United Nations as its policy-making body.

Whatever the solution adopted, it would assuage many fears and would allow the closest possible link to the United Nations, if it should be made clear from the beginning that the main organs of the new organization would have complete operational responsibility and that the General Assembly would only give policy guidance and would in no way interfere in the decision-making processes of the new agency. While this could be assured most easily through giving to the new organization the status of a specialized agency or its equivalent, proper safeguards could be developed even if the new entity should be established as a subsidiary organ of the United Nations, as exemplified by UNDP, UNCTAD and UNIDO.

5. The texts of the constitutional documents of international organizations mentioned in this section are conveniently collected in H.F. Van Panhuys and others, *International Organisation and Integration: A Collection of the Texts of Documents relating to the United Nations, Its Related Agencies and Regional International Organizations* (Leyden, 1968), 1141 pp.

The viability of the whole system would depend on the stability of the regime to be established and the acceptance by the General Assembly of self-denying restrictions concerning revisions of the statute of the agency and the operational activities of the separate organs of the agency.

A separate issue requiring exploration is whether the proposed agency should be global in scope, or whether there should be separate agencies for all the major sea-bed areas. One could envisage a separate organization for the sea-bed of the Gulf of Mexico or the Indian Ocean or for the sea-bed facing the East Coast of Africa or the West Coast of Latin America. This seems to be, however, a dangerous idea as it would plunge the new authorities into a battle as to the boundaries of each area, and it might result in the development of a variety of standards and modes of operation and in an uncoordinated dumping of vast amounts of raw materials on an unprepared market. The need for a uniform policy in economic and technical matters is here so overwhelming that a universal agency is certainly desirable. This would not prevent this agency from establishing regional offices for the supervision of specific areas and for providing technical assistance to countries in a particular region. This can be accomplished easily without creating at the same time a whole host of competing regional agencies which could set back the development of the resources of the sea-bed by many years.

Finally, it would be necessary to clarify the relationship between the new agency and the existing international organizations. Various specialized agencies of the United Nations have been dealing with maritime problems, ocean exploration and living resources of the sea.⁶ In particular, the Intergovernmental Oceanographic Commission (IOC) of UNESCO has done an excellent job in coordinating international research programs with respect to the sea, and the General Assembly in 1968 assigned to it the leading role in connection with the International Decade of Ocean Exploration. It might be expected

6. See Eugene B. Skonkikoff, "National and International Organization for the Seas", in American Assembly, *Uses of the Seas* (Englewood Cliffs, N.J., 1968), p. 98, at 98-105; Letter from the Chairman of the IOC to the Secretary-General of the United Nations, 27 February 1969, U.N. Doc. A/AC.138/10 (17 March 1969); U.N. General Assembly, Resolution 2467 (XXIII), Section D.

that the new agency would take advantage of the expertise and experience of existing organizations and would develop harmonious relations with them through a series of bilateral agreements. The problems are so vast that the mobilization of all international resources is necessary to cope with them effectively.

2. *Membership*

If the new organization for the sea-bed should be established by a resolution of the General Assembly, all the Members of the United Nations would automatically become members of it and would be entitled to participate in its activities. Such a resolution could also open the membership to States members of the specialized agencies and of the International Atomic Energy Agency, as was done with respect to UNCTAD and UNIDO. Similar action would probably be taken by any conference for the establishment of the new agency, especially if the conference should take place under the auspices of the United Nations.

This approach would permit the participation in the new agency of Switzerland, West Germany, South Korea, South Vietnam, as well as of some microstates which are members of the specialized agencies. It would exclude, however, such countries as East Germany, North Korea and North Vietnam, and pending the settlement of the Chinese representation question, the People's Republic of China. An admission of these four countries to the new organization would require a change in the practice of the United Nations. As all four countries border on the sea, their participation from the beginning in a new regime for the sea-bed would be extremely desirable, and their exclusion might cause grave difficulties in the future. In other areas, the United Nations has sometimes departed from previous rules when the special circumstances of the occasion demanded it. There seems to be a clear case for making a departure here from the ordinary membership rules, with proper reservation, of course, that this step would not constitute a precedent for other dissimilar or less important cases.

The new organization should also safeguard the special interests of the present and future microstates, most of which are islands or groups of islands and greatly depend on the sea. If the proposal were adopted for dividing all the sea-bed areas in accordance with the median line equidistant from the shores of the opposing coastlines, great chunks of the sea-bed would become possessions of the strategically located microstates. While this suggestion has found little support, equitable consideration of the interests of microstates should allow them to derive some benefit from their favorable location in the middle of vast areas of the sea-bed distant from any other State. In particular, they should receive from the new organization some special financial assistance which would compensate for their usual lack of other natural resources and for the refusal of the international community to grant them any special privileges with respect to the sea-bed. To protect their special interests, the microstates should be granted special membership in the organization which would impose no financial burdens on them but would allow them to obtain a proper share in the development assistance to be given by the new organization. To distinguish such membership from that of the non-self-governing territories, it might be called limited membership. Such membership might entitle the microstates to elect one or more from among their midst to represent them in the principal organs of the new agency, with or without a vote. In any case, whenever the interests of one of them would be specially affected, by analogy to Article 31 of the United Nations Charter, it should be invited to participate, without vote, in the relevant discussions of the organs concerned.

There are many precedents for an associate membership of non-self-governing territories in international organizations, and similar status should be given them in the new organization. In this particular case, there are special reasons for such membership. Many of the remaining non-self-governing territories, like the microstates, are islands or groups of islands or border on the sea. They have a special interest in the activities of the new organization and have a better claim to some benefits from its activities than some of the more developed countries which administer them. They are already under the protection of Chapter XI of the Charter, or in case of the

two remaining trust territories in the Pacific they benefit from the international trusteeship system (Chapters XII and XIII of the Charter). By giving them associate membership, the new organization would enable them to protect directly their own interests. As in the case of the microstates, however, some restrictions might be imposed on their participation in various organs of the new agency, except where their interests are specially affected. It might be sufficient, for instance, to allow them to select one or more of them to represent them in these organs.

3. *Principal Organs*

A separate new organization would need a whole panoply of principal organs — a general conference, a smaller governing board or council, and an executive or administrating organ (a single administrator or an administrative commission). Should the new organization be closely integrated with the United Nations, the General Assembly of the United Nations might act as the policy-making organ of the new agency, in a manner similar to its role with respect to the United Nations Development Program and UNIDO. On the other hand, UNCTAD has its own Conference meeting triennially. A separate General Conference of the sea-bed authority could be specially tailored to the needs of the new agency. It could be based on a weighted voting system similar to that prevailing in the International Bank for Reconstruction and Development and the International Monetary Fund. It could more easily provide for proper representation of microstates and non-self governing territories. It would be composed largely of delegates with some knowledge of sea-bed problems. On the other hand, a separate conference would be more likely to interfere with the day-to-day functioning of the organization and would leave less leeway to the governing board and the administration.

If the General Assembly of the United Nations should retain control of the policy-guidance of the new agency, two possible lines of development might be considered. The agency might report to the General Assembly through the Economic and Social Council, and that Council might scrutinize the

activities of the agency and furnish the General Assembly with its recommendations on the subject. The General Assembly would consider this report and recommendations through its Second Committee, on which all Members are represented, and after a short debate either formally note the report or adopt some recommendations or policy guidelines. Alternatively, the new agency might report directly to the General Assembly and the General Assembly might set up a special permanent committee, similar to the Special Political Committee, to consider that report. In such a special committee, it would be quite easy, on the basis of existing precedents, to provide for representation of non-member States, of microstates and non-self governing territories. It might be even possible to provide special voting rules requiring, for instance, concurrent majorities of two or more groups of States represented on the committee, including the developed, the developing and the landlocked States. The membership of the Committee need not include all Members, and the number of developed and developing Members to be represented on the Committee might be properly balanced. The Committee's draft recommendations would then be considered in a plenary session of the General Assembly, which in view of its crowded schedule would seldom engage in revising them. Should the majority of the General Assembly feel, however, that the Committee is on a wrong track, it might send the recommendations back to the Committee with some general instructions as to how they should be revised. In view of the close liaison existing among the various regional groups in the General Assembly and those of their members who are represented on various committees this eventuality would seldom occur, especially if the special committee should operate mostly through consensus and conciliation rather than overriding majority votes.

The second most important organ of the new agency would be a smaller governing board or council. Most of the boards established recently by the United Nations are rather large; for instance, the Governing Council of the United Nations Development Program has thirty-seven members, the Industrial Development Board, forty-five, and the Trade and Development Board, fifty-five. In all of them account is taken of proper geographical distribution, a specific number of seats is allocated

to each region, and in the last two instances the members belonging to each region are listed in annexes.⁷ The Council of UNDP is composed of nineteen members from the developing States and seventeen members from the economically more developed States, the thirty-seventh seat rotating in a complicated fashion among various regions. Some of the other agencies provide also in detail for the structure of their governing boards. For instance, in the IAEA some members of the Board of Governors are selected by the outgoing Board, while others are elected by the General Conference of the Agency; the first group includes members most advanced in the technology of atomic energy in general and in each of eight regions, and members producing source materials or supplying technical assistance. The Council of the Inter-Governmental Maritime Consultative Organization (IMCO) is composed of three groups of six Members each: Members with the largest interest in providing international shipping services; Members with the largest interest in seaborne trade; and Members having special interest in maritime transport or navigation or whose election will ensure the representation of all major geographic areas of the world. Similar provisions govern the composition of the Council of the International Civil Aviation Organization (ICAO). The Constitution of the International Labor Organization (ILO) gives direct representation on the Governing Body to ten Members of chief industrial importance.

There are thus various precedents for structuring an adequately representative governing board. The Council of the new organization for the sea-bed might be composed, for instance, of members selected by the following groups of States:

(a) fifteen from the group of States most highly developed in sea-bed technology; (b) twenty-five from other States with access to the sea; and (c) five from States having no access to the sea. Again it might be hoped that most decisions would be arrived at by consensus and conciliation. Should votes be required, however, care must be taken that no one-sided decisions would be made. Thus, it might be desirable to re-

7. ROGER REVELLE (*loc. cit. supra* no. 2) has suggested that the new agency "could best be governed by a board of directors representing major continental areas, rather than individual nations".

quire, in addition to an overall majority, concurrent majorities of each of the first two groups of members of the Councils at least for specified categories of important decisions.

To provide adequate continuity, the terms of members of the Council should be relatively long (for instance, four years). It might be hoped also that several members would be usually re-elected, especially in the first category. The election would be by the General Assembly (or by the separate general conference), though nomination (or even selection) by the outgoing Council of States in the first category, as is done in IAEA, might be a useful safeguard.

4. *Executive Organs*

The character of the executive or administrative organs would depend largely on the division of power within the organization. Should most important decisions, especially about the exploitation rights, be in the hands of the Council, the direction of the administrative staff might be left to a Secretary-General, Director-General, or a Managing Director (as in the IMF). He might be subject to the Secretary-General of the United Nations, who might name him, subject to consultations with the Council; or he might be quite separate from the United Nations Secretariat and appointed directly by the Council.

Alternatively, should the Council be limited to political direction and should it leave the principal executive decisions to the executive organ, there might be reluctance to confer such important powers on a single individual. In such a case, one might wish to follow the precedent of the European Communities and establish a relatively independent commission, composed of experts with a relatively independent commission, composed of experts with technical knowledge and political understanding, coming from various regions, and acting collectively.

While the three European Communities had originally three separate commissions (or, in the case of the European Coal and Steel Community, a High Authority), they were merged by a treaty signed in 1965 which came into force in 1967. The

merged Commission of the European Communities consists of nine members, "chosen on the grounds of their general competence". Their independence is fully guaranteed, and they act "in the general interest of the Communities." It includes the nationals of all Member States, and in no case can have more than two members who are nationals of the same State. Similarly, it might be possible to appoint a commission of nine persons for the sea-bed agency, four from the developed States, four from the developing States, and one from a landlocked State. Alternatively, one could have a Secretary-General and eight Assistant Secretaries-General, who could act collectively in certain important matters.

The staff of the new agency might form part of the United Nations staff and should be governed by the same staff rules and regulations.

5. Powers

While the new organization might be closely connected to the United Nations structurally, its success would depend greatly on the strict separation of functions between the United Nations and the sea-bed agency. The role of the United Nations would be primarily restricted to the adoption of the basic statute of the agency, the approval of a declaration of general principles, the adoption from time to time of general guidelines for the implementation of these principles, and the annual discussion of the reports of the agency, on the basis of which some general resolutions might be adopted specifying the direction in which the agency should proceed in order to better accomplish its mandate.

Most other powers should be in the hands of the special Council of the agency. Unlike other organs of the United Nations, this Council would have true regulatory powers. It would adopt regulations which would be binding on Members, in a manner similar to those adopted by ICAO or the World Health Organization (WHO), but perhaps going one step further in not permitting deviations. After their adoption by the Council by a special majority, these regulations would come into effect on a specified date unless rejected by a majority of

Members. Within the framework of the guidelines adopted by the General Assembly, these regulations would provide detailed rules for the conduct of all activities of the agency, including those relating to the granting of exploration and exploitation rights and to the supervision of the performance of those to whom the grants were made. All the contracts or agreements made by the agency would be subject to these regulations, and the amendments thereto, and all the grantees would have to accept them expressly.

Both the guidelines, in general, and the regulations, more precisely, would determine: the minimum and maximum size of areas with respect to which exploration and exploitation rights would be granted; the minimum and maximum length of such grants; the performance requirements; the payments of various kinds to be made to the agency; the rules to be observed in order to minimize interference with navigation, fishing, submarine cables and pipelines; anti-pollution standards; and other similar matters.⁸

Within the framework of these guidelines and regulations, the proper authority of the agency (either the Council on the basis of recommendations of the Secretary-General or the Managing Director, or the executive commission of the agency, if one is established) would determine in each case: the area of a particular grant of exploration and exploitation rights; the period of the grant; and the specific conditions of the grant, especially with respect to performance and payments.

The grants (or concessions or leases) might be made directly to individuals or private or public enterprises, or there might be a two-tier system.⁹ In the latter case, the grant would be made to a State which might either itself engage in exploration or exploitation, or transfer its rights to an individual or a private or public enterprise. The State concerned would be responsible to the agency for the performance of the condi-

8. For different approaches to the functions of a sea-bed agency, see American Assembly, *Uses of the Seas* (Report of the 33rd Assembly, Arden House, N.Y., 1968), p. 7; Daniel S. Cheever, "The Role of International Organization in Ocean Development", 22 *International Organization* (1968), p. 629, at 646-48; Christy, *Economic Criteria*, *op. cit. supra* note 1, at 229-32; Neild, *op. cit. supra* note 3, at 284-90.

9. See International Law Association, *op. cit. supra* note 4, at 7; Netherlands, Letter of 4 March 1968, U.N. Doc. A/AC.135/1, pp. 21-25.

tions of the grant, though direct responsibility of the operating enterprise might also be envisaged, in which case the State would be only subsidiarily responsible as a guarantor of effective performance.

To ensure that the grantee had complied with the general regulations and specific conditions of this grant, the sea-bed agency would have to establish an inspectorate which would be allowed access to each installation or drilling operation on conditions specified in the regulations.

The agency should be entitled to rescind the grant in case of inadequate performance, non-performance, violation of specified conditions, or non-payment of the amounts due to the agency.

Appeal against the decisions of the agency should be allowed, either to a special tribunal to be instituted by the agency or to the International Court of Justice. In the latter case a special chamber of the Court might be established composed of specially qualified judges or sitting with specially qualified assessors, without the right to vote. (Statute of the Court, Articles 26 and 30). Pending its decision, the Court might indicate the necessary provisional measures, under Article 41 of its Statute, including a permission to continue exploitation operations.

Other functions of the new organization would include: protection of the sea against pollution from sea-bed operations, and more positively the use of its resources for the improvement of the sea environment; technical assistance to the developing countries, with the specific purpose of increasing their capability, through trained manpower and new industrial developments, to participate in the exploration and exploitation of the resources of the sea-bed; promotion of scientific research with respect to the sea-bed through existing channels, national and international, and the establishment of its own research facilities to the extent necessary for a better performance of the agency's functions.

In its exploitation policy, the new agency would have to take into consideration the world markets for various products and would have to exercise special care to prevent a disastrous fall in prices of the materials produced both in the developing countries and on the sea-bed. A close cooperation with

UNCTAD and other international organizations might be required in this connection.

It is less clear what should be the role of the new organization in the supervision of the disarmament provisions relating to the sea-bed. Some of the major powers prefer reciprocal inspection to supervision by an international agency, while most other countries do not trust such arrangements and are likely to opt for an international authority. Should a general disarmament organization be established to deal with disarmament on both land and sea, it would be probably given jurisdiction also over the sea-bed. Pending, however, the creation of such an organization, it would seem desirable to equip the new sea-bed agency with effective means for supervising the disarmament measures relating specifically to the sea-bed.

6. *Financial Questions*

It is generally accepted that the resources of the sea-bed should be exploited "for the benefit of mankind" and that the regime to be established should "meet the interests of humanity as a whole."¹⁰ One could envisage various methods for achieving these objectives. The most direct approach would seem to be — to use the revenues from the resources of the sea-bed for the purpose of increasing the funds available to the United Nations development programs for reducing the dangerous gap between the developed and the developing nations. Two goals need to be combined: to ensure the economically most efficient use of the resources of the sea-bed, and to provide maximum possible revenue.

The General Assembly of the United Nations (or the general conference of a separate organization for the sea-bed) would determine the ways in which revenues should be obtained from the grants of exploitation rights. There might be initial payments, specified annual payments, or taxes on profits or per volume of production, or such a combination of these me-

10. U.N. General Assembly, Resolution 2467 (XXIII), Section A, subpara. 2(a).

thods which would provide for most efficient exploitation and maximum revenue for the international authority.¹¹

The revenue thus obtained would be used in the first place for the payment of the administrative costs of the sea-bed agency, and in the second place for technical assistance to the developing countries designed to improve their ability to participate equitably in the exploration and exploitation of the resources of the sea-bed.

The remainder of the revenues should be turned over to the United Nations development programs, to be spent either through the existing machinery, including the United Nations Special Fund, or through a special new agency. The main decisions on how these funds should be spent and through which channels, and on the principles which should govern their distribution to the various developing countries, should be made by the General Assembly of the United Nations on the advice of the Economic and Social Council. The new sea-bed agency should be restricted to regulatory and administrative functions; it should not be burdened with the additional task of distributing the funds collected by it.

Conclusions

In this general exploration of the problems involved in the establishment of an international regulatory agency for the sea-bed, it proved only possible to deal with a limited group of questions and to sketch a few options which might be available. Greater studies in depth are needed, by both official and unofficial bodies, including various universities and institutes. While many preliminary decisions might have to be made before these studies would be completed, nevertheless all the interested institutions should continue to work on them vigorously. At the same time, it would be dangerous to delay crucial decisions until studies are completed. The developments in this area proceed at a pace which could not be anticipated a few years ago, and it must be subjected to the rule

11. Some of the ways in which this may be done are spelled out in Neild, *op. cit. supra* note 3, at 288-89.

of law before a point of no return is reached. The problem is too important to permit the law and the new institutions to lag behind technological developments. The available options need to be weighed, but the mere act of weighing, discussing and deliberating should not be a substitute for decision-making. The matter needs to be put as soon as possible in the hands of an effective international agency, able to regulate future development of the resources of the sea-bed for the good of mankind.

POSSIBLE FUTURE REGIME OF THE SEA-BED
SOME LEGAL ASPECTS OF THE USES
OF THE SEA-BED

BY

Dr. ANDREY K. ZHUDRO and Dr. ANATOLY L. KOLODKIN *

The Research Institute of Maritime Transport, Moscow

I

The problem of the uses and exploitation of the sea-bed and the subsoil thereof, beyond the limits of national jurisdiction, is at present the centre of attention of the United Nations, generated by the debates in the General Assembly, by the activities of the *Ad Hoc* and the permanent Committee on the sea-bed, and, lastly, the activities of the Eighteen Nations Disarmament Committee, which has on its agenda the question of prohibition of the military uses of the sea-bed.

As correctly noted by Prof. W. Burke, the ocean is now "a major focus of national and international political considerations" ¹.

Wide activity of different scientific organisations and bodies in this field should also be noted. One has to mention here the International Law Association, which has formed the Committee on Deep-Sea Mining; the Law of the Sea Institute of the University of Rhode Island; and the SIPRI in Stockholm — which have held conferences and symposia devoted to this problem.

The problem is studied and discussed by many well-known scientists and lawyers, whose works are at present known in world scientific circles, including those of the U.S.S.R.

* The paper reflects personal opinions of the authors.

1. W.T. BURKE, Contemporary Legal Problems of Ocean Development, "Towards a Better Use of the Oceans. A Study and Prognosis", SIPRI, Stockholm, 1968, p. 17.

In the Soviet Union the legal problems of uses of the sea-bed, including the problem of the continental shelf, are also the centre of attention, which is reflected in a number of works by Soviet authors.

The scientists of many countries are interested in the problem of uses of the sea-bed not only because of its importance but also because many legal aspects of this problem have not yet been developed enough in the contemporary doctrine of international law.

II

Among the problems of an international regime of the sea-bed, the question of prohibition of its military uses occupies the central place. In the light of the existing trend to extend the armaments race to all newly accessible areas of the world, it is hardly necessary to argue about the importance of this question. The warnings against possible-fatal consequences of military uses of the sea-bed are being heard ever more often.

A. Pardo in his article "Who will control the sea-bed?", published in 1968, notes that:

use of ocean floor for military purposes would almost certainly lead to an immediate and rapid escalation of the arms race in the seas ... The addition of an arms race in a new environment, as now appears to be prospect, would further strain the financial resources of the major powers, causing postponement of those comprehensive measures for the improvement of standards of living which are widely considered to be imperative. The disappointment of impatient expectations could increase both internal and international tensions.

In view of these circumstances, and wishing to contribute to the slowing down of the armaments race and to disarmament, the Soviet Union submitted to the Eighteen Nation Disarmament Committee a draft treaty on the prohibition of the use of the sea-bed for military purposes². It should be noted that the statement of the U.S.S.R. attached to this draft shows the

2. Eighteen Nations Disarmament Committee, Doc. ENDC/240, 18 March, 1969.

Soviet Union's active struggle to prevent the use of practically undeveloped areas, and — in particular — the sea-bed, for military purposes.

As early as 1958, at the Geneva Conference on the Law of the Sea, the Soviet Union strongly supported the proposals made by Bulgaria and India to the effect that the continental shelf should not be used for the construction of military bases or facilities. Unfortunately, at that time, those proposals were not adopted.

In the same vein, the Declaration on the Continental Shelf of the Baltic Sea, of October 23, 1968, signed by the U.S.S.R., Poland, and the German Democratic Republic, was an important contribution showing that all these states use the continental shelf of the Baltic Sea exclusively for peaceful purposes.

In the above-mentioned draft treaty on the prohibition of the use of the sea-bed for military purposes a proposal is made that "emplacement of objects with nuclear weapons or any other types of weapons of mass destruction, setting up military bases, structures, installations, fortifications, and other objects of a military nature" (tr. from Russian) be banned.

Provision is made for a control and checking of the implementation of the treaty. All the plant and constructions on the sea-bed, and in the subsoil thereof, would be open to representatives of other parties to the treaty, on the basis of reciprocity, in order to verify compliance with the commitments entered into by the states which emplaced such objects.

The above-mentioned prohibition is to be established immediately "beyond the limits of the 12-mile maritime zone of coastal states". Outer limit of this zone is to be measured from the same base-line which is used for the measurement of the territorial waters of the coastal states.

The following essential features of these proposals are to be pointed out.

First, in the draft submitted by the U.S.S.R., a proposal is made that the emplacement

of objects with nuclear weapons or any other types of weapons of mass destruction, setting up military bases, structures, installations, fortifications, and other objects of a military nature (tr. from Russian)

be banned.

In this connection, it is important to stress that the sea-bed can be used not only for nuclear armaments, but for conventional armaments as well.

The statement of the American professor, W.T. Burke, concerning the prohibition of all kinds of military uses of the sea-bed also merits approval. At the same time Prof. Burke believes that now "it seems to be realistic" to look for appropriate ways to prohibit

certain kinds or all kinds of military uses of the deep sea environment³.

An attempt to limit prohibition of the military uses of the sea-bed to weapons of mass destruction only, was criticized at the 23rd session of the General Assembly. E.g., the representative of Sweden said that such a limitation

could mean in our opinion that we do not go far enough. A "usual" type of explosives ... in the case of putting them on the sea-bed can lead to the same political consequences as nuclear explosive devices and could do damage to merchant ships and other peaceful users of the sea surface. The observation posts or communications centres, operated far from the sea-shore and set up on the sea-bed, could do damage to the political climate to the same extent as nuclear weapons. It seems to us to be a potent argument in favour of the conclusion that the sea-bed must be free of all military plant (tr. from Russian).

Second, it is to be noted that the proposal regarding the 12-mile zone, beyond which the regime of demilitarization should be established, follows the contemporary practice of states. Twelve miles is at present accepted by the majority of states as the limit of their territorial waters, or fishery zones and other contiguous zones. It is no coincidence that the American author, D. Pharand, notes that the 12-mile limit is agreeable from the point of view of customary international law⁴.

Third, acceptance of the proposal to prohibit military uses of the sea-bed beyond the 12-mile coastal zone, would mean that the prohibition applies to the areas of the continental shelves of many nations. Making areas on the shelves subject to intern-

3. W.T. BURKE, *op. cit.*, p. 20.

4. Cf. 62 *The American Journal of International Law*, 1968, p. 929.

ational legal regulations for the specific purpose would comply with the universally accepted principles and rules of international law, regulating the regime of the continental shelf. As is known, the jurisdiction of the coastal state over its shelf is, under the Convention on the Continental Shelf, not unrestricted. Coastal states exercise sovereign rights on the shelf only "for the purpose of exploration and exploitation of its natural resources" (Art. 2 of the Convention). These circumstances attracted the attention of the U.N. *Ad Hoc* Committee on the sea-bed⁵.

Fourth, the prohibition of the military uses of the sea-bed, and the subsoil thereof, beyond the 12-mile coastal zone, i.e. really in the areas which are more accessible for military uses, could have a significant impact on the limitation of the arms race.

In this connection it should be noted that — as has been rightly remarked in one of the studies prepared by the U.N. Secretariat —

in technical respect the emplacement of arms and other plant in the area of the continental shelf and on the tops of seamounts, as is known from available information, either is already possible or will be possible in the near future. On the contrary, the deep ocean floor is an area which yet remains only an object of military research and further developments (tr. from Russian).

III

Scientific and technological progress has raised a new legal problem. The essence of this problem, in short, is to determine, what principles and rules of international law are applicable to those areas of the sea-bed and its subsoil, which extend beyond the limits of national jurisdiction of the coastal states. Should new rules of international law be considered, or should it be agreed that those areas are covered by the existing rules of law?

In this case, the application of any of the already existing rules of a general character does not exclude the advisability of

5. Cf. Report of the *Ad Hoc* Committee to study the peaceful uses of the sea-bed and the ocean floor beyond the limits of national jurisdiction. - U.N., Gen. Ass., Off. Rec., Twenty-third session, (Doc. A/7230), New York 1968, p. 11.

a further development of more specific rules to regulate this or that aspect of the uses of the sea-bed and its subsoil.

In the opinion of the authors of the present paper, the regime of the sea-bed and its subsoil beyond the limits of national jurisdiction is based on the generally recognized principle of freedom of the high seas. Accordingly, the sea-bed and the ocean floor beyond the limits of national jurisdiction, and the subsoil thereof, are in common use by all nations; are open to all the nations; and not a single state may claim sovereignty over the sea-bed and its subsoil, or over any part thereof, beyond the limits of national jurisdiction. It appears, therefore, that there is no necessity to answer at any price the question of to whom the sea-bed and its subsoil, beyond the limits of national jurisdiction, belongs. As was noted at the session of the U.N. Committee on the sea-bed in March 1969,

The International Law Commission and 1958 Geneva Conference on the Law of the Sea had sought to define the status of the high seas without specifying to whom they belonged or who exercised sovereignty over them ⁶.

One cannot help recalling that attempts to establish separate regimes for the water column of the high seas and the under-jacent sea-bed have already been made. Thus, at the Conference of 1958, the representative of Brazil in Committee II noted that

the general concept of the sea was divided into four separate parts - waters of the sea, living resources of the sea, the sea-bed, and the airspace above the sea, and attempts were made to legislate for each separately ⁷.

Believing that the principle of freedom of the high seas is also the basic principle of a legal regime of the sea-bed and its subsoil beyond the limits of national jurisdiction, we suppose at the same time that the elaboration of the rules of international law, which at present regulate the regime of the continental shelf and have been codified by the Convention on the Continental Shelf, was an exception to this general principle.

6. U.N., Gen. Ass., Off. Rec., Doc. A/AC.138/SC.1/SE.8, 26 March 1969, p. 5.

7. U.N., Gen. Ass., Off. Rec., Doc. A/AC.135/19/Add.1, 18 June 1968, p. 6.

The recognition of the sovereign rights of the coastal states to exploration and exploitation of natural resources on their continental shelves has meant, in part, that the sea-bed and its subsoil *within* the limits of national jurisdiction, *ceased to be in common use by all states*. At the same time, the sea-bed and its subsoil, *beyond* the limits of national jurisdiction, continue *to be in common use*. It is known that the sea-bed of the high seas, including the continental shelf (insofar as it is covered by the high seas) was regarded not only as subject to the common use of all nations, like the high seas proper, but frequently was being declared to be a "thing" — generally *res nullius*.

Thus the first that could take possession of the thing without owner would be considered the owner of that thing because *res nullius cedit primo occupandi*⁸. Hence, the conclusion was made that the sea-bed of the continental shelf *a fortiori*, like its subsoil, may be subject to occupation by any state. Prof. L. Oppenheim wrote:

This occupation of the subsoil of the open sea can be extended up to the boundary line of the subsoil of the territorial maritime belt of another State, for no State has an exclusive claim to occupy such part of the subsoil of the open sea as is adjacent to the subsoil of its territorial maritime belt⁹.

However, this concept, like others declaring the sea-bed and its subsoil as *res nullius*, came from the traditional notion of the high seas as a transportation way and important means of development of international trade.

At the present time the meaning of the high seas is far from that described above. The growing importance of the high seas, with not only the water column but also the sea-bed and subsoil becoming an object of use by people, entails such an understanding of the principle of freedom of the high seas, according to which this principle applies not only to the water column but the sea-bed and its subsoil as well. Attention should

8. Cf. P.N. Galanza, *Gosudarstvo i pravo drevnego Rima*, Moskva 1963, p. 94.

9. L. Oppenheim, *International Law. A Treatise*, 8th ed., vol. 1, London 1960, p. 630.

also be drawn to the fact that the Convention on the High Seas already, to some extent, applied the principle of freedom of the high seas to the sea-bed and its subsoil, when it provided in articles 2 and 26 for freedom of laying submarine cables and pipelines. Moreover, art. 26, para. 2 provides that the coastal state, as a rule, may not prohibit laying or maintenance of submarine cables and pipelines on the continental shelf. In the commentary to this article, the International Law Commission stated that

the coastal state is obliged to permit laying of cables and pipe lines on the bottom of its continental prominence (tr. from Russian).

It means that, while the coastal state has sovereign rights for the exploration and development of the natural resources of the shelf, other states enjoy there all other freedoms of the high seas, in particular that of laying cables.

Moreover, the overall use of the sea-bed and its subsoil, beyond the limits of jurisdiction of the coastal state, is reserved for the common use of all nations.

The problem of extension of the principle of freedom of the high seas to the areas of the sea-bed and its subsoil, as well as the question of their legal regime, were discussed at international conferences and touched upon in theory. The representatives of a number of states in the U.N. *Ad Hoc* Committee on the sea-bed drew attention to the necessity of leaving not only the water column of the high seas, but also their bed and subsoil, as inappropriable by any state¹⁰. For instance, the government of Finland considered that

the principles of freedom of the high seas, set forth in the 1958 Convention on the High seas, can also be related to the ocean floor, and that the prohibition of occupation contained in these principles refers also to attempts to appropriate any part of the above-mentioned ocean floor for national purposes¹¹ (tr. from Russian).

10. Cf., e.g., statements of the representatives of Cyprus (Doc. A/C.1/PV. 1530, p. 21-22), of Finland and others (Doc. A/AC.135/1, Add. 6, p. 2); also U.N. Conference on the Law of the Sea, Off. Rec., Geneva 1958, vol. VI, p. 2-3, 12, 21.

11. U.N., Gen. Ass., Off. Rec., Doc. A/AC.135/1, Add. 6, p. 2.

Such a position on the question at stake was recognized also in one of the studies prepared by the U.N. Secretariat:

If the principle is generally accepted that any claim to sovereignty over the high seas would be incompatible with the doctrine of the freedom of the high seas, the question then arises whether this principle applies equally to the ocean floor, or merely refers to the water above the ocean floor of the high seas ¹².

In the doctrine, this problem found a different solution. As was noted, many scientists — still before the rules regulating the regime of the continental shelf were elaborated — recognized the occupation of the sea-bed as lawful, although they entirely shared the concept of freedom of the high seas. Prof. H. Kelsen wrote, for example, that

the sea-bed and the subsoil of the open sea possessed the status of no-state's land and could be acquired through effective occupation ¹³.

But the fact is that scientists did not divide the sea-bed of the high seas into the continental shelf, on one hand, and the sea-bed beyond the shelf, on the other hand. True enough, in recent works the regime of the continental shelf has been already considered; and the problem of defining the outer limit of the shelf, which arose recently, led scientists to the idea of definition of the shelf and of the rest of the ocean floor.

However, the question of elaboration and determination of a regime of the sea-bed beyond the limits of national jurisdiction has been not taken up immediately by scientists.

Thus, if we mention the works of authors who recognized the admissibility of occupation of the sea-bed, we mean that the question was that of the right of states to extend their jurisdiction over the areas of the sea-bed, contiguous to their shores, for the purpose of extracting pearls, corals, etc. This is just what Hurst believed when, as far back as 1924, he wrote that the demands of the exceptional possession of part of the sea and the resources which it produces in the form of pearl-shells, sea-shells, coral sponges or other fruit of the subsoil, correspond to the general accepted

12. *Ibid.*, Doc. A/AC.135/19, Add. 1, 18 June 1968, p. 5.

13. H. KELSEN, *Principles of International Law*, New York 1952, p. 226-227.

norm, regulating shipping in the high seas or permitting community to be engaged with fishing in the high seas ¹⁴.

Also Fauchille ¹⁵ and O'Connell ¹⁶ wrote about the fact that the sea-bed contiguous to the state territory may be occupied.

On the other hand, G. Gidel ¹⁷ C. Colombos ¹⁸, K. Strupp and H. Schlochauer ¹⁹ believe that the sea-bed, like the waters of the high seas, cannot be occupied, and that the regime of the waters of the high seas extends to their bottom as well. C. Colombos also notes that the sea-bed is incapable of occupation by any state and that "its legal status is the same as that of the waters of the open sea above it".

But C. Colombos recognized that

exceptionally, on grounds based on historical and prescriptive considerations it has been generally admitted that a limited portion of the bed of the open sea is capable of occupation by individual states for well-defined purposes, and entitled to recognition by other states. This is notably the case of the pearl fisheries off the coasts of Ceylon and the Persian Gulf, which belong to Great Britain by immemorial usage and effective occupation ²⁰.

In spite of Colombos's mention of the rights of states, relating as a matter of fact to the exploitation of the living resources of the shelf, the position is, in principle, against recognition of right to the sea-bed, and thus the latter is recognized not as *res nullius* but as *res communis*, i.e. in common use. At the same time, all the authors have been in agreement on the opinion that the status of the sea-bed differs from that of its subsoil; and that it is possible to be an owner of the subsoil of the sea-bed.

Assuming a possibility of extending the regime of the high seas to its bottom, but not to its subsoil, these authors proceed

14. C. HURST, Whose is the Bed of the Sea?, "British Yearbook of International Law", 1923-1924, p. 43.

15. H. FAUCHILLE, Traité de droit international public, 1925, vol. I, part II, p. 17-19.

16. D.P. O'CONNELL, International Law, 1965, vol. I, p. 571.

17. G. GIDEL, Le droit international public de la mer, 1932, t. I, p. 498-501.

18. C. COLOMBOS, The International Law of the Sea, 1967, p. 67.

19. K. STRUPP-H. SCHLOCHAUER, Wörterbuch des Völkerrechts, 1961, Bd. I, p. 791.

20. C. COLOMBOS, *op. cit.*, p. 67-68.

from inadmissibility of appropriation of portions of the sea-bed, as likely to lead to the violation of freedom of the high seas - in particular, the freedom of navigation. In their opinion, the appropriation of the corresponding or other portions of the subsoil is, however, quite possible, as it cannot threaten the freedom of navigation. Thus these authors consider the resources of the sea-bed as a "soil under water" and place them under the regime of *res nullius* (e.g. H. Smith)²¹. Such a doctrine, as testified by Strupp and Schlochauer, follows an old British practice in the field of mining legislation (Cornwall Submarine Act, 1858, is in mind) which stems from the possibility to occupy the subsoil²².

Prof. Francois, as a special rapporteur of the International Law Commission, was also of the opinion that the regime of the high seas is not applicable to the subsoil of its bed:

The arguments, which are at the basis of recognition of the principle of freedom of the high seas, are not applicable to the subsoil of the sea-bed. There is no rule forbidding the states to exercise their jurisdiction with respect to the subsoil of the sea bed (tr. from Russian).

As a matter of fact, G. Gidel, C. Colombos and M. Mouton, who hold the same opinion, are advocating such a right of states by pointing out to the fact that the occupation of the subsoil does not interfere with the freedom of the high seas.

Colombos's opinion is based on the fact that in this case obstacles to navigation will not be created.

It would therefore be unreasonable to withhold the recognition of the right of a littoral state to drive mines or build tunnels in the subsoil even when they extend considerably beyond the three-mile limit of territorial waters, provided that they do not affect or endanger the surface of the sea²³.

Also Gidel writes on this²⁴.

It is known, however, that the question of ensuring the freedom and safety of navigation in the waters covering the continental shelves is being solved through a series of specific measures envisaged by the Convention on the Continental Shelf

21. H. SMITH, *The Law and Custom of the Sea*, 1959, p. 81.

22. K. STRUPP-H. SCHLOCHAUER, *op. cit.*, Bd. II, p. 495.

23. C. COLOMBOS, *op. cit.*, p. 69.

24. Cf. G. GIDEL, *op. cit.*, vol. 1, p. 510.

and by national legislations. This includes the creation of safety zones around the constructions and plant erected on the continental shelf, regardless of whether these facilities are used for the exploitation of the surface of the shelf or of its subsoil. The Convention, as well as national legislations, provides also for the necessary formal action related to this question — the notifications of such zones, indicating the distance at which they are set up, the order of erection of constructions and plant, etc. It is of significant importance that neither constructions and plant nor the safety zones around them may be created in places where they may create an obstacle to the customary sea routes of significant importance to world shipping (cf. art. 4, para. 6 of the Convention).

Thus an attempt at drawing a distinction between a regime of the seabed of the high seas and a regime of the subsoil thereof is hardly warranted under the present conditions. In addition, the necessity of making such a distinction, and the arguments of those scientists who try to make it, is questionable.

It is easy to see that some of the above-mentioned statements of the theory of international law, concerning the status of the sea-bed and its subsoil, do not deal at present with the new problems.

In this connection, seven principles proposed by the U.N. *Ad Hoc* Committee on the sea-bed should be noted as a constructive step, and — in particular — the following two of them should be mentioned, namely that:

- 1) there is an area of the sea-bed and its subsoil which lies beyond the limits of national jurisdiction;
- 2) this area is not subject to national appropriation.

These principles constitute an important contribution to the consideration of the legal aspects of uses of the sea-bed and its subsoil.

It is submitted that the use of the sea-bed and the subsoil thereof beyond the limits of national jurisdiction must be — in principle — subject to international regulations similar to those which govern the use of the high seas.

The concept of common use, which is a legal basis of the principle of freedom of the high seas, is capable of promoting cooperation among states, and of removing possible anarchy.

It should be borne in mind that the sea-bed and its subsoil, being in common use, are not a "common property" or "common heritage of mankind". The concept of "common heritage" was reflected in some official drafts submitted to the U.N. *Ad Hoc* Committee on the sea-bed and in a number of unofficial drafts published later on.

In this connection it should be noted that the concept of "common heritage" is not new. Nor does it differ from the concept of "common property". Those who support the concept of "common heritage" note this themselves.

Thus speaking about the concept of "common heritage of mankind" at the session of the U.N. Committee on the sea-bed in March 1969, Mr. Deber (Belgium) frankly admitted that

that concept was actually a variant of the concept of joint property²⁵ (tr. from Russian).

The representative of Brazil, Mr. Kabral de Mello, recognized the same, and Mr. A. Pardo believed that the principle of "common heritage" derives from the principle of "joint property" and that

it implied something to be administered in common and thus contained the notion of a trust and trustees (tr. from Russian)²⁶.

It is significant that Mr. Deber, in fact, did not draw a distinction between the concepts of "common heritage" and joint property". He really operated with the term "joint property" when speaking of the status of "common heritage", and positively emphasized the existence of co-owners.

It was an exaggeration in that respect to say that the concept of *res communis* implied a state of anarchy, for when joint property was established, the rules of relationship among the co-proprietors were established as well (Russian).

Meanwhile, in our opinion, the concept of "joint property" cannot be applied to the determination of the legal status of the

25. U.N., Gen. Ass., Off. Rec., Doc. A/AC.138/SC.1/SR.5, 24 March 1969, Russian, p. 2.

26. *Ibid.*, p. 9.

sea-bed and its subsoil beyond the limits of national jurisdiction, just as it could not be applied before to the elaboration of the status of the high seas.

As is known, the recognition of the high seas as being in common use has not meant the adoption of the concept of "common property". In Roman law, things which are in common use — air, running waters, seas, shores of the seas — were termed "*res omnium communis*" (common things of all) ²⁷.

But common use of the sea, as it was understood in Roman law, was not tantamount to common property, since the sea was a matter of public order and was not subject to appropriation, either as a whole, or in part. *Res communis* was distinguished in Roman law from all kinds of things which could belong either to private persons (*res privatae*), or to the state (*res publicae*) by right of title (or ownership).

Res communis is not included even in the category of such things which belong to the state — *res publicae*. And the question here is not about goods, slaves, houses — i.e. about things which could be alienated (*res in patrimonio*), but about such *res publicae* which have a national character and are in use by the whole nation, such as navigable rivers, roads, ports, and therefore could not be alienated (*res extra patrimonium*).

The American professor, P. Fenn, confirms that *res communis* belongs to nobody. They are *res extra nostrum patrimonium*. And further:

The sea included in *res communis humani iuris* is open for universal use, according to *iure naturale* and belongs to nobody ... All people can use the sea ²⁸.

And while it was recognized that the state had the right of property to the ports,

a right of property to the sea belonged to nobody (tr. from Russian)

27. These problems are considered in our legal literature, in particular by: I.B. Novitski, *Principy rimskogo grazhdanskogo prava*, Moskva 1960, p. 91; P.N. Galanza, *op. cit.*, p. 86-87; V.M. Khvostov, *Istorija rimskogo prava*, Moskva 1907, p. 104. See also e.g. P. Fenn, *Justinian and Freedom of the Sea*, 19 *American Journal of International Law*, 1925, No. 4.

28. P. FENN, *op. cit.*, p. 720-721.

At the same time, Roman Law recognized that the sea is subject to the jurisdiction of the emperor — the sea is in common use, “ but Caesar possesses jurisdiction over it ”, as is said in Digests 1.8.2.

Thus, Roman law made a distinction between the property and the jurisdiction²⁹. Fenn points out frankly that

the concession to the state of a right to the realization of jurisdiction in the sea did not bring with it the title to the sea (tr. from Russian)³⁰.

Taking into consideration the historical development and the essence of the principle of freedom of the high seas, and assuming that this principle applies to the sea-bed and the subsoil thereof, beyond the limits of national jurisdiction, it is possible to draw the following conclusions.

First, the sea-bed and its subsoil beyond the limits of national jurisdiction, like the high seas proper, are open to all nations, and no state has the right to claim sovereignty over any part of it (cf. art. 2 of the Convention on the High Seas). The legal concept of freedom of the high seas has been accurately defined by the U.S. Supreme Court in the *Maul vs. U.S.* case (1924), where it was laid down that “ the high seas are common to all nations and foreign to none ”³¹.

The same concept is accepted now in the doctrine:

Die hohe See steht weder im Miteigentum noch im Gesamteigentum der Staaten, ist vielmehr eigentumsunfähig³².

Secondly, it is necessary to make a distinction between property and jurisdiction with respect to the sea-bed. Exercising state jurisdiction over the construction or plant built by that state on a specific portion of the sea-bed is quite conceivable without recognition of a property title to the sea-bed.

Thirdly, recognition of the sea-bed as being joint property, or in common ownership, might lead to a conclusion about

29. See also: S.V. Molodtsov, *Mezhdunarodno-pravovoi rezhim otkrytogo moria i kontinentalnogo shelfa*, Moskva 1960, p. 10.

30. P. FENN, *op. cit.*, p. 718.

31. N. SINGH, *International Law Problems of Merchant Shipping*, *Academie de droit international, Recueil des cours*, t. 107 (1962-III), 1963, p. 25.

32. K. STRUPP-H. SCHLOCHAUER, *op. cit.*, p. 791.

the existence of co-owners — with the consequent admission of the right to share this property among co-owners.

In view of all that has been said above, the concept of the sea-bed as “common heritage of mankind” seems to be legally unfounded, insofar as it is really the same concept as that of joint property.

At the same time, extension of the principle of freedom of the high seas to the sea-bed and the subsoil thereof — with all the legal consequences resulting therefrom — is a firm and well-grounded basis for securing the development of international cooperation in the field of the use of the sea-bed and its subsoil beyond the limits of national jurisdiction. This would mean confirmation of the fact that the sea-bed and its subsoil beyond the limits of national jurisdiction are in common use.

IV

The question of legal regulation of the exploitation of the resources of the sea-bed and its subsoil beyond the limits of national jurisdiction is one of an independent significance. We suppose that the solution to this question should not be sought on the basis of speculative considerations divorced from the established practice and accumulated experience. On the contrary, the solution must be found on the basis of already existing rules of international law.

It is known that, while recognizing the principle of freedom of fishing in the high seas, contemporary international law at the same time regulates fisheries by means of bilateral and multilateral conventions concluded by states, and providing for a whole range of different methods of protection of living resources of the sea through appropriate regulation of fisheries in the high seas. E.g. it provides for such specific measures as the fixing of the maximum annual catch of fish in specific areas, establishing closed areas and closed periods, introducing limitations of implements of catching, etc.

Moreover, many conventions provide for the setting up of special commissions to give recommendations to the member-states of the convention, concerning appropriate measures to be

undertaken, methods of supervising the area under convention, rules aimed at the conservation of resources, etc.

Suffice in this connection to recall such conventions as the Convention regulating whale-fishing, of December 2, 1946; the Provisional Convention on conservation of the fur-seal in the North Pacific, of September 27, 1957; the Convention of fishing in the North-Eastern Atlantic, of January 24, 1959; and in the North-Western Atlantic, of February 8, 1949; and others.

It should be especially emphasized that proposals for setting up a special international machinery to regulate fisheries were considered by the International Law Commission, when it was preparing the Convention on Fishing and Conservation of Living Resources of the High Seas. However, the

conception of the international machinery, which could have a legislative authority, was left ³³ (tr. Russian).

Thus, we deem it advisable to seek an analogy with the established and binding rules of international law and with the experience which has already been accumulated in the field of regulation of the exploitation of living resources of the sea.

At the same time it is to be noted that nations came to consider this system of regulation only when conditions of technological progress took shape, and realities of cultivation of living resources of the ocean brought about this progress.

In this connection it is interesting to recall the opinion of the American author, L. Henkin:

If there is no urgent need, no obvious direction, no assured success, now is the time to try to make a law governing the resources of the deep oceans ³⁴.

In the recommendations of the Stockholm Symposium of 1968 it was also noted that

... the knowledge of mineral and other resources being too small to allow for the establishing of clear and firm guidelines at present ³⁵.

33. The Report of the International Law Commission on the work of its 8th session, April 23-July 4, 1956 (Gen. Ass., Off. Rec., Eleventh Session, Supplement No. 9 - A/3159), New York 1956, p. 59.

34. L. HENKIN, *Law for the Sea's Mineral Resources*, 1967, p. 5.

35. "Towards a Better Use of the Oceans", SIPRI, Stockholm 1968, p. 9.

Our conclusion is that the elaboration of a legal regime of exploitation of the resources of the sea-bed and its subsoil beyond the limits of national jurisdiction must be based on the accumulated practical experience of states in this new field of human activity; on the existing international law, including the U.N. Charter; and must be in the interests of States and of the international community as a whole.

V

To summarize what has been said above, the following should be stressed once more:

1. The uses of the sea-bed and its subsoil, beyond the 12-mile limit, for military purposes must be prohibited.

2. The sea-bed and its subsoil beyond the limits of national jurisdiction have the same status as the high seas. It is submitted that the sea-bed and its subsoil beyond the limits of present national jurisdiction are for the common use of nations, like the high seas proper.

3. The work of the U.N. Committee on the sea-bed, directed towards the elaboration of legal principles, is of great importance. In particular, attention should be concentrated on the statement that no part of the sea-bed and its subsoil beyond the limits of national jurisdiction "is subject to the national appropriation by claim of sovereignty, by use or occupation, or by any other means"³⁶. It is easy to see that this statement reproduces the concepts of freedom of the high seas according to which no state may claim sovereignty over any part of the high seas.

4. The elaboration of a legal regime of the exploitation of resources of the sea-bed and its subsoil beyond the limits of national jurisdiction must be based on the existing international law, on the accumulated experience of states; and must be in accordance with the interests of all states and of the international community as a whole.

36. Report of the *Ad Hoc* Committee to Study the Peaceful Uses of the Sea-Bed and of the Ocean Floor Beyond the Limits of National Jurisdiction - U.N. Gen. Ass., Off. Rec., Twenty-third session, doc. A/7230, New York, 1968, p. 19.

SUMMARY OF DISCUSSION

WORKING GROUP I

Present Legal Regime of the Sea-Bed

The opinion was expressed that perhaps the Working Group might agree that the present regime of the sea-bed beyond the limits of national jurisdiction may be summarized as follows: it is open for all states for exploration and exploitation, with due respect to other recognised uses of the sea, and to the same rights of other states.

Another participant noted, however, that such a statement would be unchallengeably correct only with respect to the superjacent water column of the high seas. As regards the sea-bed itself, there are examples — true enough, exceptional and based on historic rights — of acquisition of the exclusive rights with respect to the portions of the deep sea-bed.

It was furthermore pointed out by another international lawyer that it is possible to interpret the existing law so that the rules of acquisition apply to the sea-bed. Similarly, as there was nothing in international law in 1945 that might prevent proclamations of the exclusive national rights on the continental shelf, there is also nothing now that might effectively prevent a repetition of similar proclamations with respect to more extended areas of the the sea-bed. The United States made a strong point that what is to be prevented is the colonisation of the sea-bed. But if no preventive action is undertaken this is likely to happen. We live in a crucial period with respect to the developments on the sea-bed, and unless it is said that something cannot be done, it will be done. If some principles are not adopted, international lawyers would find a way to justify what states want to do. And this is why the existing law should

be amended accordingly. This view was supported by some other participants, although at least one of them at the same time expressed the opinion that also under existing law claims of exclusive rights on the sea-bed may not be extended beyond "reasonable limits".

In reply to the specific question regarding the grounds on which it may be asserted that such "reasonable limits" are inherent in the existing law — i.e. in the Continental Shelf Convention — it was indicated that this followed from the debates on the Convention. If the text is ambiguous, interpretation must take into account the *travaux préparatoires*.

One participant expressed some doubts whether an interpretation of the existing law, admitting acquisition of the areas on the sea-bed is not contrary to the Geneva Convention on the Continental Shelf of 1958; and another participant was of the opinion that the rules of acquisition apply only to the land areas but not to the sea-bed.

In reply to this latter argument it was recalled that Sir Cecil Hurst's famous article in "The British Yearbook of International Law" of 1923-24, which initiated the whole discussion on the status of the sea-bed, pointed to the opposite. True enough, the arguments were limited then to the problem of sedentary fisheries.

Another participant indicated that — though the state practice is extremely scarce in this respect — it seems possible under the existing law to acquire a title to a portion of the sea-bed — and then to retain it through historic consolidation of title.

Against the argument of the admissibility of claims of exclusive national rights on the deep-sea bed, it was said that heretofore in all such claims an element of adjacency was present. However, one cannot invoke the argument of adjacency in the middle of the ocean.

Another speaker, however, was of the opinion that states may validly claim that they have established historic rights even in the middle of the ocean, e.g. on the the seamounts and banks, if only such claims have not been protested. Before 1945 no one would think it possible to establish exclusive rights on the continental shelf. But a rationale was found; claims were made and were not protested; other states subsequently have done

the same — and within less than 30 years such claims became law. To-morrow, states may start claiming exclusive rights to the seamounts and banks.

Delimitation of the Continental Shelf

A great majority of speakers expressed the view that clear delimitation of the outer limit of the continental shelf is indispensable.

At the same time, a number of speakers pointed out that the most difficult problem is that of the interpretation of the outer limit of the continental shelf.

One speaker saw three possibilities here, i.e.:

1. that the continental shelf is just “continental shelf”, whatever its legal definition;
2. that, taking into account the criterion of exploitability, the outer limit of the continental shelf should be construed as practically meaning the outer limit of the continental slope;
3. that the outer limit of the continental shelf is out in the ocean up to a trough (i.e., the limit of adjacency) or up to a median line.

Another participant expressed an opinion that the 200 m. isobath line was, perhaps, justified in 1958 but is outdated now. At the same time the Convention is so vague that it may mean anything. Under the Convention any depth which becomes exploitable falls under the jurisdiction of a coastal state. He thought that it is inappropriate to define the outer limits of the continental shelf by depth, and preferred the distance-from-the-coast criterion as more equitable for all states. In this context an opinion was expressed that the Geneva Convention cannot be considered as untouchable as we are facing new developments, and it was also indicated that a number of states — signatories to the Continental Shelf Convention — now have doubts as to the definition of the continental shelf contained therein. The speaker also expressed the view

that in a new regulation all states should have access to the wealth of the sea-bed beyond the limits of national jurisdiction, including the landlocked countries.

Two international lawyers, while appreciating the merits of the distance-from-the-coast criterion (clarity and certainty), were, however, of the opinion that the complete abandonment of the 200 m isobath line might infringe upon the acquired rights, and in this case would be hardly acceptable to states. Such an infringement upon the acquired rights would also affect the credibility of international conventions in general. A combination of the two criteria might provide for a relief from that difficulty.

The preoccupation about the acquired rights and the credibility of international agreements was shared by another speaker, who indicated, however, that with such a vague criterion as that depending on technological development (exploitability) there exists always a bargaining area.

A social scientist was of the opinion that it is difficult to discuss among scholars the question of equitable delimitation and apportionment of the sea-bed between countries. The question is that of the distribution of wealth — who gets what — and we don't know what the wealth of the sea is. We shall not know this still for some time to come. It may well happen that a boundary at a distance of 600 miles offshore one country (e.g. Chile, Ecuador, Peru) may give to the coastal state less wealth than a boundary at a distance of 30-40 miles offshore another country (e.g. Saudi Arabia). Different states may also have different perception of such a distribution. And, therefore, the delimitation has to be negotiated between states. There is no question about the desirability to draw a limit; but where to draw it — is another question.

An international lawyer observed that what is at stake now is not so much the interpretation of the Geneva Convention on the Continental Shelf as making a policy decision. Interpretation of the Convention should be as narrow as possible so as to leave as much area as possible for utilisation to the benefit of the international community as a whole.

Another international lawyer believed that the proper way to proceed is first to establish a regime of the sea-bed beyond national jurisdiction, and only then to draw boundaries between

the two areas which are to be subject to the different regimes taking into account the character of each regime and the differences between them (this point of view was also supported by another participant). The speaker felt that in the discussion on the future regime of the sea-bed beyond the limits of national jurisdiction, the regime of Antarctica and of outer space should be taken into consideration. Although the three areas in question are very different in some respects, in some other respects many similarities may be noted in all the three cases.

According to another view, however, any regime of the deep-sea bed is likely to become inoperative until and unless there is a boundary between the two areas in question. Otherwise, in case of a dispute there is no possibility of ascertaining which one of the two regimes applies to a specific place. But, on the other hand, history does not allow for too much optimism as to the likelihood of establishing such a boundary in the near future. Up to now all attempts as a univocal delimitation of whatever boundary outside the land areas have failed (upper limit of airspace — in 1919, in 1944, and also thus far in current discussions; outer limit of the territorial sea in 1930, 1958, and 1960). In outer space it was possible to establish a new regime without a precise boundary because flight-space of aircraft and space-craft — at least at the present stage — are clearly separated by technical conditions of flight. But such an implied separation based on technological criteria is impossible in the case of the sea-bed.

It was remarked in this connection that the lack of an internationally agreed limit of the territorial sea has not prevented elaboration and quite satisfactory operation of the distinct regime for the the high seas.

It was pointed out, on the other hand, that this has been so because precise outer limits of the territorial sea do exist. They are being determined in each case by the coastal state. But this is precisely what we want to avoid with respect to the outer limit of the continental shelf.

A view was expressed by a geologist that effectiveness of any international arrangement for the sea-bed beyond national jurisdiction depends on delimitation of a boundary between that area and the continental shelf, and that such delimitation

must be based on natural facts. One may distinguish at least three such natural boundaries:

1) between the continental shelf and continental slope — which is most easily discernible;

2) between the continental slope and continental rise (the boundary of the continental terrace) — which is less easily discernible;

3) between the continental rise and the abyssal plain (the boundary of the continental margin) — which is still more difficult to trace.

There may be other natural boundaries, such as the one between the continental crust (which is thick and light) and the oceanic crust (which is thin and heavy). Between them lies an intermediate region.

On boundary 1) there is no principal change of the structure of crust. Boundary 2) corresponds more or less to the boundary between the continental crust and the oceanic crust (or, more specifically, the continental crust and the intermediate region) and from the morphological and geological point of view seems to be the most important and the most natural one. There seem to exist three ways of delimiting this boundary:

a) to trace it continuously along all continents (the depth would then change from place to place);

b) to adopt some statistically average depth of this boundary (e.g. 2,500 m) and trace this isobath;

c) to accept a mean distance of that boundary from the coast and draw the line accordingly (no ready data about such a mean distance are available at the moment).

A reference was further made in the discussion to the Judgment of the International Court of Justice of February 20, 1969, which made it clear that there is an end of a natural prolongation of continents under the sea. However, the question arises whether — in terms of the presentation just made — this end should be attributed to boundary 2) or rather to boundary 3). Natural scientists differ on that and this puts lawyers in a difficult position.

It was also recalled that the continental rise (i.e. the area beyond boundary 2) is covered by sediments from continents and this fact is referred to in support of a view held by business companies that this is also a natural prolongation of continent and thus might be subject to extension of valid national claims.

However, another participant pointed out that also abyssal plains are covered by the sediments from the continents — in some places (e.g. offshore Brazil) as far as 2,000-3,000 km from the coast and thus reference to the sediments cannot be considered as valid argument for extension of national claims up to the outer edge of the continental rise.

Attention was also drawn to the proposal put forward by the World Peace Through Law Center, which envisages the outer limit of national jurisdiction on the sea-bed on the 200 m isobath or at a distance of 50 miles from the coast — whichever gives more to the coastal state.

An international lawyer, summarizing the views on the subject, felt that the future delimitation of the continental shelf should take into account the notion of the "continental shelf" in the morphological and geological sense. However, the distance-from-the-coast criterion should be applied where the continental shelf is very narrow or non-existing, and, on the other hand, an absolute limit should be established for those cases where the continental shelf is very large. The speaker was also of the opinion that it would be advisable to establish an intermediary zone on the sea-bed between the continental shelf and the deep-sea area — similar to the contiguous zone between the territorial sea and the high sea. This intermediary zone might extend down to the outer edge of the continental slope but the special rights of the coastal states in this zone should be strictly determined. There should be some division of economic rights in this intermediary zone while the area beyond it should be reserved exclusively for the international community as a whole.

Question of the Revision of the Continental Shelf Convention

A number of participants spoke in favour of the revision of the Geneva Convention on the Continental Shelf, i.e. of a more precise definition of the outer limit of the continental shelf. It was pointed out, however, that the conference for this purpose cannot be convened in any case earlier than in March 1971. According to one view, a new conference on the law of the sea is needed to clear the air generally — not just for the revision of one convention. The conference must not necessarily involve an immediate revision of the Convention on the Continental Shelf. This has seemed to be the prevailing view within the UN Committee on the Peaceful Uses of the Sea-Bed.

At least two speakers were of the opinion that convening a conference to revise the Continental Shelf Convention in 1971 would be premature, and it is difficult to say at the moment when it would not be premature. The discussion in the UN Committee should continue still for some time before a decision is made to convene a conference. It was furthermore pointed out that the revision of the Continental Shelf Convention is connected with other developments regarding the sea-bed and that the delimitation of the continental shelf and the regime of the sea-bed beyond it should be discussed jointly.

A view was also expressed that the final report of the Symposium should at least state that the majority of participants supported the opinion that the revision of the Continental Shelf Convention is necessary, and suggest also the direction of its revision. Otherwise, the impression would be that the participants to the Symposium forgot about the problem, which would be against the prevailing trend.

Question of the Freezing of Claims

An international lawyer, supported by some other participants, suggested that claims to the sea-bed should be frozen, as, e.g., of January 1, 1970. This was believed to make the problem of the revision of the Continental Shelf Convention less pressing.

Another participant expressed some doubts as to the effectiveness of such a measure.

Still another expressed the view that the proposal for a freeze is unacceptable since it would be discriminatory for states which thus far have not put forward any claims. A view that this may be remedied by a reservation that the freeze is without prejudice to claims analogous to those already made — was opposed on the ground that this would provoke a series of claims which would not be put forward otherwise, and would thus reduce the area of the sea-bed which might be used for the benefit of all mankind.

An opinion was also expressed that actual claims to the sea-bed at the moment of adoption of any new regime should not prejudice the decision on the question of limits of national jurisdiction on the sea-bed. However, if according to such a new regulation, certain places already claimed would not fall within the area of national jurisdiction, an appropriate compensation should be made.

Purposes of a New Regime

One participant pointed out that, in view of a general agreement prevailing as to the fact that there is an area of the sea-bed beyond the limits of national jurisdiction, much depends on whether the concept of “common heritage of mankind” is accepted. There appear to be conflicting interests between the advanced coastal states — which would prefer to have under their jurisdiction as much of the sea-bed as possible — and the technologically less developed states. According to the speaker, the latter would prefer a narrow continental shelf, since they are afraid that otherwise the extensive exploitation of the sea-bed by the developed states on a national basis would seriously affect the world prices on certain raw materials, and, consequently, the economy of the developing countries. Acceptance of the criterion of exploitability for drawing a boundary of national jurisdiction on the sea-bed would mean that only unexploitable areas would be left beyond, which would lead to a nonsense. The concept of “the benefit of mankind” should not be construed in an abstract, idealistic manner but

in terms of tangible material and positive benefits to all the sections of mankind. Hence — the idea of leaving a widest possible area of the sea-bed outside the limits of national jurisdiction, as a common heritage of mankind. This area should be administered so as to ensure the equitable distribution of benefits. This would reduce the disparity of standards between the developing and the developed countries, which is one of the main sources of tension and unrest in the contemporary world.

An international lawyer referred to the development of the philosophy of law in general over the last century: from the stage of acceptance of an unrestricted competition — through the regulatory stage — to what was called “the social stage” involving not only formal regulations but also a help to underprivileged groups and regions in order to enable them to make practical use of their formal rights. It was recalled further that Prof. Roling in his works has shown that the same trend of development applies *mutatis mutandis* to international law. And the question of how to provide for a “social type” of the regime of the sea-bed is the crucial point of the issue under discussion.

In supporting this latter view, another international lawyer added that the contemporary tendency is to accept the principle that everybody receives something of everything — and the question at stake is how to distribute the expected profits from the exploitation of the sea-bed beyond limits of national jurisdiction.

Principles of a New Regime

One participant was of the opinion that the following principles might be formulated right now:

- confirmation of equal position of all states with regard to the resources of the area in question, regardless of their size, geographical location, stage of economic development, etc.;
- principle of non-appropriation of the area in question;
- principle of limitation of military activities in this area;
- principle of international responsibility of states of all national activities carried out in this area.

It was recalled that analogous principles have already been adopted with respect to outer space.

Another international lawyer added that it should be also explicitly confirmed that there exists an area of the sea-bed that is beyond the limits of national jurisdiction.

Some members of the Working Group felt that the sea-bed beyond the limits of national jurisdiction should be reserved for peaceful purposes only. Some other members, however, felt that a more profound opinion on this matter may be formulated only after the discussion on the material which relates to the possible military uses of the sea-bed.

Attention was drawn to the set of principles advanced by the Commission to Study the Organisation of Peace, and especially to principles 1-4.¹

A point was raised regarding the meaning of the concept of "common heritage of mankind". The speaker felt that it is acceptable and has already been accepted, in a general sense, with respect to outer space and celestial bodies. If, however, any specific legal meaning is to be attached to this formula, it must be clarified before all can subscribe to it.

Two other speakers were of the opinion that one cannot agree on a principle otherwise than in a general way, but another international lawyer said that even in this case one must have some more or less clear understanding of a concept one subscribes to.

Two other speakers said that the concept of "common heritage of mankind" is intended to reflect the general idea of

1. 1. The sea-bed and ocean floor, and the subsoil thereof, which underlie the high seas and lie beyond the generally recognized limits of national jurisdiction, are the common heritage of mankind.

2. A precise boundary for this area should be defined with all possible speed. This area should be as large as possible so as to preserve the largest amount of resources for the benefit of mankind and to diminish the possible area of controversy.

3. The resources of this area should be developed for the benefit and in the interest of all mankind, taking into account the special needs of the developing States. All states, including the landlocked, have an equity in the resources of this area.

4. No State should be permitted to claim or exercise sovereignty, jurisdiction or any exclusive rights over this area, and no part of this area should be subject to national appropriation by any means whatsoever.

"The United Nations and the Bed of the Sea", Nineteenth Report of the Commission to Study the Organization of Peace, New York, March 1969, p. 21).

belonging to mankind rather than any strictly legal notion of property or jurisdiction of mankind. One of them added that this concept should be upheld — regardless of how it may be put into practice.

On the other hand, a view was expressed that “common heritage of mankind” has little meaning and perhaps “common use of people” might be considered as a more adequate wording. Another participant strongly insisted on this latter wording.

A suggestion was made to put in the report of the Working Group a proposal which would combine the ideas expressed in paragraphs 1, 3 and 4, or — alternatively — in paragraphs 1 and 3 of the above quoted Report.

The following opinions appeared in the report of the Working Group:

“The use and exploration of the sea-bed and subsoil of the high seas beyond the generally recognised limits of national jurisdiction should be developed in the interest of mankind and of all states — whether coastal or landlocked — taking into account the special needs of the developing States”.

“A precise boundary between the continental shelf and the deep-sea area should be defined with all possible speed. The deep-sea area should be as large as possible so as to preserve the largest amount of resources for the benefit of mankind”.

“No state should be permitted to claim or exercise sovereignty, jurisdiction or any exclusive rights over the deep-sea area, and no part of this area should be subject to national appropriation by any means whatsoever”.

As regards the principle of the responsibility of states for all national activities on the sea-bed beyond the limits of national jurisdiction and references to the analogous provision of the Space Treaty, it was observed that the analogy should not be pushed too far since the space operations are carried out in any case either directly by states, or by private agencies which must necessarily utilise state facilities (launching sites, etc). On the other hand, no such participation of states is necessary with respect to the sea-bed operations.

Another participant raised the argument that responsibilities should be commensurate with rights, and once the regime which is contemplated for the deep sea bed is to deny any exclu-

sive rights of states over this area, it would not be proper to impose upon states the responsibilities with respect to these areas.

On the other hand, however, it was indicated that the principle of state responsibility for national activities is not corollary to exclusive rights over the area that are to be denied but to the right of free exploration and use that is to be confirmed.

Attention was also drawn to the Convention on liability of operators of nuclear-powered ships, which might provide for some analogies. The following opinion appeared in the report of the Working Group:

“ Appropriate provisions should be made for fixing responsibility in case of any default or damage caused by activities relating to the deep-sea area and for preventing any unjustifiable interference with the freedom of the high seas ”.

Problem of an International Machinery and of Its Functions

On the suggestion of the Chairman, the Working Group adopted the following course of further discussion: *a*) question of the need of an international machinery — in principle; *b*) its possible functions; its possible structure. A majority of participants expressed themselves, in principle, in favour of setting up some kind of international machinery to deal with the problems of the sea-bed.

One participant suggested two stages by which to proceed on the official level:

— to agree, in the form of Declaration, on general principles regulating the activities on the sea-bed, which would not be prejudicial to any further possible arrangements;

— to make a real institutional arrangement involving an independent authority, possibly dissociated from the U.N., in which experts and not politicians would dominate.

Another speaker referred to some official statements of the Soviet representatives and also to a paper presented to the Symposium. He noted that although it is being said in these materials that the international cooperation on equal footing

with respect to the sea-bed should be fostered, they show the Soviet Union's opposition against setting up any international machinery. This might become a major impediment to creating an international agency.

Another participant pointed out in this connection that what is needed to ensure an orderly exploration and exploitation of the sea-bed is an appropriate international "regime" rather than "machinery". He felt that the regulation of exploration and exploitation of the sea-bed beyond the limits of national jurisdiction should be based on bilateral and multilateral conventions concluded by states in accordance with their accumulated experience and with the binding provisions of international law.

Still another participant preferred to speak about an "international mechanism" as something intermediate between the "regime" and the "machinery".

A social scientist specified at least five categories of functions which should be performed by an international machinery for the sea bed:

- resolution of conflicts of different uses;
- guarantee of the security of investments; this seems to be one of the main functions, since those who develop resources must have some kind of exclusive rights on a sufficiently large area and for a sufficiently long period of time to get an adequate return from their activities;
- allocation of such exclusive rights according to some established criteria. In this connection the speaker expressed the opinion that the criterion of public interest may be economically inefficient, but on the other hand the "first come-first served" criterion might lead to an unsound race. The auction (bidding) mechanism seems to be the most appropriate one, and it might be tempered by taking also into account social reasons;
- extraction of royalties, taxes, income — whatever terminology is used — which should be utilized for the benefit of mankind; but the way and criteria for imposing and collecting such charges are still subject to discussion;
- the distribution of wealth; this is to be decided through international negotiations, but this distribution should be ma-

naged in such a way that the nations which do not exploit the resources of the sea-bed should remain content with the system.

Another participant stressed that the most important function of an international regime for the sea-bed is that of ensuring the economically most efficient uses of the resources of the sea-bed. Another important function would be that of control of these resources in the interest of mankind.

Some speakers expressed doubts as to the order in which the proposed functions were listed, and, more specifically — as to placement of the “resolution of conflicts”. It was, moreover, indicated that it would be perhaps more appropriate to speak about “prevention” rather than about “resolution” of conflicts.

An international lawyer expressed the view that the function in question should be probably not limited to conflicts between different uses of the marine environment but should also include:

- adjustment of conflicting interest of individual states;
- accommodation of interests of certain groups of states.

Another participant added that the functions of an international machinery should include elaboration of new regulations related to the activities on the sea-bed beyond the limits of national jurisdiction.

Still another function proposed was that of protection of existing rights with respect to the freedom of navigation, fisheries, laying submarine cables and pipelines, and also protection of the freedom of scientific research, including archaeological research.

It was also added that appropriate provisions should exist at least for the settlement of disputes — regardless of whether or not an international machinery will be set up, and if so — of what type.

Several speakers were of the opinion that some of the functions mentioned by previous speakers are prejudicial to certain specific types of international machinery, which might become too centralised (e.g., the ICAO does not allocate airlines).

Other speakers, however, felt that all these functions must not necessarily be performed by the same agency.

It was also stated that the functions of a regime are implied in the principles subscribed to.

Considerable attention was concentrated on the problem of a possible granting of licences.

An international lawyer expressed the opinion that the organ involved may be too much influenced by the great powers to the dissatisfaction of the less developed countries. It would be, therefore, necessary to establish clear criteria of granting licences, and this creates serious difficulties — still greater if licences are to be granted to states rather than directly to enterprises. The latter, however, would involve an elaboration of an entirely new mining law. The speaker was not in favour of a bidding system which might prove to be unacceptable not only to the developing nations but also to the smaller developed countries.

Doubts about the appropriateness of a bidding system were also supported by an oil expert.

It was also suggested that there might be a two-level system of granting licences: by an international agency to states, and then by states to national companies. One of the speakers was of the opinion that this system appears to be preferable since national control of the operations on the sea-bed is likely to be more effective than a direct international control over companies. Moreover, he felt that a direct granting of licences by an international agency to national companies might create a hardly acceptable situation in which a national company would be somehow in a position to disregard national legal order of the flag state on the basis of the fact that its rights would stem directly from international legal order. These preoccupations were shared by another participant who felt that it would be extremely difficult to recognize the rights of a state for intervention in and control of operations of a company if it obtained an appropriate permission directly from an international authority.

An international lawyer expressed the view that one should think rather of international corporations as beneficiaries of rights to operate on the deep-sea bed. Such corporations would be chartered by an international body and subject to international supervision. Although this idea may be disliked by national companies, it is an intriguing one.

This idea was supported and developed by another international lawyer who thought that such an international enterprise would have the same legal status all over the world; would have no nationality; would pay no national taxes but would be taxed for the benefit of international community. The speaker also felt that adoption of such a pattern would eliminate difficulties regarding the settlement of disputes which would be based on a system depending only on international law, to the exclusion of national courts. As regards the exercise of criminal and civil jurisdiction, the speaker was of the opinion that if the idea of international enterprise was adopted, states would have a number of possibilities to choose the law to be applied, e.g.:

- the national law of the defendant;
 - the national law of the nearest coastal state;
 - any law agreed upon;
 - an international code specially elaborated for the purpose.
- He also pointed out that the question of the law to be applied outside the limits of national jurisdiction would arise anyway, regardless of the idea of international enterprises.

During the discussion, some examples of international enterprises already existing, such as "Intelsat", "Air Afrique" etc., were referred to. On the question of the distribution of income from the deep-sea bed operations it was stated by one participant that this should depend on whether the income is big or small. If it is small, it should be distributed through the United Nations Development Programme. If it is large enough, the needs of the United Nations Organisation as such should be met first, as this would be unquestionably to the benefit of all mankind. Technical assistance for the developing countries should be recognised as second priority, and the general needs of the specialised agencies as the third one. Compensation to the developing producer countries for the reduction of prices, and compensation to the landlocked states should be also taken into account in a scheme of the distribution of income.

All oil expert pointed out, however, that there is still a question whether in the near future there will be any income

from the exploitation of the sea-bed, to be distributed to the benefit of mankind.

Question of the Type of an International Machinery

An opinion was expressed that while the need of an international machinery is widely recognised, its shape is still subject to discussion.

One international lawyer presented three possibilities:

- an agency exploring and exploiting the sea-bed itself;
- an agency granting licences to states;
- an agency granting licences directly to private operators.

Another participant was not in favour of creating an agency exploring and exploiting the sea-bed with its own staff and equipment, and preferred to use national capabilities for these purposes. This, however, should not be done through granting licences and allocating exclusive rights since this would introduce an element of national property. The speaker favoured, therefore, an agency which would utilise the resources of national technology and would itself employ national companies as contractors in return for royalties. Another question is that of administration and of distribution of benefits. Most international organisations have no income of their own. The World Bank might offer the closest parallel but the speaker was not satisfied with the system of weighted voting. His choice would be for an international organ of a quasi-parliamentary character and structure but the shape of the organisation should not be elaborated in advance in too much detail. He suggested, to start with, as simple a machinery as possible to serve the purpose, and to leave further developments to its evolution.

A social scientist noted that operators would prefer to deal with states rather with an amorphous international agency, and that, therefore, its competences should be defined with precision and clarity.

Another participant indicated that a rudimentary machinery already exists in the form of the UN Committee on the Peaceful Uses of the Sea-Bed, which, moreover, cooperates with existing

specialised agencies. For the future a specialised agency or an autonomous organisation like the I.A.E.A. might be envisaged.

With reference to two papers presented to the Symposium the question was raised whether it would not be practicable to create an organisation with broader competences with respect to the activities in the marine environment, which would also include: regulation of navigation and of laying submarine cables and pipelines; control of pollution; and also questions of management of the living resources. The speaker also submitted for discussion another question — that of a possible combination of a global arrangement with regional arrangements.

In connection with this question one of the rapporteurs expressed the opinion that a single organisation dealing with all the activities in the marine environment, attractive as it may seem from a purely theoretical point of view, would in practice involve more disadvantages than advantages.

This opinion was shared by another rapporteur, who added that in spite of such advantages as the reduction of bureaucracy and avoiding the problem of coordination, he would be afraid of too great a concentration of power. He expressed himself in favour of the division of functions with respect to the sea-bed between two organisations:

— one, which would handle the problems of exploitation, and in which a preponderant position would be held by the developed countries;

— another, which would handle the problems of the distribution of benefits, and in which a predominant position would be held by the developing countries.

He felt that what is needed in the new contemplated organisational arrangement is a combination of the concept of equality of all nations with the utilisation of technological capabilities of one group of states. As for the structural concept, he expressed preference for a model intermediate between the I.A.E.A. and the specialised agencies. The question also arises whether the new authority would utilise managerial capabilities of national organisations.

Speaking on the question of the separation of functions within an international machinery for the sea-bed, an international lawyer felt that while the function of allocating rights and that of collecting royalties should be concentrated in a single agency, functions with respect to conflicts should be separated. Conflicts may arise not only between different uses or between states but also between an international agency and operators. To solve such disputes an independent institution would be needed.

In the further course of discussion, the following choices were also presented insofar as the character of a future organisation is concerned:

- a coordinating agency, i.e. an agency coordinating national and regional activities;
- an agency which adopts international regulations and standards like I.C.A.O.;
- an international licensing or registration agency;
- an organisation of an "Intersat" type;
- an organisation structured along quite a new pattern, most appropriate for the specific purpose.

In any case there will arise the problem of a relationship of a new agency to the agencies already in existence.

In this connection one participant drew the attention of the Working Group to the fact that some coordinating functions are already being performed by the UN Committee on the Peaceful Uses of the Sea-Bed and various other inter-governmental agencies active in the field of ocean development.

Another participant raised the question of the future of the UN Committee if a new agency for the deep sea bed is created and, alternatively, if no other agency comes into existence.

Still another speaker felt that the minimum required is a codifying organ which would establish rules applicable to the activities on the sea-bed beyond national jurisdiction.

WORKING GROUP II

Present Legal Regime of the Sea-Bed

It was suggested in the opening statement that the Working Group should first assess the advantages and disadvantages of the present legal regime, and then, on this basis, explore the needs for the future. The Working Group should discuss to what extent the present regime is workable and efficient, and what elements should be changed or added. Insofar as the present regime of the sea-bed is concerned, the speaker submitted the following problems to discussion:

- the extent of the applicability of the existing law;
- existing *lacunae* in the rules governing the exploration, use, and exploitation of the sea-bed;
- legal nature of the sea-bed beyond the limits of national jurisdiction under existing law;
- possible conflicts which may arise under the present regime;
- question of a possible revision of the Continental Shelf Convention;
- question of the delimitation of the continental shelf.

An international lawyer said that he could not agree with one of the existing views, according to which under the present law the sea bottom has already been potentially partitioned by the coastal states. He indicated that no state supports this view, and that practice has been to the contrary. Referring to the

existing maps giving a picture of the ocean floor totally partitioned, the speaker said that these maps may only serve as an evidence that such a solution is wholly unacceptable.

This position was shared by several other participants. One of them — while admitting the uncertainties involved in the Continental Shelf Convention and the deficiencies of the criterion of exploitability — pointed out that the principle underlying that Convention was not one of partitioning the sea-bed. On the contrary, the assumption was that the continental shelf is something different from the sea-bed of the territorial sea, on the one hand, and from the sea-bed of the high seas beyond the shelf, on the other.

The participant whose views were thus challenged, clarified that he was neither advocating the concept of partitioning the sea-bed nor asserting that such was the intention of the negotiators of the Continental Shelf Convention. He believed, however, that introducing the criterion of exploitability in the Convention was a mistake. Under this concept, if literally applied, any area at any depth, once it becomes exploitable, falls within the concept of the continental shelf, which may thus be gradually extended without limitation. True enough, the Convention also set forth the condition of adjacency. But, according to the speaker, this concept is a very relative one whereas that of exploitability is much more tangible.

A geologist felt that a mistake was made in 1958 while drafting the Continental Shelf Convention since the physiographic concept of the continental shelf was confused with the legal concept. He pointed out the fact that in many areas the outer edge of the continental shelf is deeper than 200 m. He felt that the coastal states would not permit others to explore and exploit natural resources even at the 300m depth, if it is still on their continental shelf.

Two other speakers admitted that the Continental Shelf Convention is vague on the question of the outer limits of the continental shelf, and that there exists a danger that under the Convention a very large part of the deep sea bed (not necessarily all the sea-bed) might be appropriated, or that the interpretation of the Convention may lead to the establishment of a national lakes system (as it was put in the final conclusions adopted at the meeting at SIPRI in 1968, referred to in the discussion).

One of these speakers stressed, however, that according to his opinion this would not be in accordance with either the letter or the spirit of art. 1 of the Continental Shelf Convention. According to the speaker, the criterion of exploitability is only of secondary importance, and must be viewed in the light of the general concept of the continental shelf and the 200 m depth.

Another international lawyer, while agreeing with this point of view, and not insisting on any particular interpretation of the Convention, felt, however that if more extensive claims are made, they may have some degree of plausibility, even if contested.

It was remarked in this connection that, under the existing law, states are not prevented from undertaking exploration and exploitation of the sea-bed or from granting leases or licences to this effect at whatever depth. The existing law provides only that beyond certain limits such activity may not be undertaken on the basis of exclusive rights of the coastal state, i.e. to the exclusion of others from the zone in question. This view was supported by another international lawyer.

An oil expert was of the opinion that the Continental Shelf Convention was very sensibly worded in the sense that if someone wants to go a little beyond the 200 m depth limit, and can exploit natural resources there, he is allowed to do so. But the very title of the Convention shows that under its provisions one may not go to the deepsea. At the same time he expressed the view that for quite a long time to come the portions of the sea-bed wanted for oil exploitation would not be large.

An international lawyer felt that the existing law, especially the Geneva Convention on the Continental Shelf, although not devoid of weak points, has served some useful purposes thus far. He added, however, that the present legal regime of the sea-bed is not fully adequate to cope with all kinds of activities on the sea-bed or to solve new problems. Some rules — more general, or more specific — do exist, but there are gaps and deficiencies.

Another international lawyer expressed the view that at present one cannot speak about any legal status of the sea-bed beyond the limits of national jurisdiction. Only very vague,

or loose provisions of the existing law apply there, and a new law must be drafted for these areas which are now becoming accessible to humanity.

Two other international lawyers, however, felt that no *lacunae* exist in the *lex lata* insofar as the regime of the sea-bed beyond the limits of national jurisdiction is concerned. It follows only from the lack of any specific provisions that everyone is free to explore and exploit the sea-bed beyond the continental shelf, and that the principle of the freedom of the high seas applies to that part of the sea-bed. On the question of *occupation* and *appropriation*, it was pointed out by an international lawyer that strict distinction must be made between these two notions. Appropriation of any part of the high seas or of the sea-bed underlying the high seas — except for the continental shelf — is prohibited, and there can be no doubt about it. This, however, does not prevent utilisation of the high seas and of the sea-bed. The point is that in order to exercise the exclusive rights of exploration and exploitation of the resources of the continental shelf, granted under the Geneva Convention, the coastal state must inevitably operate also in the superjacent water column and on the surface of the sea and, consequently, occupy them. Although the occupation of the high seas is also prohibited as such, this type of operation is not prohibited. It is only subject to the rules applicable to the high seas, since the water above the continental shelf is part of the high seas.

This is true for the exploration and exploitation of the sea-bed as well as for the exploitation of the high seas (e.g. fishing fleets occupy parts of the surface of the high seas). However, this is something very different from appropriation. Appropriation may stand valid even if physical occupation ceases.

A geographer noted in this connection that a portion of the deep-sea floor has already been appropriated along the Pacific coast of South America by Chile, Ecuador, and Peru — as the distance of 200 miles from the coast is well beyond any conceivable limit of the continental shelf in the physiographic sense.

An international lawyer remarked that this is quite a problem, but the area of the sea-bed within the 200 mile distance

from the shore is — according to the views of those states — their continental shelf in the legal meaning.

A marine biologist, however, noted that the legal concept of the continental shelf cannot be referred to in this particular case, since what is at stake here is not the interest of those states in the bottom of the sea but their interest with respect to the fishery resources in the high seas.

In this connection an international lawyer raised the question whether under the Geneva Convention on the Continental Shelf the coastal state enjoy certain rights only with respect to the sea-bed, or also to the superjacent water column, with the exception of the surface of the sea. He indicated that in legal literature there is a tendency to claim the latter, and that this matter should be clarified.

Another international lawyer expressed the opinion that in the existing law there is no ground whatsoever for making a distinction between the legal status of the water column and that of the surface of that water column. He referred to his earlier statement regarding occupation and appropriation and reminded that occupation or appropriation of the high seas as such is prohibited, although installations on the continental shelf may occupy also a part of the water of the high seas, and that this is allowed.

The following opinions appeared in the report of the Working Group: “ that literal interpretation of art. 1 of the Geneva Convention on the Continental Shelf might lead to the division of the whole ocean floor by the coastal states; on the other hand, a view was expressed that current practice has not yet been moving towards the total division of the sea-bed, based on art. 1 of the Continental Shelf Convention ”:

“..... that there is a body of international law applicable to the sea-bed, but it has to be admitted that gaps do exist, so that new rules have to be developed ”.

Delimitation of the Continental Shelf

An international lawyer noted that recent discussions on the question arrived at the concept of the “ continental margin ” which is to replace the concept of the “ continental shelf ” proper.

He believed that this is being done for political reasons — to justify claims to more extensive areas.

A marine biologist expressed the view that the answer to the question of whether or not the present regime of the sea-bed is adequate depends on the limits of national jurisdiction. He pointed out in this connection that, except for a few authors who believe that the Continental Shelf Convention might be so interpreted as to justify the total partition of the ocean floor between the coastal states, the prevailing view is that there is an area of the sea-bed which is beyond the limits of national jurisdiction. He believed that if the outer limit of the national jurisdiction over exploration and exploitation of natural resources of the sea-bed is drawn in the vicinity of the outer edge of the continental terrace (thus including the continental slope), this will very well take care of the needs for the near future. The existing regime could then be considered as adequate for this area. And another regime should be established for the deep-sea beyond that limit.

An international lawyer was, however, of the opinion that if the regime of national jurisdiction over natural resources of the sea-bed encompasses not only the shelf but also the slope, the area left beyond will not be of much value for some years to come. He admitted that the proposal to include the slope in the regime of the Continental Shelf Convention may have its merits but in that case the question of an international regime for the area left beyond has little meaning, and discussion becomes purely academic.

A geographer held a view that neither the depth nor the distance criterion is fully adequate as a basis for delimitation of the continental shelf. Instead we advocated a physiographic criterion — namely, the break of the shelf, which generally does exist.

According to a geologist, there are probably very few resources on the continental slope. He thought that this is not a promising area for oil, and it is too shallow for ferromanganese deposits. He believed, therefore, that the continental slope would be a very proper place as a boundary between the rich resources of the continental shelf and those of the deeper sea-bottom, which are of quite a different nature.

An international lawyer pleaded for establishing the outer limit of national jurisdiction on the continental shelf just along the 200 m depth line, thus waiving the exploitability criterion. Since many states have a very narrow continental shelf, this inequality may be remedied by introducing the distance-from-the-coast criterion as an auxiliary one. According to some authors, the average distance of the outer edge of the continental shelf from the coast is 43 miles; according to some others it is less. Consequently, he proposed an alternative limit of national jurisdiction at a distance of 30-50 miles from the coast in the case of states with very narrow continental shelf. He believed that the actual exploitation of the sea-bed does not go beyond the limits so proposed, and, therefore, they are not prejudicial. An oil expert noted in this connection that experimental drillings were carried beyond the 200 m depth but it might take some time before anyone wants to exploit deposits at those depths. On the other hand he believed that it would not be logical to build a legal wall on the sea-bed at the 200 m depth, if the continental shelf actually spreads beyond this depth, and if it may be exploited. He did not deem it possible to secure equal size or equal position in general for all of them.

A geologist remarked that the outer boundary of the continental shelf, if drawn very strictly along the 200 m depth line, might just go across an oilfield, which would much complicate the situation since an oilfield should be exploited as a single unit.

A navy expert referred to the Report of the U.S. Commission on Marine Science, Resources and Technology, and supported the idea of a narrow continental shelf plus a contiguous zone. He believed that this would leave the necessary flexibility in view of many uncertainties as to the future development of the use of the continental shelf. He believed furthermore that if the continental shelf is limited too much artificially, some resources would be left up to the states which will not exploit them, and, at the same time, will not want others to exploit those resources. However, some countries with the necessary capital and spirit of venture might undertake exploitation. The speaker strongly recommended drawing the outer limit of the continental shelf along the 200 m depth line, or a distance of 50 miles from the coast — whichever gives the

larger area to the coastal states. He was of the opinion that the notion of adjacency extended to the middle of the ocean does not make sense, and he also felt that a choice of geological criteria would be arbitrary.

Another participant, however, felt that choosing a natural criterion for drawing a boundary seems to be more appropriate than choosing an artificial criterion. The choice of a natural criterion leaves no room for raising the question of equity.

A marine biologist supported this view and reiterated his proposal for drawing the outer limit of national jurisdiction at the base of the continental slope. This would also separate different kinds of resources, according to a geologist's view. The speaker did not see any equity in drawing the outer limit of national jurisdiction at the 200 m depth, or at a distance of 50 miles from the coast. Such a line would be beyond the slope in case of Northern Chile or Southern Peru, but these states would get just the sea bottom with nothing on it. On the other hand, in case of Argentina such a line would be still on the slope but much wealth may be found there. The equity may be provided for by some kind of economic transfer rather than by introducing artificial rules.

A navy expert felt that while natural features might provide a good basis for solution, there may be as much arbitrariness in natural features as in the principle of equity.

A marine biologist remarked in this connection that what he was proposing was not just a natural criterion but a specific one which recommends itself from the morphological and geological point of view as well as from the point of view of separation of natural resources.

An international lawyer recalled that the distance-from-the-coast criterion was proposed at the United Nations Committee on the Peaceful Uses of the Sea-Bed Beyond the Limits of Present National Jurisdiction. But the speaker's personal opinion was that it had been done just to satisfy psychological feelings of those states which have a narrow continental shelf.

An opinion was expressed that from the point of view of the developing countries it might be better to agree on — and thus to acquire — a wider area of national jurisdiction and to grant, for certain royalties, leases to those who can exploit the resources, rather than to leave the whole matter to the Uni-

ted Nations. It may be not quite in accordance with the principle of equity but may be just better business.

Another participant expressed the view that whatever the criterion of delimitation, the principle of a narrow continental shelf should be adopted.

The following opinions appeared in the report of the Working Group: "That, according to present international law, there is an area of the sea-bed beyond national jurisdiction";

"That the concept of natural boundaries, whatever they may be, can be used as a basis for delimitation, and that a narrow continental shelf should be accepted as an underlying principle of delimitation, if boundaries other than natural are to be drawn";

"That whatever concept of delimitation is accepted, there should be an area beyond national jurisdiction, even if this area is at present not yet exploitable".

Question of the Revision of the Continental Shelf Convention

A geographer expressed the view that all the present confusion about the Continental Shelf Convention is due to the concept of exploitability — be it in the technical or the economic sense — introduced into the definition of the continental shelf. He believed that for this reason the Convention is inadequate and should be completely modified. Also some other participants spoke in favour of the revision of the Continental Shelf Convention.

One of them pointed out that totally different conclusions are being drawn from the same departing point — the Geneva Convention. Everybody speaks of the area beyond the limits of national jurisdiction but this area is not clearly defined in the Convention. He referred in this connection to the final conclusions of the meeting held at SIPRI in 1968.

Another participant, speaking in favour of the revision of the Geneva Convention on the Continental Shelf, also referred to that provision, which includes some living resources in the regime of the continental shelf and which the speaker considered to be most unfortunate. He saw no similarity between the

mineral resources and the living resources of the sea-bed, and pointed out that almost all the provisions of the Convention are drafted with only the mineral resources in view. Consequently, the speaker was of the opinion that provisions regarding the living resources should be excluded from the Convention on the Continental Shelf.

A view was also expressed that the question of whether the living resources should be subject to the rules governing the high seas and the conservation of living resources of the sea, or to those pertaining to the regime of the continental shelf — should be further studied. An oil expert felt that the Continental Shelf Convention is a perfectly sensible and adequate instrument, and hardly needs any revision..

Also a marine biologist believed that from the point of view of orderly exploitation of the resources of the sea-bed, the present conventional regime does not require any changes, if it is understood that it applies to the whole continental terrace.

Another participant felt that the present conventional regime, though it may have served some useful purposes thus far, presently requires clarification and improvement.

The following opinion appeared in the report of the Working Group: "That there is a need to revise article 1 of the Geneva Convention on the Continental Shelf in order to avoid differences of interpretation, and confusion in the light of advancing technology."

Question of the Freezing of Claims

Reference was made to the meeting held at SIPRI in 1968, which in its final conclusions recommended a moratorium on the claims on the sea-bed, since it was believed that future negotiations on a possible regime of the sea-bed beyond the limits of national jurisdiction would be of little value, if in the meantime states established sovereign rights on some parts of the area in question.

Another participant suggested that the report of the Working Group might include a proposal for the freeze of claims on the sea-bed, as a provisional instrument to prevent further extension of national jurisdiction over the areas of the sea-bed.

The question was raised as to the exact meaning of the word "further": is it to be understood as 'further than the 200 m depth line'? In this connection it was recalled that the U.S. had already granted leases on the sea-bed beyond that line, and that according to the Continental Shelf Convention the criterion of exploitability may be applied somewhere beyond the 200 m depth line, though this is not defined with precision. The speaker would deem it more useful to recommend that states should not go beyond the continental slope with granting leases.

In this connection it was remarked that, in the suggestion for a freeze of claims, preservation of the *status quo* was at stake. A proposal to limit claims to the 200 m depth line may be unrealistic.

An international lawyer noted in this connection that one must know first what is *status quo*. If it is to mean the 200 m depth line plus the criterion of exploitability, then the proposal for a freeze is devoid of any sense. This is why he abandoned his earlier position favouring a freeze.

Other speakers pointed out that the confusion over the contents of the *status quo* is the result of the poor definition of the continental shelf in the Geneva Convention, and that the discussion would turn in a vicious circle as long as the fact of exploitability of a portion of the sea-bed would automatically qualify that portion as part of the continental shelf.

A marine geologist referred to the fact that exploiters act faster than lawyers. Therefore, it seemed to him that in any case it is unlikely that a moratorium on the extension of the exploited areas on the sea-bed could take place.

An international lawyer thought that an appeal to stop the extension of claims on the sea-bed could be made but it would not produce any result unless it is based on generally agreed principles.

Purposes and Principles of a New Regime of the Sea-Bed

An international lawyer was of the opinion that some measures should be taken if the process of the extension of claims on the sea-bed is to be stopped; otherwise, it will continue.

A marine biologist expressed the view that the regime of the exploration and exploitation of the deep-sea floor must not necessarily be based on the same premises as the regime of the continental shelf. The kind of rights needed on the bottom of the deep-sea depends on homogeneity or heterogeneity of resources existing there. Thus far the knowledge of relevant facts is not precise and the speaker was afraid that until they are known, the consideration of a future regime of the deep sea floor would turn in a vacuum.

This point of view was supported by a navy expert who added that law develops slowly and, therefore, proposals for a new regime must anticipate a long-term trend. When the details of law are in conflict with reality, reality always prevails. Therefore, there must be a correct assessment of what the reality is going to be.

One of the rapporteurs was of the opinion that any future regime of the deep sea bed must be based on the following premises:

- revision of the Continental Shelf Convention of 1958 to eliminate the criterion of exploitability, and to exclude the living resources from the applicability of its provisions;

- recognition that any regime of the sea-bed will have certain effects on the superjacent waters, and would require certain departure from the traditional concept of the freedom of the high seas.

This latter point was taken up by a navy expert who supported the view that it is impossible to exploit the sea-bed without asking for some rights in the superjacent water column. He felt that the discussion of the regime of the continental shelf and of the sea-bed beyond is based on an erroneous assumption. It seems to have been aimed at regulating the legal regime of the whole area in question, while what in fact is needed is the protection of exploration and exploitation on very small portions of the sea-bed. In these small portions however, the rights to the sea-bed must inevitably affect the superjacent water column: some operations on the sea-bed require total exclusion of everything else from the water column at some distance from the operating device.

An international lawyer was of the opinion that equal access of all states — whether coastal or landlocked — should be the basic principle of a future regime of the sea-bed. *De lege ferenda* he also advocated the principle of as narrow a continental shelf as possible since its extension would only add to the inequality of states — to a disadvantage of the landlocked states, of those with a short coastline, and of those situated on the coast of small seas. For example, 16 states would have to share the continental shelf of the Mediterranean while only 37 states would have to share the continental shelf of the Atlantic Ocean, 40 times bigger than the Mediterranean. He also doubted if bigger allotments of the sea bed to the coastal states would be of any utility — both to the developing and the developed countries. Referring to the report of the U.S. Commission on Marine Science, Engineering and Resources, an international lawyer felt that the main motive behind the idea of a contiguous (buffer) zone is the wish to monopolise the exploitation of as wide an area of the sea-bed as possible. Under the concept of such a zone, the coastal state would have the monopoly of exploitation in both the continental shelf zone and in the buffer zone (down to the 2-3,000 m depth). However, some portion of profits extracted from the exploitation of the intermediate zone would be dedicated to international purposes. The area of the sea-bed beyond the buffer zone would be entirely subject to an international control.

Another international lawyer referred to the interview granted to the "Ocean" by the Vice President of the United States, Agnew, who was reported to have said that whatever the future agreement on the sea-bed, the integrity of the investments made prior to such an agreement must be respected. The speaker was afraid that this is to mean that everything will go as it is.

A marine biologist explained that the leases on the sea-bed granted to explorers and exploiters by the U.S. authorities have been published and have been granted only pursuant to the Outer Continental Shelf Act. This Act applies to the area which under the existing international law is under the exclusive jurisdiction of the United States. The speaker interpreted the statement of vice-President Agnew in the sense that pending an international agreement on the sea-bed, the United States would continue on this basis. But if later on it is decided

to go back to the 200 m depth line, the U.S. Government would reimburse or otherwise protect the interests of the people who legitimately went beyond that line in the meantime. He recalled that other countries also grant leases on the sea-bed beyond the 200 m depth line on the assumption that the areas in question fall within their exclusive jurisdiction. It may always be possible to go back to the 200 m depth line but it cannot be said that the area beyond the 200 m depth line is actually open for everybody. If the U.S. granted leases beyond that line off Newfoundland, Canada would legitimately claim that this area is under exclusive Canadian jurisdiction. Such is the legal position now. It may be changed through negotiations but the speaker believed that the future must provide for some kind of exploiter's exclusive access to the exploited resources.

A navy expert referred to a report presented to the Symposium, in which different patterns of possible legal status of the seabed beyond the limits of national jurisdiction were examined ("res nullius", "res communis", etc.). He felt that whichever the concept there must be a jurisdiction on the sea-bed. Jurisdiction is necessary for the adjudication of rights.

The question then arose whether the jurisdiction exercised beyond the continental shelf — e.g. in an intermediate zone as envisaged in the report of the U.S. Commission on Marine Science, Engineering and Resources — would be of territorial, or of personal and real, character. One international lawyer expressed his anxiety that a dispute over appropriation *versus* non-appropriation of the sea-bed areas might go on for several years, and in the meantime the international community would be facing a *fait accompli*.

Another international lawyer stressed in this connection that there seems to be a general consensus on the concept of non-appropriation of the deep-sea bed. This, however, is closely connected with the definition of the continental shelf because the criterion of exploitability makes the present definition open-ended.

Another participant pointed out that the encouragement of exploitation should be considered as the main purpose of an international regime of the sea-bed. Consequently, the exploiters must be given some guarantees. While admitting that any regulation, by its very nature, somehow limits an absolute

freedom of action, the speaker felt that the freedom of activities should still be recognised as an underlying principle.

An international lawyer presented two different aspects of the question of utilisation of the resources of the sea-bed to the benefit of mankind. One aspect is that of who is entitled to exploit the resources. This is mainly the problem of competition between the most advanced nations and companies (they require certain security of investments). The interests of the developing countries are not affected here. *Another aspect* is that of sharing profits from the exploitation and it is in this aspect of the problem that the developing countries are mainly interested. The question arises how to satisfy them, although they will not actively participate in the exploitation.

A marine geologist was of the opinion that if the developing countries are unable to exploit the resources of the sea-bed, they should be at least able and willing to secure and protect the investments made by others on the sea-bed. Otherwise, one may assume that they have no corresponding right to tax others.

A geographer felt that the whole problem of profits for the developing countries is one of theory rather than of practice. He was afraid that for a long time to come there would be no profits to be shared and he felt that it would be wiser to say this openly now.

This point of view was supported by an oil expert. However, he did not think that — at least insofar as oil is concerned — only the most advanced countries are in a position to undertake exploitation.

An international lawyer noted in this connection that profits from the exploitation of the sea-bed to be shared by nations depend on where the outer limit of national jurisdiction will be drawn.

Another international lawyer remarked at this point that whenever discussion arises on whatever aspect of the sea-bed problem, the question of the delimitation of the continental shelf immediately arises.

According to another participant an assertion that no profits will be drawn for the benefit of international community presupposes that there will be no exploitation of the sea-bed beyond the limits of national jurisdiction. But the developing coun-

tries may not agree to such a wide zone of national jurisdiction over the natural resources of the sea-bed, which leaves nothing worthy of exploitation beyond. Being not bound by any such agreement they may intrude into such quasi-reserved areas. Therefore in order to ensure an orderly exploitation of the sea-bed, it is necessary to reach a general agreement and, consequently, to entitle the developing countries to share in the profits.

Two international lawyers referred to the two sets of principles submitted to the UN Committee on the Peaceful Uses of the Sea-Bed by a group of Afro-Asian and Latin American countries (set A), and by a group of West European and some other developed countries (set B). It was noted that in both sets many points seemed to be generally acceptable. Special reference was made by one of the speakers to the respective provisions of both documents, which mention the special needs of the developing countries. He drew attention to the fact that in the wording of relevant paragraphs of both versions, the special needs of the developing countries are taken into account precisely in terms of the distribution of profits rather than in terms of participation in the exploitation. This is also true for the draft submitted by the developed Western countries, and this should be taken as evidence that those needs of the developing countries are generally recognised and not challenged.

A navy expert pointed out that the problem of assistance to developing countries is a very serious one and could be resolved by allocating some means for this purpose by the world community. However, he did not think that the problem of assistance to these countries should be tied up with the problem of the exploitation of the deep-sea bed. This would mean that the assistance to the developed countries is made dependent on something very uncertain, about which no one knows at present if it would provide any revenue for distribution. He would prefer, therefore, to divorce the problem of assistance to the developing countries from the question of the exploitation of the sea-bed.

This point of view was supported by an international lawyer who believed that it would be dangerous to assume that substantial funds may be drawn from the sea-bed.

Also a geographer felt that associating assistance to the developing countries with the exploitation of the deep-sea floor is a very long-term prospect. He believed instead that the suggestion to provide technical assistance to those countries is the most appropriate one.

Referring to this suggestion, another international lawyer suggested that every exploratory oceanographic expedition should include an expert from the developing countries. He believed that this would be important because the developing countries lack information on the resources of the sea-bed and this makes their position more rigid. They are reluctant to accept limitations of the scope of their rights since they are afraid that they would thus be deprived of great wealth.

A marine biologist believed that, from the logical and philosophical point of view, there is a certain contradiction in speaking of the deep sea bed as the "common heritage of mankind", and, at the same time, in according priority to only a part of mankind, namely to the developing countries.

The following opinions appeared in the report of the Working Group: "That technology is moving fast and in this connection measures of political, legal and administrative character should be taken to ensure orderly development and to prevent harmful competition";

"That the goal of the approach should be the encouragement of exploration and exploitation, and the elimination of the possibilities of conflicts";

"That the principle of non-appropriation of the sea-bed and ocean floor beyond the limits of national jurisdiction should be accepted by all";

"That there should be a pronouncement on this question in order to prevent further extension of national jurisdiction. In this connection it was noted that there is a tendency among nations to move the outer limits of the continental shelf more seawards";

"That the problem of appropriation of the area is closely connected with the problem of delimitation";

"That the interpretation of the criterion of exploitability, contained in art. 1 of the Geneva Convention on the Continental Shelf adds to the uncertainty on the issue of appropriation of the sea-bed".

“ that the sea-bed and the ocean floor beyond the limits of national jurisdiction should be considered as common heritage of mankind ”.

“ that the main incentives to exploration and exploitation of the area are: security of access, security of tenure, participation of states as well as individual enterprises, reduction of complicated bureaucratic processes ”.

“ that the developing nations expect to share in the benefits drawn from the exploitation of the sea-bed and ocean floor resources ”;

“ that sharing benefits with the developing nations can also take the form of technical assistance, in order to increase their know-how, and to expand training and knowledge of the sea-bed, including the continental shelf ”;

“ that the two sets of principles proposed at the United Nations Ad Hoc Committee on the Peaceful Uses of the Sea-Bed in 1968 should be taken into consideration when thinking about the contents of a future international regime ”.

Problem of an International Machinery and of its Functions

An international lawyer expressed the opinion that if one thinks of an international machinery to administer the questions related to the deep sea bed, one should take into account regional organisations. This might facilitate the establishment of an international machinery since people sometimes mistrust global organisations.

An oil expert held the view that there will always be a suspicion among the exploiters about administering the system by a public international body; he believed that an efficient administration of a system requires a body which would not be under obligation to ask everybody, every time, to whom property should be allocated, etc.

Advantages of regional bodies were stressed by another participant who referred to the existence of many regional arrangements applicable to different sea basins.

Also a marine biologist was of the opinion that regional arrangements may have certain advantages. He referred to

a tendency in the field of fisheries to operate through regional arrangements, and noted that they deal either with geographical regions or with species or groups of species.

A geologist referred to a regional arrangement in another field, i.e. to the Committee for Co-Ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas, which is a subsidiary body of ECAFE. He was of the opinion that this Committee is an example of a very fruitful cooperation between the countries of the region, and noted that the area of its activity is now being further extended to South-East Asia.

Another participant felt that there is no analogy between the examples referred to and the matter under consideration. In the field of fishing, the main problem is that of conservation of resources; in the ECAFE Committee, that of prospecting. But in the field of the deep-sea exploration and exploitation the main problem is that of the distribution of revenues. He doubted whether the cooperation within the ECAFE Committee will be as effective as it is now, if and when it comes to the exploitation of the resources. He was not opposing regional organisations; he felt, however, that they are not necessarily the most appropriate ones for the purpose.

According to another view the differences between fishing or prospecting for resources on the one hand, and the exploitation of the resources on the other, although well taken, do not discredit the concept of acting through regional organisations also in the latter case. The problem is who is deciding what. The countries deciding on the exploitation must be the ones which will have to apply directly the decisions adopted. It would seem most inappropriate that all countries should decide on the regulations to be applied in a particular region in which they may have no interest or responsibility.

It was remarked in this connection that once the discussion is about the sea-bed beyond the limits of national jurisdiction, it should be assumed that this is an area in which all the countries of the world have equal interest.

On the other hand it was felt that at the present exploratory stage of activities on the deep sea-bed the analogy to other examples not involving direct exploitation stands fully valid.

Another participant noted that there is a tendency to subject the marginal seas, like the Baltic and the Mediterranean,

to a specific different regime. Should it be so, only the area of big oceans would be left for discussion.

It was also said that regional and global cooperation might be combined.

As to the functions of an international machinery for the sea-bed beyond the limits of national jurisdiction, it was suggested that they could be steadily developed from the simplest towards more comprehensive ones. The following possible stages of development were suggested:

1) Registration — without fees and not subject to any conditions; such registration would result in acquiring some degree of protection by the exploiter (e.g., some exclusive rights); the registering organ might be connected, or not, with the United Nations.

2) Registration with authorisation for exploration and exploitation of the sea-bed resources; such a procedure would involve application of certain criteria for granting authorisation, which might be similar to those existing in domestic law: e.g. some minimum technical competence and keeping up with some minimum social standards.

3) Practical embodiment of the idea of “common heritage of mankind”, which would additionally involve payments of royalties by exploiters to the benefit of the international community; it remains an open question how funds thus collected should be distributed.

4) A form of direct ownership of the sea-bed resources by the United Nations.

The speaker pointed out that if alternative 1) or 2) is chosen for the beginning, the system might steadily develop towards more comprehensive forms. But if, on the other hand, the start is made with alternative 3) or 4), there would be no way back to the simpler forms.

A navy expert added that the maximalisation of exploitation and minimalisation of conflicts must be kept in mind when a possible evolution of an international regime for the sea-bed is discussed. He would prefer to start with the second alternative, provided that the conditions of getting authorisation

would also include obligation of a registrant to exploit the resources. Otherwise the way will be opened for a frivolous registration which would be incompatible also with the principle of non-appropriation.

The warning against frivolous registration was strongly supported by an oil expert who was of the opinion that rights may be allocated only against a sound working programme. While he felt that it was not the business of oil companies to tell the rest of the world how to run an international system of exploration of the sea-bed, the following points should be stressed:

— allocation of rights must be combined with security of tenure since it takes several years to develop production;

— it should be envisaged that rights may be allocated not only to states: one should not discriminate against individual companies.

An international lawyer spoke in favour of alternative 1) or 2), not because he considered them better but simply more feasible. Elaboration of a system based on alternative 3) or 4) would take — according to his opinion — too much time. He thought, however, that even the registration system involves some problems. On the one hand, in order to avoid frivolous registration, some fees should be paid by the registrant upon registration. On the other hand, it may happen that under these conditions the developing countries will never appear as registrants. However, they might share in the fees paid by other registrants. The speaker supported the view that an international registration must involve a certain degree of international protection of the operator, e.g. exclusive rights over a certain area for a sufficient period of time.

Another international lawyer felt that the fees mentioned by the precious speaker may be quite insufficient to satisfy the needs of the developing countries. But these countries may also be offered technical assistance for the exploitation of their own continental shelf.

Still another international lawyer expressed the opinion that in any case the international authority should not be directly involved in the exploitation of the resources of the sea-bed beyond the limits of national jurisdiction.

The following opinions appeared in the report of the Working Group:

“There should be a combination of global international arrangement with regional arrangements; regional arrangements should serve both as foundations for a universal regime and as means to concretise general rules”;

“the correct approach in the matter of functions of the system is the evolutionary approach, starting from a registration system without fees, proceeding gradually to a registration system with special permits (taking into account minimum social and technological standards); subsequently moving towards a system with a division of royalties (taking into account that the sea-bed beyond the limits of national jurisdiction is the heritage of mankind); and finally establishing direct ownership of the resources of the area by the United Nations”.

WORKING GROUP III

Present Legal Regime of the Sea-Bed

One participant expressed the view that there are at present no legal norms which would determine "who is entitled to what" beyond the continental shelf. There are a number of theories but there is no provision of law which might prevent occupation of some portions of the sea-bed beyond the continental shelf by individual states.

An international lawyer remarked in this connection that occupation, especially a temporary one, does not necessarily involve acquisition of sovereignty over a territory.

Other international lawyers contested the view according to which there are no legal norms relating to the sea-bed, and according to which it is possible in the existing legal situation to occupy portions of the seabed beyond the continental shelf.

One of the speakers suggested that the principle of freedom of the high seas applies to the sea-bed. He personally believed that this principle applies to the subsoil of the sea-bed as well, although he admitted that according to some other authors the distinction should be made between the legal status of the sea-bed and that of its subsoil.

It was furthermore said that while one may claim that the present legal situation with respect to the sea-bed is unsatisfactory or undesirable, it would be difficult to accept a submission that no legal rules apply there.

According to several speakers, it cannot be assumed that, under the existing international law, states may occupy portions of the sea-bed beyond the continental shelf, or still less, that

the existing law gives the right to the partitioning of the ocean floor. One of them was of the opinion that the state practice of to-day does not show a tendency in this direction. Another speaker submitted that the criterion of adjacency puts a limit to possible claims of states to the sea-bed. He added that extension of claims of sovereign rights to the water column over the continental shelf as well as claims that the continental shelf itself is an integral part of national territory are contrary to the Geneva Convention on the Continental Shelf.

At the same time it was indicated that already at present the domestic legislations of at least 3 countries, have defined limits of their jurisdiction on the sea-bed by the criterion of exploitability only, and that this creates a potential danger of the seaward extension of national sovereignty on the sea-bed as the technology of undersea exploitation develops. By 1967, 15 states issued licenses for exploration on the sea-bed beyond the 200 m depth limit — up to a distance of 200 miles off coast. By 1968 these figures increased to 29 states and 350 miles respectively. The speaker added that 25 years ago also the continental shelf was considered to be unappropriable, and expressed the view that the customary international law regarding the sea-bed beyond the continental shelf is now exactly in the same stage of development as it was before 1945 with respect to the continental shelf. He would not rely, therefore either on the present state on the future spontaneous development of customary international law, or on the fact that under the existing international law the area of the sea-bed beyond the continental shelf is not appropriable. There may be some interests in such interpretation of art. 1 of the Continental Shelf Convention, according to which the exploitability criterion gives title to acquisition of exclusive rights on the sea-bed ever further seaward. One day we may face a number of unilateral declarations regarding the deep sea bed, just as happened earlier with respect to the continental shelf. To prevent such developments, a legal action is needed right now.

One participant expressed the view that the rights of states on the continental shelf are of functional rather than of territorial character. As long performance of specific functions (exploration and exploitation of natural resources) is not at stake, there is no jurisdiction of the coastal state over the continental shelf

as such. Moreover, the speaker believed that it is difficult to conceive spatial rights over a territory which is not clearly defined.

Several other international lawyers contested this view and insisted that the rights of the coastal state over the continental shelf are of spatial character. One of them added that one should not confuse spatial rights, which are limited in scope, with the non-spatial nature of rights. He, furthermore, recalled that the colonisation of Africa began also with scattered settlements but finally led to the establishment of spatial territorial rights in Africa.

An international lawyer referred to one of the fundamental freedoms of the high seas, namely — freedom to overfly them, which is usually being omitted in discussions on the sea-bed. He raised the question whether any possible developments on the sea-bed may lead to a situation in which some interests might prevent overflying some portions of the high seas (sea-bed).

Some participants presented their summaries of and comments on the existing theories regarding the present legal situation of the sea-bed. The following theories were mentioned:

— the concept referred to as the “ Oda theory ”, according to which the sea-bed is potentially divided by the coastal states pursuant to the application of the exploitability criterion; two speakers found this theory unacceptable;

— the “ occupation theory ”, according to which the sea-bed beyond the limits of the continental shelf may be occupied by any state as a *res nullius*; this theory was qualified by one speaker as legally untenable and politically dangerous;

— the “ freedom of the seas theory ”, according to which the principle of freedom of the high seas applies to the sea-bed beyond the continental shelf.

One speaker noted that this theory involves all the difficulties connected with the flag state system; another one added that this system is extremely vague and is likely to turn into the flag of convenience system, if one takes into account the possibilities of international companies to manipulate. Finally, it was stated that if companies start operating under the flag nation

system, the areas of their operation would easily become subject of national appropriation within a short time.

Confrontation of all these theories led one of the speakers to the conclusion that the only acceptable theory is that the sea-bed beyond the continental shelf belongs to mankind. He preferred this concept to that of *res communis*.

Several international lawyers noted in various forms that, as shown by the discussion, quite different conclusions regarding the present legal status of the sea-bed may be drawn from the same facts. They suggested, accordingly, that the discussion should proceed on the basis of the fairly uncontested assumption that there is an area of the sea-bed which is beyond the limits of national jurisdiction, and then to focus main attention on the future legal regime of that area.

One international lawyer remarked that the present legal status of that area should be clarified first. If it is considered as *res nullius*, it may be acquired through some complicated process; if the principle of freedom of the seas is applied there, a state may exploit this area but may not acquire sovereignty over it. But in this case the state may be incapacitated in exercising the necessary legislative control. The speaker also drew attention to the complexity of the problem of jurisdiction over the continental shelf in cases of federal states with competences divided between federal and state authorities. Since a number of federal states exist in the world, and some of them have fairly long coastlines and big continental shelves, the question seems to gain importance.

Some other participants were of the opinion that these matters should be solved within the framework of respective national constitutions and could hardly become a subject for international discussions.

Delimitation of the Continental Shelf

One participant submitted that the area of national jurisdiction on the sea-bed should be as narrow as feasible. He suggested outer limits of this area at the depth of 200-500 m, or at a distance of 50 miles from the coast, whichever is less. Beyond

these limits the sea-bed should be subject to an international regime or to an international governing body. It should be remembered, however, that — from the economic point of view — it is only the remaining part of the continental margin, and not the vast areas of the deep ocean floor, which would constitute the main element of such an internationalised area of the sea-bed. The speaker also expressed his concern over the present attitudes of states. He felt that if a vote were taken now on the question of the outer limit of the continental shelf, a majority of states — both the developed and the developing ones — would vote for getting as wide a shelf as possible. He did not think that in the long run this would be in the interest of either group of states.

Another speaker proposed an alternative line at just 200 m depth or at a distance of 50 miles from the coast.

In connection with numerical proposals for the delimitation of the continental shelf, it was remarked that the 200 m depth limit is not always the most appropriate one. Reference was made to the Norwegian Trough beyond which the continental shelf is still extending. The 200 m depth limit plus the criterion of adjacency seems, therefore, more appropriate.

Commenting on the expected attitude of states towards the question of delimitation of the area of national jurisdiction on the sea-bed, one participant expressed the view that an assessment made earlier in the discussion is correct only to a certain extent. The attitude of states would depend on the specific numerical proposal advanced. Should it be proposed to limit the area of national jurisdiction on the sea-bed, e.g. to the 12-mile distance from the coast, such a proposal would probably be opposed by more than 100 states. But on the other hand, a proposal to extend national jurisdiction very far seaward would also meet with opposition from the majority of states. According to his personal assessment, a proposal to extend the limits of national jurisdiction on the sea-bed beyond the 500-mile distance from the coast would hardly gain the support of more than 10 states; even a proposal for the 300-mile distance would provoke opposition from a majority; but votes on the 100-mile distance would probably be fairly balanced.

An international lawyer felt that it may be difficult to agree right now on any specific figure as a limit of national jurisdiction

on the sea-bed because sufficient knowledge of all pertinent data is lacking.

Another international lawyer felt that, while discussing proposals for a future international regime of the sea-bed and for the delimitation of the area of national jurisdiction, one could afford to be more daring insofar as the future regime of the area beyond national jurisdiction is concerned; but it would be advisable to be realistic and prudent in making pronouncements on what states already possess. It may be possible to convince states not to go any further, while it is hardly possible to convince them to give up what they have already acquired. This attitude was contested by one participant who felt that it is not necessary at all to accept every *fait accompli*.

Two other speakers noted that a great majority of states with big continental shelves already went beyond the 200 m depth line with granting licenses, and that pressing for too restrictive proposals regarding the limits of national jurisdiction on the sea-bed would make states less receptive to any convention on any international regime for the areas of the sea-bed beyond.

A number of speakers stressed that the delimitation of the continental shelf is an essential element of the solution of the problem under discussion. Two of them were of the opinion that at this stage of discussions it may be sufficient to reassert the principle that there is an area of the sea-bed beyond the limits of national jurisdiction, and that this area should not be subject to appropriation by any states. Another speaker felt that the discussion might go a little further, and advanced the view that the definition of the legal continental shelf should be based on the strict observance of the depth criterion and of the principle of adjacency to the coast. Still another speaker was of the opinion that methods of delimitation of the continental shelf should be further studied. According to still another view, the legal continental shelf should be as narrow as possible.

Question of the Revision of the Continental Shelf Convention

Referring to a recent criticism of the Continental Shelf Convention, an international lawyer remarked that perhaps this Convention came too soon. If this is so, the question arises

whether the time has already come for a new convention regarding the sea-bed. He noted that the Geneva Convention on the Continental Shelf came into force only five years ago, and if it is being asserted already now that it is unsatisfactory, the question should be answered first, in what respect it is unsatisfactory. Some people — from the point of view of certain interests — believe that the Convention is quite satisfactory.

Another participant remarked that from point of view of big developed countries the Continental Shelf Convention seems to be ideal. They may go ever deeper to the ocean and establish their jurisdiction there. He pleaded, therefore, for a deeper study of national interests of different groups of countries in order to see whether any considerable group of nations would advocate something other than a mere extension of national jurisdiction. He expressed the opinion that the problem has two aspects. One is what is considered by the majority of states as their interest; the other aspect is the interest of mankind. He was afraid that the prevailing climate is not auspicious for action to the benefit of mankind, and that, accordingly, a new convention necessarily must not be elaborated right now.

An international lawyer noted that the prevailing tendency in the UN Committee on the Peaceful Uses of the Sea-Bed was rather to leave the existing law as it stands; or, in any case, not to move on too fast but rather to discuss first what is unsatisfactory in the *lex lata*.

According to another view, whatever might be said on the merits of the Geneva Conventions scheme, it has not been working well as a whole. This has been due to the fact that the body of the law of the sea had been arranged in four conventions which were ratified or acceded to selectively. At the same time the speaker submitted that in order to be realistic one should avoid pressure for alteration of the Convention on the basis of which states have already made certain claims.

With reference to the discussion regarding the present legal status of the sea-bed it was noted that it follows clearly from this discussion that the customary international law is obscure on this question, and that the Geneva Convention on the Continental Shelf is capable of very controversial interpretations and reinterpretations. Consequently, both customary and conventional international law is a very precarious basis for

a discussion on a future regime of the sea-bed. The speaker thought, accordingly, that it would be preferable to work out a new conventional regime which would replace customary law and — at the same time — would render the interpretation of the Continental Shelf Convention unnecessary.

Question of Freezing of Claims

One of the participants, while maintaining that a new regime of the sea-bed must not necessarily be elaborated right now, expressed the opinion that some kind of a holding action to prevent further claims would be of primary importance. The speaker referred to the example of Antarctica, where a holding arrangement is working very effectively.

The idea of the freezing of claims on the sea-bed was supported by another participant who recalled the Swedish proposal to this effect submitted in the United Nations in 1967. However, this suggestion did not meet with much enthusiasm. The speaker expressed the opinion that perhaps too many coastal states have already vested interests on the sea-bed at great depths, so that it might be difficult to get much support for a holding action.

An international lawyer added that this proposal was simply turned down, which was in a sense natural because one cannot freeze a hot problem.

A submission was further made that perhaps holding action might work effectively if a reasonable (i.e. sufficiently liberal) limit was proposed for the freezing of claims. In such a case no one would be interested in pushing further expansion beyond such a limit.

That submission was contested on the ground that one cannot stop the development of technology on which the expansion towards the greater depths depends. Moreover, it was indicated by way of illustration that, as far as the manganese nodules on the deep ocean floor are concerned, an appropriate technology for their exploitation already exists, and if this resource has not been yet exploited, this was due to the prices of the most important metals contained in manganese nodules, i.e. nickel and copper. But price relations may change.

Two international lawyers were of the opinion that there is no analogy between Antarctica and outer space on one hand and the sea-bed on the other hand. There are no exploitable resources in Antarctica or in outer space, such as are at stake in the case of the sea-bed. This is why a freezing action is not likely to prove workable here.

*Need for an International Regime or Machinery
for the Sea-Bed*

According to one international lawyer, the discussion on the question of a future regime for the sea-bed should not be based on abstract premises and should not be dissociated from the established practices, the accumulated experience, and the existing body of international law, including both bilateral and multilateral conventions. He felt that the actual knowledge of problems relating to the sea-bed is too limited, and that perhaps it is not so urgent to press for the establishment of any new regime for the sea-bed.

Another international lawyer expressed the opinion that exploitation of sea-bed resources requires a certain amount of legal security for operators — otherwise, companies would not invest there. A number of practical problems are involved in economic activities on the sea-bed, such as insurance, workmen's compensation, jurisdiction in case of a breach of contract, criminal jurisdiction, etc. Legal security in such matters can be provided now only by national governments, and not by any international authority. He was, therefore, sceptical about participation of states in any international arrangement as long as international organisations have no power to legislate.

Some other participants felt, however, that these and similar questions falling within the competence of states have little relevance for an international arrangement which is contemplated.

An international lawyer felt that more confrontation is needed between natural scientists, economists, lawyers, diplomats, etc. in order to collect enough facts and identify interests before an international action may be safely contemplated. He referred to one of the dissenting opinions from the Judgement of the International Court of Justice of February 20, 1969, in

which it was stated that the case had not been properly pleaded because neither party had seen fit to tell the Court what the real interests were. Accordingly, he felt that what is needed at the present moment at the international level is not so much a political discussion as a technical conference on the questions of the sea-bed. This should be done before it is too late.

Several other participants, however, were of the opinion that the situation calls for a certain speed in proceeding with the establishment of at least the rudiments of the regime of the sea-bed beyond the limits of present national jurisdiction. Massive intrusion of man to this new environment is going on, and time will not wait for lawyers.

References were made to claims of sovereignty over, and to granting leases on, certain portions of the sea-bed at great depths and great distances from the shore. This, according to a number of speakers, calls for the establishment of an international regime of the sea-bed before such claims consolidate and lead to international conflicts. One of the speakers pointed out that what mankind is facing now is a colonial-like struggle for the sea-bed, and that new rules must be formulated before a point of no return is reached.

Referring to the opinions that more studies should be undertaken in order to collect facts and identify interests of different groups of states, an international lawyer expressed his concern over the fact that, before enough facts are collected and before people become educated enough to understand their common interests, the sea-bed will be sliced. He admitted that the developing countries are looking with some mistrust at an international regime for the sea-bed because they lack knowledge on the resources on the sea-bed areas adjacent to their coasts. But the present regime of the sea-bed is not capable of providing such a knowledge to the developing countries and, therefore, according to the speaker, the question should be reversed: what should an international regime do in order to provide more knowledge of the sea-bed to the developing countries? While admitting the usefulness of confrontation between representatives of different sciences, the speaker felt that what really is at stake is not the lack of technical information but rather political reasons. Therefore, he would not rely too much on a conference of a scientific and technical type. Much inform-

ation would be lacking in any case; much would be withheld. Reforms of all types — said the speaker — take place upon pressures from some quarters which do not collect data but are just aware of a certain objective to be pursued. Waiting for volumes of materials would not lead anywhere. While sharing the idea of a need for speedy action, the speaker, however, would not support the idea of a rudimentary regime or arrangement of provisional character. He was afraid that such a “provisional” regime could be likely to become final.

Another international lawyer believed that, when speaking of an international regime of the sea-bed, one must be idealistic and realistic at the same time. He felt that in order to accept an international regime for the sea-bed, the operators should be shown that this would pay; in other words — that they would lose less on limiting national continental shelf than they would have to pay in royalties to foreign countries for exploitation of resources on their continental shelves, if those shelves were to expand seaward. Referring to the already existing and quoted example of a redistributoin of benefits (i.e. compensating Japan by other Pacific countries for her refraining from fishing king crabs), the speaker felt that the example is not quite relevant. Japan is compensated for refraining from what she is actually capable of doing. This would not be true for the developing countries with respect to the exploitation of the resources of the sea-bed. He felt that in order to attract people to the idea of an international regime of the sea-bed, the basis for mutual advantage must be shown. On the other hand, he was not worried about the question of the enforcement of law within a framework of an international regime if the advantages of such a regime are demonstrated and this regime is accepted.

On the question of a basis for compensation to the developing countries it was remarked that, individually, these countries really possess no capability or power for which they have to be compensated. But collectively, they have power, which need not necessarily be constructive but may still considerably increase difficulties for the major powers. The speaker believed that if the developed states pushed the extension of the continental shelf, other countries would follow suit. Since it is known from past experience that sovereign rights on the sea-bed have a tendency to extend to the superjacent waters, the smaller states

may considerably embarrass the military, fishing and other interests of bigger states. According to the speaker, there cannot be any doubt that an international regime of the sea-bed with a narrow continental shelf would be advantageous to operators. The contemplated contributions to the benefit of mankind would be incomparably lower than the royalties now being paid by oil companies to foreign states for operations on the sea-bed, which usually exceed 50 % of the revenue. The speaker also felt that an international regime is capable of ensuring more stability to the operators than they enjoy within national regimes.

Another participant felt that the atmosphere of the discussion was more conservative than that in the United Nations. He pointed out that new problems arise and new solutions must be found. One cannot stick only to the old norms. Referring to the question of realism in approaching the question of the regime of the sea-bed, the speaker remarked that a nationalistic approach in this case is not a realistic one since the nature of the problem is international.

What should be aimed at is national legislation for the continental shelf and international regime for the areas beyond it. It is not necessary for states — at least for the next 10-15 years — to appropriate huge areas of the sea-bed only in order to secure law and order for oil companies.

A natural scientist noted that a regime of the sea-bed based on the principle of freedoms of the high seas and free access to all would mean in practice an access to only very few, because of technological and financial capabilities. Moreover, it may happen that two or more states would grant leases to their respective national companies for the same area. This would be inefficient economically and would lead to conflicts. The speaker believed that states would not extend their jurisdiction on the sea-bed endlessly, up to the middle of the ocean, simply because major powers would not wish this to happen. They have different reciprocal interests balancing one another. Economic considerations might call for extension of jurisdiction on the sea-bed, but military considerations would rather call for limiting this extension. He believed that an international regime for the sea-bed beyond the limits of national jurisdiction might be introduced partly through an international agreement and partly through the establishment of some kind of international

organisation. According to the speaker, such problems as: delimitation of the area of national jurisdiction on the sea-bed, proclamation of the principle of non-appropriation of the sea-bed beyond such limits, the question of freedom of scientific research beyond the limits of territorial sea, and questions relating to the protection and legal status of personnel, equipment, etc. involved in marine operations — could be settled by an international agreement only. Other questions, such as: use of benefits from the exploitation of the sea-bed for the welfare of mankind, effective control of pollution of the oceans, encouragement of beneficial exploitation of the resources of the sea-bed, measures to ensure the conservation and wise use of the resources of the sea and of the sea-bed, and measures to minimise the conflicts between different uses of marine environment — would have to be handled by an international organisation.

Several participants spoke in favour of the establishment of an international machinery to deal with the problems under discussion. However, according to the prevailing opinion it would be difficult at this stage to decide which particular questions should be dealt with by an international agency, and which ones only in an agreement. Some speakers believed that such a distinction would hardly be possible or desirable at all, and that an international agency, if and when created, would probably have to have an insight into all relevant questions. One participant referred to the Chicago Convention of 1944 as an example of a single instrument, which both contains the statement of principles and norms, and at the same time provides for an organisational framework.

A natural scientist stressed that an international agency for the sea-bed is needed to ensure that the benefits from the exploitation of the sea-bed beyond the limits of national jurisdiction be used, for the interests of mankind; to ensure that exploitation of the sea-bed and related technological development be fostered; to develop rules and procedures for the prevention and control of pollution; to promote measures which are necessary and agreeable for conservation and rational use of marine resources; and to encourage and facilitate scientific research.

Another participant pointed out that an international machinery is needed for several reasons besides ensuring the most

effective exploitation of the sea-bed resources and the equitable distribution of benefits drawn from such an exploitation. One reason is the maintenance of world power balance, because it would be adversely affected by the domination on the sea. Predominant national control of the sea-bed may cause tremendous increase in power — political, military, and economic. The economy of about 30 countries depends on export of minerals found on the sea-bed, and a regime of the sea-bed must take account of this reality. It must insulate the sea-bed from political and economic competition. The speaker furthermore drew attention of the Working Group to the foreseeable needs of mankind as regards food and energy. He felt that these needs cannot be satisfied with land resources alone. Therefore, massive intrusion into this new environment, i.e. the sea-bed, should be promoted but at the same time frictions and conflicts in the area should be reduced. To achieve these objectives there is no alternative to an effective international regulatory organisation for the sea-bed. The speaker stressed that the hydrospace represents one global ecological unit, and that anything occurring on the sea-bed inevitably affects the superjacent waters (although the opposite is not necessarily true). He therefore advocated a global agency administering not only the sea-bed but superjacent waters as well. Through such an agency the scope of the changes in the legal status of the superjacent waters could be minimised. Otherwise, such changes will occur in disorderly fashion — if the flag state approach is accepted for the activities on the sea-bed; or will occur violently — if a partition of the sea-bed among the coastal states takes place. One should remember that even limited sovereign rights on the sea-bed have a tendency of inevitable and uncontrollable expansion to the superjacent waters. Another reason for establishing such an international agency is that it would be able to reconcile different uses of the seas and of the sea-bed, including the use of living resources. Finally, it would concentrate efforts which are now dispersed among about a dozen agencies. Such a dispersion cannot contribute to managing hydrospace in a consistent manner.

A case for a global marine agency dealing not only with the problems of the sea-bed was supported by another participant, who felt that an agency dealing exclusively with the resources

of the sea-bed outside the limits of national jurisdiction would have practically very little to do for some years to come.

One international lawyer recalled that, while elaborating the Geneva Conventions on the law of the sea, the International Law Commission abandoned the concept of an international organisation. He thought that this approach should not be changed. The solution should be sought on the basis of a multilateral convention, providing for a commission or council, like those provided for in numerous fisheries conventions. He believed that establishment of an agency with legislative or administrative authority would be contrary to the United Nations Charter and the fundamental principles of international law.

An opposition against establishment of an agency was also voiced by another international lawyer who was of the opinion that if such an organisation is to be composed of official representatives, it would not be efficient. He recalled the work of the Deep-Sea Mining Committee of the International Law Association, where the prevailing trend did not favour establishment of any new international organisation for the sea-bed. The most extreme proposal in favour of an organisational arrangement envisaged a registration agency only. Referring to the influence of activities on the sea-bed upon the superjacent waters, the speaker noted that conflicts of uses in the marine environment have always existed and have been handled in a quite satisfactory way by a rudimentary machinery.

Still another international lawyer indicated that the question of establishing an international agency is not only that of desirability, but first of all that of feasibility. He expressed his doubts on this latter point.

*Purposes and Principles of an International Regime
of the Sea-Bed*

One participant submitted for discussion in the Working Group a set of principles, containing i.a. the following statements: "There shall be minimum feasible appropriation of the seabed by states.

International agreement is needed on spatial and functional limitations of national jurisdiction (suggested agreement: coastal states shall have the exclusive right to exploit the mineral and fossil fuel resources of the sea-bed of their coast, out to a depth of 200 metres or a distance of 50 miles, whichever is less).

The benefits from the exploitation of the resources of the sea-bed beyond the agreed limits of national jurisdiction shall be used for the welfare of mankind.

International agreement is needed to ensure the protection and legal status of personnel, equipment and investments employed in all marine operations, including exploration and exploitation of the resources of the sea-bed”.

Two speakers felt that speaking about “minimum feasible appropriation” amounted, in practice, to opening the door, for appropriation. They prefer to speak rather about non-appropriation.

One international lawyer, however, was of the opinion that speaking just about minimum feasible appropriation is preferable.

According to another suggestion, not only appropriation but also acquisition of exclusive rights on the sea-bed beyond the limits of national jurisdiction should be prevented.

However, an international lawyer remarked in this connection that exploitation of the sea-bed is hardly conceivable without some kind of exclusive rights. Another international lawyer added that any statements suggesting inadmissibility of exclusive rights of a non-spatial character with respect to installations on the sea-bed should be avoided. Some participants referred to pp. 2 and 4 of A Declaration of General Principles contained in the Nineteenth Report of the Commission to Study the Organisation of Peace, and felt that suggestions of the Working Group should be formulated along the lines of that Declaration.

An exchange of views took place regarding the definition of the area of the sea-bed to which the principle of non-appropriation should apply.

One participant noted that that it is difficult to speak about an area “beyond the agreed limits of national jurisdiction” because no such agreed limits exist as yet.

Another participant recalled that references to an area "beyond the limits of national jurisdiction" appear throughout all documents of the United Nations.

An international lawyer recommended avoiding references to "national jurisdiction" at all, once the Working Group is discussing general concepts and ideas and not drafting a legal text.

Another international lawyer suggested that the area in question may be defined as that "beyond the limits of the continental shelf, whatever these limits are".

Two other participants objected to making references to the notion of the continental shelf.

A number of speakers felt that the Working Group should agree on some very general principles regarding the future regime of the sea-bed. Various speakers proposed various combinations of such general principles which they considered to be the most important ones.

According to one of them, the first thing to be established is that:

- there is an area beyond the limits of national jurisdiction;
- that area should be treated as the common heritage of mankind.

In another version, the Working Group might agree that:

- the continental shelf should be as narrow as possible;
- the area beyond is the common heritage of mankind.

Furthermore, it was suggested that the following concepts should be embodied in the principles the Working Group might wish to support:

- a definition of the limits of the area of the sea-bed subject to national jurisdiction;
- a definition of the scope of rights to be exercised by states in the area of the sea-bed subject to their jurisdiction but beyond the territorial waters (since these rights have tended to expand);
- making clear that whatever regime is established on the sea-bed, it would not extend to the superjacent water column.

According to a third version, the Working Group might agree that:

- there is an area of the sea-bed beyond the limits of national jurisdiction;
- it is urgent to define this area;
- this area should be defined by a limited depth of water and in accordance with the principle of adjacency.

With respect to the definition of the area of the sea-bed beyond the limits of national jurisdiction, an international lawyer, while noting different opinions as to the numerical boundary of this area, suggested that the Working Group might agree that:

- precise limits of this area should be defined; and
- this should be done by an international agreement.

He furthermore submitted the following principles:

“The use of the sea-bed and its subsoil should be in accordance with the principles of contemporary international law, including the United Nations Charter and the principle of the freedom of the sea.

The state bears the responsibility for all national activities concerning the exploration and exploitation of the natural resources of the sea-bed and its subsoil. The installations and other artificial constructions for the exploration and exploitation of the natural resources of the sea-bed and its subsoil should be subject to the jurisdiction of the flag state”.

An exchange of views took place regarding the notion of the common heritage of mankind.

Some participants strongly advocated this concept. It was recalled that it had been accepted in the outer space treaty, and that some important consequences derive from the acceptance of this concept — i.a. the principle of peaceful uses.

One international lawyer strongly opposed the concept of the common heritage of mankind. In his opinion, this concept pertains to private law and should not be transferred to intern-

ational law and international community; this concept does not appear in any textbook on international law. International law knows the concept of *res communis*, which means the common use.

Another international lawyer expressed the opinion that the concept of *res communis* might be quite acceptable if an international agency for the sea-bed is established. In municipal law there is a statute that ensures that *res communis* should not become *res nullius*. There must be a corresponding international authority if the concept of *res communis* is to be adopted for the sea-bed.

One participant felt that the concept of common heritage of mankind might be dropped if it causes controverises, since it does not say very much.

Several speakers opposed the submission according to which the sea-bed should be used in accordance with the principles of contemporary international law and with the principle of freedom of the high seas.

The speakers stressed that the existing international law is unsatisfactory on the question of the status of the sea-bed, and that the whole issue at stake is precisely that of its modification. It was, furthermore, stated that the concept of "contemporary international law" is ambiguous.

Reference to the use of the sea-bed in accordance with the principle of freedom of the high seas was objected to on the ground that application of this principle to the use of the sea-bed would amount to an acceptance of the flag state approach. However, the solution of the problem should be sought in establishing an international regime. The principle of state responsibility for national activities on the sea-bed was supported by several speakers.

One international lawyer, while supporting in principle the idea of the responsibility of state for the activities on the sea-bed, felt, however, that this question is extremely complicated and can hardly be dealt with in an adequate manner within the framework of the present discussion. He would prefer, therefore, to say only that the general principles of international responsibility of states apply also to the activities on the sea-bed.

On the question of the use of benefits from the exploitation of the sea-bed resources in the interest of mankind, it was said that

the corresponding principle should reflect the idea that all states should participate directly or indirectly in the benefits drawn from the exploitation of natural resources on the sea-bed beyond the limits of national jurisdiction. The speaker added that the international community may not expect sharing in all the benefits but only in a part of them — the exploiters will take a part of the benefits for themselves.

One international lawyer had some misgivings about the proposal regarding “direct or indirect” participation in the benefits. He was afraid that an “indirect” participation would become purely fictitious since it is difficult to conceive what specific rights and titles may be involved in an “indirect” participation.

Another international lawyer, however, felt that an “indirect participation” in benefits is theoretically quite conceivable: e.g. taking advantage of lowered prices for raw materials as a result of exploitation of minerals from the sea-bed. In any case, however, he wondered whether the proposed principle had anything specific in view, or would remain only a lofty phrase.

Some drafting changes in the formulation of principle dealing with the use of the resources of the sea-bed for the welfare, benefit, or in the interest of mankind were also proposed.

Other participants, however, felt that the discussion should not dwell on the details since the Working Group is not drafting any legal text. At the present stage it is most important to advance some general ideas and principles — that the sea-bed beyond the limits of national jurisdiction is the common heritage of mankind, and that, consequently, some mechanism should be devised to enable all states to participate in the benefits drawn from this area.

A natural scientist raised the question of the grounds on which initial leases or licenses for the exploitation of the sea-bed would be granted: to the highest bidder, or on some other grounds.

Another participant was of the opinion that two ways are possible: application of the principle “first come — first served”, or an auction system, which the speaker considered preferable. He noted, however, that the question of the grounds on which licenses are to be granted depends on the character of an international machinery to be established. If such an international

machinery is a registration office only, the question of such a choice will not arise at all. Similarly, the question of choice will not arise if it is decided that applicants for a license have to meet any preestablished conditions.

Some other speakers had certain doubts about the appropriateness of the highest bidder principle in this case. They believed, however, that at this stage of discussion it would not be helpful to go into details. One of them felt that there are certain precedents with the procedures of granting licenses for oil exploration on the continental shelf, and that they might also be taken advantage of.

Some speakers were of the opinion that licenses or leases for exploitation of the resources of the sea-bed beyond the limits of national jurisdiction should be granted to governments only. Operating companies would then acquire rights to exploitation from their respective national governments. Two speakers said that it may be difficult for some states to accept, in an official international agreement, the procedure of direct licensing of private companies by an international agency.

Two other speakers, however, were of the opinion that direct licensing of operating companies would be preferable. One of them remarked that, in some states, companies may be quite fictitious or may have insufficient competence to exploit the resources of the sea-bed. It would be better, therefore, to deal directly with a potential beneficiary of the rights to be granted. Another speaker, while recognising the existence of states with different economic and social systems, believed that this is no reason for excluding private companies from a direct participation in a licensing system. Such a system should be devised so as to allow states with whatever economic system to follow their own pattern. The speaker referred to the example of space, where direct participation of private companies in space operations is also not excluded.

A question was raised whether the contemplated regime for the sea-bed should also include the living resources, or was meant only for the mineral resources of the sea-bed. One speaker felt that it follows from the formulation of the proposed principles that their authors had only mineral resources in mind. He asked whether the authors assumed that there will be another regime for the living resources on the sea-bed; or on the

contrary, if it was to be assumed that they cannot be separated from the superjacent water column and its regime.

Two speakers believed that the living resources should not be subject to any exclusive rights of the coastal state beyond the contiguous zone. They felt it was a mistake to include some living resources in the regime of the Geneva Convention on the Continental Shelf, and that the compromise arrived at in Geneva on this question should be corrected.

It was furthermore noted that the exploitation of living resources on the sea-bed actually went to greater depths than that of mineral resources. The question therefore arises whether the exploitability of one category of resources gives exclusive rights also with respect to another category of resources. The speaker therefore raised the question of two different international regimes: one for mineral resources of the sea-bed and its subsoil, and another for living resources of the sea and the sea-bed.

One participant felt that the living resources should be included in the discussion on the international regime of the sea-bed.

The author of the proposed principles felt himself that the living resources cannot be completely separated from the regime of the sea-bed — if only in order to minimise interference between different uses of the marine environment. He did not intend to exclude living resources from the scope of application of the proposed principles. He would, however, prefer to avoid discussion on fisheries, in order not to open Pandora's box.

The following opinions appeared in the report of the Working Group:

“The resources of the high seas, including those of the underlying sea-bed and subsoil, shall be used and conserved in the common interest of all men;

“Outside those areas in which by international law the coastal state exercises exclusive rights for exploration and exploitation of the resources of the sea-bed and subsoil, individual states and their nationals shall not appropriate the sea-bed in any manner;

“The areas in which individual states exercise exclusive rights shall be as small as feasible;

“The outer limits of the areas over which the coastal states exercise exclusive rights shall be fixed by a definite depth and

or distance from shore. This will require modification of the present Convention on the Continental Shelf. This depth and or distance, together with the nature of the exclusive rights to be exercised, should be determined by international agreement as soon as possible.

International agreement is needed to ensure the protection and legal status of personnel, equipment, and investments employed in all marine activities, including research, exploration, and exploitation of the resources of the sea-bed.

For the attainment of the foregoing principles there should be intensified international cooperation and coordination of activities involving the sea-bed and the overlying waters, outside the agreed limits of the zones and functions over which the coastal states exercise exclusive rights”.

Question of the Type of an International Agency

An international lawyer expressed the view that none of the existing organisations is able to cope with the new problems of the exploitation of the sea-bed. He stressed more specifically that neither the United Nations nor its specialised agencies are the proper organisations to administer an international regime of the sea-bed. Also any new agency should not be structured along the models of the UN and the specialised agencies. The speaker would rather think of a model of the European Economic Community without its integrating policy, and expressed his belief that it would be possible to devise an effective international regime for the sea-bed. At stake now is just the sea-bed and not the vital issues of international peace and security. Accordingly, an agency should be one of rather technical character.

Another participant concurred in the opinion that the United Nations has now no organ to deal with the matters of the sea-bed, and that a scheme for a new agency should be outlined.

It was furthermore noted that any international machinery for the sea-bed must be based on two prerequisites:

- clear definition of the continental shelf, accepted by an overwhelming majority of states;
- conclusion of an international treaty.

According to one opinion a new organisation should be vested with legislative powers. The speaker felt that states and operators must have the assurance that whatever happens on the sea-bed would not happen in a legal vacuum.

According to another speaker, the powers of the proposed agency should be rather limited — of administrative rather than of legislative nature. For tort cases etc., the national law of the flag state could be applied.

An international lawyer believed that if the existing international organisations are considered unable to cope with the problems of the sea-bed, it is not because of their structure but because of the attitude of member-states who do not allow existing international organisations to do certain things. There is no guarantee that a different structure would change the attitude of member-states. Moreover, it is questionable whether states, precisely because of such an attitude, would agree to a different structure. Thus, the problem is that of feasibility. The speaker felt that the reference made to the mood prevailing at present in the United Nations have only shown that setting up a new organisation for the sea-bed with a new type of structure may just not be feasible. The speaker felt that strengthening the competence of existing organisations may be an alternative.

Referring to the existing trend towards establishing a new organisation for the sea-bed, another participant expressed the view that the great powers would not accept at present any type of an elaborate organisation, and that their attitude would prevail. To recognise this is an act of realism, and not an act of defeat. The speaker felt that it is not easy to devise an appropriate model of a contemplated international agency because of the different uses of the environment involved, including military uses. He mentioned the EEC-type and the World-Bank-type of international organisation and noted also that the I.L.O. structure — with its built-in conflicting interests is one reflecting reality, and is quite effective. He recommended following closely the models of the Special Committee on Oceanographic Research, of the Intergovernmental Oceanographic Commission, as well as that of the Intergovernmental Maritime Consultative Organisation — without being bound by them. He also warned against overburdening the existing organisation with new tasks,

and pointed out that the terms of reference of any new organisation should be clearly spelled out.

A political scientist said that he would personally prefer an international agency of a government-like type. He admitted, however, that such an organisation is not feasible at present. Accordingly, he felt that the agency should have regulatory functions — but with some more competences than just licensing. It should be effective enough to deal with any area of the seabed reserved for mankind. It would have to find a way to ensure that the resources of the seabed are harvested and distributed to the benefit of mankind. According to the speaker, such an agency should be set up by international treaty under the auspices of the United Nations, — and form a part of the United Nations family. However, the speaker would not favour administration of the sea-bed by an organ similar to the UN General Assembly. The membership in the agency should be universal. The power within an executive body of the agency should be balanced between the following categories of countries:

- countries possessing capabilities to exploit the resources of the sea-bed;
- countries with major interests in the marine environment, but not in a position to exploit the resources of the sea;
- landlocked countries;
- countries which at the moment are not greatly interested in the marine environment but are parts of the world community.

The speaker would contemplate fairly wide terms of reference of the agency. The problem of pollution would be one of immediate interest to the agency. But eventually its terms of reference might include also fisheries and even control of demilitarisation.

Also a natural scientist pointed out that none of the existing agencies has sufficient flexibility and ability to make decisions in the field of conservation, development and exploitation of marine resources to the benefit of mankind. The Intergovernmental Oceanographic Commission has but limited terms of reference. Theoretically, they could be enlarged, but practically this would be extremely difficult, since the I.O.C. has no budget of its own and is dependent on several international

organisations, first of all on its mother organisation, i.e. — UNESCO, but recently also, to an increasing extent, on FAO, WMO, etc. The speaker further stressed the complexity of the problem of governing a new agency. He felt that it should be governed by a small board, with each member of the board representing a group of states, e.g. according to the following scheme:

one member -	from	African States
„	„	„ Asian States
„	„	„ South American States
„	„	„ the U.S.S.R.
„	„	„ Europe
„	„	„ the U.S., Australia, Canada, Japan, New Zealand.

The speaker thinks that the decisions of the board should be unanimous.

Another participant suggested that the functions of a new agency should not be the same in all parts of hydrospace to which different regimes apply. With respect to the territorial waters, the agency would exercise only general advisory functions at the request of governments; with respect to the high seas it would exercise functions already being performed by different specialised agencies of the United Nations — perhaps with one additional function, i.e. that of harmonising divergent state interests. But with respect to the sea-bed beyond the limits of national jurisdiction the agency must have not only the power to register claims but also the powers to allocate rights, to take care of the general management and conservation of the resources, and of redistribution of the revenue derived from the exploitation.

The speaker said that balance of forces within the administration of an international machinery should be secured. He suggested the following representation of interests:

45 % - representing the interests of the advanced coastal states;

45 % representing other coastal states;
10 % - representing the landlocked countries.

He felt that no decision of an agency with executive power should be taken without concurrence of at least two of these groups.

An international lawyer supported the idea that the terms of reference of a new agency should be fairly global, since much more has to be done in the high seas than on the sea-bed beyond the limits of national jurisdiction. However, the organisation should not be over ambitious. He also supported the idea that the executive body of such an agency should be fairly small, but he could not support the idea that the members of the board should be government representatives.

Nor would he support the concept of a tripartite representation of group interests. He would rather see government representatives sitting in a kind of a general conference of an agency, with a rational distribution of votes. However, members of the board should be selected in their individual capacity like judges of the International Court of Justice. The speaker stressed the importance of avoiding political issues and political difficulties which have been preventing the United Nations organs from acting effectively. The agency should be confronted with mainly technical tasks involving the administration by people who are experts — and not by lawyers or politicians. He believed that under these conditions all states would be interested in having an effective agency, and there would be no need to minimise its role.

Another international lawyer raised the question of what would happen if an international regime for the sea-bed and an appropriate international agency are not acceded to by all states. He was preoccupied by a danger that a country staying outside the system may challenge its viability — e.g. by issuing licence for the same place for which an agency issued a licence to somebody else. According to the speaker, two questions arise in this connection:

— what guarantee may be obtained for such case by an operating company ?

— what executive or police powers for such cases would the contemplated agency possess ?

The speaker was afraid that states might be unwilling to rely on an international agency if no satisfactory answer to these questions is found.

The previous speaker remarked in this connection that if major maritime powers, like the U.S. or the U.S.S.R. stay outside the system, there will be simply no international regime at all. If a tiny state stays outside it, this will hardly jeopardise the effective operation of the regime. He believed that an international agency may be so devised as to make it attractive also to great maritime powers.

Another participant remarked that if a country staying outside the system presents a conflicting claim, the situation would not be worse than in the case of presenting such a claim without an international system. There is no remedy, in this particular respect, in turning from the idea of an international agency to something else. The speaker felt that if a conflicting claim is made, it would be fairly reasonable to expect that matters could be settled by political means without a recourse to force. Such an expectation is based on international practice in similar situations. Naturally, the effectiveness of political means would depend on the composition of membership of an agency and on the strength of its members.

According to another opinion, however, the question of non-adherence of some countries to a new system should not be disposed of so easily. The problem is not only that of adherence of major powers but also that of government control over its own national activities. In the law of the sea the problem of the flag of convenience already exists and has its troublesome consequences. The speaker believed that it would be most desirable to avoid the extension of flag-of-convenience practices to activities on the sea-bed.

An international lawyer noted that the proposed international agency should have power to collect charges from the licenses. These charges should not be so high as to discourage exploitation of the sea-bed resources, and a guarantee in this respect must be given in advance. At the same time, these charges should be high enough to provide for some dividend to the world community. The speaker would favour financing of the U.N. operations from these funds. He was aware, however, that this perhaps is a problem for some future time, since at present

major powers prefer not to provide the United Nations with an independent source of money for peacekeeping operations, and consider voluntary contributions as a kind of control means. The speaker suggested, however, that the funds thus collected should not be transferred directly to states but rather distributed through an appropriate development agency of the United Nations such as e.g. I.D.O., U.N.D.P., or the World Bank.

Another international lawyer felt that the process of strengthening an international machinery to deal with the peaceful uses of the sea-bed should develop along two or three lines rather than aim at a concentration of all functions within one new organisation. He noted that during the discussion a very strong case has been made for the establishment of a new organisation, and that there exist many patterns to choose from. An equally strong case was made for coordination of activities of different agencies to avoid duplications and gaps. He felt, however, that a less strong case was made as to the functions of a proposed new organisation, and that this question required much more precision. The speaker was not convinced that entrusting the new organisation with all the functions mentioned during the discussion is desirable or feasible. Probably, the main function of such an organisation would be to take up such new tasks connected with the new area of human activities which are not covered by any of the existing organisations. Insofar as the structuring of such an organisation is concerned, the speaker felt that one should not be absorbed too much by the concept of the weighted voting. The main problem is to ensure representation of different interests, and this may be done in many ways. He referred to the I.C.A.O. as an example of a differentiated organisational structure — some organs are of strictly political character while others are staffed by individual experts; organs dealing with different matters are differently composed so as to represent various group interests involved in particular matters. The speaker believed that, also in the case of a new agency for the sea-bed, every organ might be composed in a different way.

PART IV

THE MILITARY USES OF THE SEA-BED
AND THEIR REGIME

PRESENT REGIME OF THE MILITARY USES
OF THE SEA-BED;
POSSIBLE REGIMES TO BE ENVISAGED

BY

Dr. JURAJ ANDRASSY

Professor of International Law, University of Zagreb, Zagreb

The present generation of mankind is witnessing an unprecedented and rapidly progressing advance of man in hitherto inaccessible regions. Just as man is gaining ability to travel and communicate in outer space, technological progress permits man to explore and utilize submarine areas. He is, at a fast pace, becoming master of the depths of the sea and of the natural resources found at the bottom and its subsoil. Man may, in a not too distant future, use the sea-bed for different purposes, as transportation, communications, food production, harvesting of natural resources and, alas, for military purposes too. In the present paper we are concerned only with military uses of the sea-bed. There is no doubt that such uses are becoming possible in an ever increasing measure. The actual situation and outlook for such uses is a matter which is dealt with in another contribution to this Symposium.

There are different starting points to approach the problem of military uses of the floor of deep seas. The first one is to take as granted that the bottom of the high sea shares the legal status of the superjacent sea as is the case of the sea-bed and subsoil underlying internal waters and the territorial sea. The high sea being governed by the principle of the freedom of the sea, the same principle should be applicable to the sea-bed and the subsoil of the high sea. Thus, the sea-bed and the subsoil of the high sea cannot be appropriated by any State but, on the other side, it is open and free for the use by every State. Especially, with respect to military uses, such uses are free for all States, subject to specific rules regulating these

matters. In time of peace, States have been using the high sea also for the navigation of their naval units and even for naval exercises. They have been not considered as encroaching upon the freedom of the sea and have been not prohibited by international law. The practice of some great powers added to it the nuclear test explosions, either on the high sea or on isolated islands surrounded by the high sea. In both cases, large parts of the high sea were closed for navigation. Therefore, in recent times, such kinds of uses (naval exercises on a large scale, nuclear tests) have met some opposition as impairing other (peaceful) uses of the high sea and being contrary to the principle of the freedom of the sea.¹

Another approach may be made by starting from the fact that the bottom of the high sea beyond a certain depth has been absolutely inaccessible for human activities. Equally, the natural resources lying on the sea bottom have been out of reach for exploitation. So, in fact, the sea-bed of the high sea has not shared the international status of the high sea itself and it cannot be considered as being subject to the rules and principles of international law which have been formed through long custom for the high sea. The principle of the freedom of the seas is a concept of international customary law, introduced and developed by a long practice. No practice has been possible with respect to the uses of the sea-bed; therefore, the principle of the freedom of the sea and other rules of international law cannot be applied to the sea-bed without being eventually extended to it by a new practice. No custom could be developed with respect to any uses for the sea-bed, peaceful or military, since no human activity concerning the use of the sea-bed has been exercised or could be exercised. The only exception of laying cables and pipelines could in this respect be disregarded.

An argument in favour of that view may be found in the recent history of the rules governing the continental shelf. In the moment when the submarine areas adjacent to the coasts became accessible for human activity and exploitation, there

1. See, e.g., the opposite views expressed, on the one side, by Margolis, *The Hydrogen Bomb Experiments and Law*, *Yale Law Journal*, April 1955, and on the other side M.S. McDougal, *The Hydrogen Bomb Tests and International Law*, 49 *American Journal of International Law*, 1955, No. 3, pp. 356-361.

were no rules concerning these activities. A new set of rules had to be developed and they developed by subsequent practice; rules different from those governing the territorial sea on the one hand and the high seas on the other hand. In support of this view, we may quote opinions of noted authors as well as observations of governments, and the protracted discussions during the elaboration of the text which finally became the Geneva Convention on the Continental Shelf, 1958.

Another analogous situation has been envisaged in the beginning of space exploration. In Jenks' opinion, the space is *res extra commercium*. Its legal status and regime is considered as a legal *vacuum* to be filled by subsequent practice and international legislation at an appropriate time, using eventually analogies for certain questions and seeking new solutions for other questions.²

The inexistence of appropriate rules concerning the regime of the sea-bed of deep seas is proven also by the fact that extended discussions took place with respect to peaceful exploitation of the sea-bed. Various proposals have been made showing wide differences of opinion as to the starting point and the fundamental principles. By analogy, it is unacceptable to say that with respect to military uses the sea-bed of the high sea is simply governed by the principle of the freedom of the seas.

If we adopt that view, it appears that no rules of international customary law have been developed concerning the uses of the deep oceans's bed. There has been a legal *vacuum* so that it cannot be said that the principle of the freedom of the seas is applicable to the sea-bed or that it shall be applicable at the moment when man becomes able to stretch out his hand towards the wealth lying on the bottom of the sea or in its subsoil. In such a situation, the behaviour of the interested subjects in the first period may give life to a new customary rule which refers especially and exclusively to the sea-bed and its subsoil in the deep sea regions. This customary rule might be permissive of any action with respect to the uses of the sea-bed and to the utilization of natural resources; but it might

2. V.W. JENKS, *The Common Law of Mankind*, 1958, p. 390 et seq. See also: *Annuaire de l'Institut de droit international*, 1963, vol. I, p. 134.

also be prohibitive of individual action and proclaiming that the sea-bed and the wealth of submarine areas be considered as common property of the whole mankind and subject to a special regime which ought to be framed by custom or by formal international agreement. The delegate of Chile at the 23rd session of the United Nations General Assembly (Reyes Vicuna) affirmed that with respect to the sea-bed outside the limits of national jurisdiction there are no rules of international law and this is equally true for the exploitation of the riches lying on the bottom of this region. A legal regime for the said submarine areas and its natural resources must be built up in conformity with the United Nations resolution 2340 (XXII).³

Although in our opinion this second approach may be possible and has its merits, it seems that the discussions in various official and scientific meetings indicate the tendency to examine whether military uses of the sea-bed should be prohibited or not, and in which measure they should be prohibited or allowed. Moreover, major military powers have at least undertaken studies and elaborated projects for the installation of defensive (and probably also offensive) devices and weapons on the sea-bed outside the limits of their national jurisdiction. In this way, instead of stating that the sea-bed of deep seas is — from the beginning of its becoming accessible — barred for all military activities and installations, the debates turn around international arrangements aiming at a partial or total prohibition or at a limitation of something that is already considered as an acquired right. In this respect we witness the same pattern of development as that of some twenty years ago, when the nuclear weapons were not declared illicit by existing international law. Instead, there were and are continuing discussions around the modalities how to prohibit the use of that kind of weapon. Taking this way, it is supposed that States are free to use nuclear weapons according to international law. This situation is illustrated also by the fact that the question of military uses of the sea-bed has been referred to the Eighteen Nations Disarmament Committee in Geneva, instead of proposing the adoption of a declaration by

3. U.N., Gen. Ass. Off. Rec. 23rd Session, First Committee, 1601st meeting, November 6, 1968.

the United Nations General Assembly proclaiming that prohibition from the beginning.

So our conclusion is that mankind has missed the occasion to stop the entry of weapons and military installation into submarine areas. Instead, the diplomatic activity will be concerned with long negotiations on more or less partial disarmament, perhaps only step by step, of a region where armaments have not been installed. It may be regrettable, but this is now the real situation and therefore we must turn our attention to the different projects dealing with the problem of the military uses of the sea-bed outside the limits of national jurisdiction.

The last preceding words draw our attention to a preliminary question: where is the limit of national jurisdiction in this respect? The individual State's sovereignty stops at the outer limit of the territorial sea. But adjacent to that limit every State has "sovereign rights" with respect to the sea-bed and the subsoil of the continental shelf as defined in the Geneva Convention on the Continental Shelf, 1958. Although these rights are limited to the exploration and exploitation of natural resources, there is no doubt that some views are in favour of putting, in relation to our question, the limits of the national jurisdiction over the sea-bed and subsoil at the outer edge of the continental shelf (in the legal sense of that term). Having in mind that the definition laid down in article 1 of the said Geneva Convention allows a wide extension of submarine areas belonging to the respective littoral States as their continental shelf, there could be vast areas which would not come under the impact of a future agreement on disarmament of the sea-bed. On the other hand, just this last consideration brings us to the inverted question, that is to say, why to limit the prohibition of military uses to the areas outside the limits of national jurisdiction as now defined, and not to extend it to all submarine areas, even to those belonging to the territorial sea of individual States.

Another question is, whether it is justified to limit the prohibition to weapons or installations seated permanently or provisionally on the sea-bed or built in the sea-bed. So long as submarines are not banned, and submarines may also stay for a longer time on the sea-bed, why prohibit vehicles which are principally moving on the sea-bed or are stationing there.

And in this sense we may continue to question the justification of prohibiting any kind of weapon or installation and we may finish by excepting one kind of weapon or installation after the other.

And now, let us consider arguments insisting upon the question whether there is any use to prohibit submarine armaments and installations. It may be argued that from completing the armaments by submarine weapons and installations a new balance of armaments will arise, which is the best deterrent against war.⁴ Such a reasoning seems to be against the general trend of endeavours to limit and reduce armaments. Asserting that a new balance of armaments should be attained by ever increasing armaments would justify every step towards more and more perfect arms and in this way annihilate the very modest advance in disarmament negotiations and arrangements, and destroy any hope for further advance in the future.

There are also views taking into account the peaceful utilization of the sea-bed and its natural resources. In some, not very distant future, there will be different human activities, including exploitation of natural resources, their underwater storing and processing, underwater transport and even underwater dwelling of those engaged in various activities. All these activities will be of great, perhaps vital, importance to the States engaged therein. Therefore, every place of such activity would be a vulnerable target of attacks on the part of the enemy in case of war. Even threats of possible attack and damage could seriously impair such activities or prevent their initiating. Consequently, it is asserted, defensive military measures and installations should not be prohibited. This leads to the thorny question of distinguishing offensive and defensive weapons and installations, especially when taking into account that most weapons may be used both ways.

Turning now to the scope of the future agreements on limitation or prohibition of armaments and military installations on the sea-bed, we are facing the question of total or partial dis-

4. See, e.g., the Report of the Thirty-third American Assembly, May 2-5, 1968; *Uses of the Seas*, ch. I: "Until arms control measures become effective, the condition of reciprocal strategic deterrence must be accepted as available insurance against a disastrous general war" (p. 4).

armament, total or partial prohibition of military uses of the sea-bed. In this respect, we must decide what is meant by military uses. Further, we must decide what is the meaning or aim of total disarmament; or the scope of arrangements for partial disarmament: prohibition of offensive weapons? of weapons of mass destruction? nuclear weapons only? In this respect, we enter into a labyrinth of highly technical questions which will give rise to interminable proposals and counter-proposals, every party trying to find out a formula which would bring that party into a better position with regard to the opposite party. In this respect we have striking examples in the long protracted disarmament negotiations concerning classical and nuclear weapons.

The discussions on the problem of military uses of the seabed and their prohibition or limitation have until now brought some proposals in the *Ad Hoc* Committee to study the peaceful uses of the sea-bed and the ocean floor beyond the limits of national jurisdiction (hereinafter: *Ad Hoc* Committee), established by General Assembly resolution 2340 (XXII), and in the Eighteen-Nation Disarmament Committee (Eighteen Nation Committee). Of course, the two military super-powers have presented their proposals, and these proposals may serve as an example demonstrating the divergences of approach and opinion which will continue and develop in further discussions during the work of the Committee established by General Assembly resolution 2467 (XXIII), entrusted with the task to continue the work of the *Ad Hoc* Committee, and in the Eighteen Nation Committee.

The first proposal, made by the Soviet Union,⁵ calls upon all States to use the sea-bed *beyond the limits of the territorial waters* of coastal States exclusively for peaceful purposes and request the Eighteen-Nation Committee to consider as an urgent matter the question of prohibiting the use for military purposes of the sea-bed *beyond the limits of the territorial waters* (emphasis added).

The next proposal was made in the *Ad Hoc* Committee by the United States.⁶ After declaring the desire that workable

5. U.N., Gen. Ass., Off. Rec., *Ad Hoc* Committee ..., doc. A/AC.135/20,

6. *Ibid.*, doc. A/AC.135/24.

arms limitation measures be achieved that will enhance the peace and security of all nations and bring the world nearer to general and complete disarmament, the operative part of the proposed draft resolution requests the Eighteen Nation Committee to take up the question of arms limitation on the sea-bed with a view to define those factors vital to a workable, verifiable and effective international agreement which would prevent the use of this environment for *the emplacement of Weapons of mass destruction* (emphasis added).

The third proposal has been submitted by the United Republic of Tanzania in the form of amendments to the Soviet Union and United States proposals.⁷ The Tanzanian draft proposes to declare

“ that the sea-bed and the ocean floor and the subsoil thereof, underlying the high seas beyond present national jurisdiction, should not be used by any State or States for any military purposes whatsoever ”

and to request the Eighteen-Nation Committee

“ to consider, as a matter of urgency, the question of (a) banning the use of the sea-bed and ocean floor beyond the limits of national jurisdiction by nuclear submarines; (b) banning of military fortifications and missile bases on the sea-bed and ocean floor ”.

Comparing the three above mentioned proposals, we see that the two super-powers are in favour of exclusively peaceful uses of the sea-bed of the high seas, but they don't consider as a principle of existing international law that these areas are barred for military uses. The prohibition of military uses should be attained by negotiations in the frame of the general United Nations work on disarmament. On the contrary, Tanzania calls at least for a declaration of principle prohibiting the use of the sea-bed for military purposes. Nevertheless, Tanzania too recognizes the need to discuss the prohibition of individual kinds of arms by the special organ for disarmament questions urging in the first line the banning of nuclear submarines, military fortifications and missile bases on the ocean floor.

7. *Ibid.*, doc. doc. A/AC.125/26 and A/AC.135/27.

Thus, the choice between the two ways of approach exposed in our introductory remarks has been made. The international community is faced with the fact that the prohibition of military uses of the sea-bed ought to be negotiated and attained by international agreement. Here, the proposals of the two super-powers differ in two principal points. First, the Soviet proposal aims at a complete interdiction of all military uses, the United States limit the interdiction to arms of mass destruction. Second, the Soviet proposal wishes to extend the prohibition to all submarine areas underlying the high sea, so that the prohibited area would include the continental shelf region in which coastal States enjoy determined "sovereign rights". Both powers have maintained their views and proposals during the last meeting of the Eighteen Nation Committee (March-April 1969). In a letter, published as an official Committee document⁸ President Nixon reaffirms the wish that the sea-bed remains free from the nuclear arms race and advocates the negotiation of an international agreement that would prohibit the emplacement or fixing of nuclear weapons or other weapons of mass destruction on the sea-bed. On the other side, the Soviet Union has presented a draft treaty on prohibition of the use for military purposes of the sea-bed and the ocean floor and the subsoil thereof. Therein, the prohibited area is determined more precisely. It encompasses the sea-bed and subsoil beyond a twelve-mile maritime zone measured from the baselines as are used in defining the limits of the territorial waters. Thus, the Soviet proposal adheres to the rule of article 24 of the Geneva Convention on the Territorial Sea and disregards all claims to larger territorial waters. Free access to all installations and structures on the sea-bed should permit the verification of the fulfillment by States which have placed such objects thereon of the obligations assumed under this treaty⁹.

Although, by now, the principal task concerning sea-bed armaments is assigned to the Eighteen Nation Committee, we adhere to the opinion that the General Assembly should retain

8. Eighteen Nation Disarmament Committee, doc. ENDC/239, 18 March 1969.

In order to preserve the authenticity of the materials presented to the Symposium, the paper is not supplemented by an account of later developments - Ed.

9. *Ibid* doc. ENDC/240, 18 March 1969.

its leading role by giving general guiding lines and, especially, by proclaiming, as a principle, that the sea-bed of the high seas should remain free of all military installations and weapons.¹⁰ Further, the area to be covered by such a prohibition should be as large as possible. Although it would be difficult to reconcile certain opposite interests, the best solution would be to include into the prohibited area all submarine areas beyond a uniform limit corresponding to the breadth of the coastal waters as defined in article 24 of the Convention on the Territorial Sea, 1958 (12 miles).

Now, saying that all military installations and armaments on the sea-bed should be prohibited, it remains to determine what is meant by that term. We must take into account that manifold underwater activities will develop in the next two or three decades and that, sometimes, it will be difficult to distinguish between peaceful installations and such which, although peaceful in appearance or in fact, may serve military purposes. In order to avoid infringements and possible misunderstandings, a detailed definition should be elaborated, subject to revision in accordance with technological progress. A supervision or inspection scheme would be needed too.

The aim of all discussions and negotiations is to bring about an agreement concerning the prohibition or limitation of military uses of the floor of the high seas. Whether arrived at at once or by stages, which is more likely, this agreement will take the form of an international multilateral treaty. In this respect it is important to recall that it is absolutely necessary that in such an arrangement all major military powers must participate. This is a *conditio sine qua non*. Generally speaking, the United Nations give a good opportunity for discussion and agreement, but the absence of the Chinese representation in its organs is a very important stumbling block for even a modest success. This is true not only from the purely technical (military) point of view: an agreement on disarmament, even partial, is closely linked to the solution of some most important poli-

10. In the opinion of many delegations at the 23rd session of the General Assembly, the demilitarization problem cannot be dissociated from the whole question concerning the regime and the uses of the sea-bed. See, e.g., the declaration of the French delegate at the 1951st meeting of the Assembly's First Committee, 30 October 1968.

tical questions. And this reflection may give rise to doubts whether any agreement might be easily attained in the next future. Every delay brings new difficulties as there will undoubtedly be a quick progress in the possibilities of construction and installation of weapons and devices into submarine areas.

Finally, when once agreed upon, any arrangement on disarmament in submarine areas should be adopted not only by major powers, but also by minor littoral States. There may happen today lesser or bigger local wars which are fought under the protection or with the connivance of major powers. Thus, little or lesser littoral States might, if not bound by arrangements, proceed to military uses and installations which could, if needed, serve to some major powers.

A NOTE ON BRIDGING THE DIFFERING SOVIET
AND AMERICAN OBJECTIVES
OF SEA-BED DEMILITARIZATION *

BY

DONALD G. BRENNAN

*Expert on National Security Affairs, Hudson Institute,
Croton-on-Hudson, N.Y.*

I

Recent official U.S. discussions relating to arms control for the sea-bed have indicated that, "the United States is interested in working out an international agreement that would prohibit the emplacement on fixing of nuclear weapons of mass destruction on the seabed" (from President Nixon's letter to U.S. Negotiator Gerard Smith at the Eighteen-Nation Disarmament Committee)¹. On the other hand, the Soviets have proposed the elimination of all military uses of the sea-bed, not only the emplacement of nuclear or other weapons of mass destruction: "The use for military purposes of the sea-bed... shall be prohibited" (from the Soviet draft treaty).² The U.S. has rejected the Soviet proposal, apparently because of the importance to the U.S. and its allies of maintaining some bottom-mounted "listening" systems used for anti-submarine warfare (ASW) purposes (the Soviets themselves are less dependent on such systems).

* The paper is based on the situation which prevailed at the time of the Symposium, i.e. June 1969. In order to preserve the authenticity of the record of the Symposium, the paper has not been brought up to date so as to take into account the subsequent developments, in particular — the joint American-Soviet draft treaty submitted to the Eighteen Nation Disarmament Committee in Geneva in October 1969. — *Editor*.

1. Eighteen Nation Disarmament Committee, doc. ENDC/239, 18 March, 1969.

2. *Ibid.*, doc. ENDC/240, 18 March, 1969.

Now, there are in fact some considerations that, even in narrow terms, constitute a positive motivation of the U.S. to consider complete demilitarization of the sea-bed (I am speaking of national military systems, not necessarily of possible international systems that might be used for policing). These include, for example, eliminating possible competition over bottom mounted systems, and eliminating worries about surveillance of U.S. systems that might either disclose their capabilities or make them vulnerable to attack in time of war. Thus, while I am sympathetic to current Western concerns over the Soviet proposal, it seems to me worthwhile to consider whether circumstances might not evolve that would make complete national delimitarization of the sea-bed more attractive to the West.

I believe it is possible and indeed quite likely, that technological developments in prospects for coming years will substantially reduce U.S. interests in bottom-mounted ASW systems, and this fact may serve as a basis for a compromise position. The present note is intended to sketch the possible developments and considerations involved.

II

It is usual to separate the overall ASW problems into three missions:

- a)* Protecting targets on land against submarine-launched nuclear-armed missiles;
- b)* Protecting the naval fleet; and
- c)* Protecting the sea lanes for shipping.

Let us consider each of these missions.

Mission (a), in a suitable sense, may be easily disposed of. At the time of writing, it is not clear if the U.S. will choose to defend itself against nuclear attack. If it does not, then there is not much motive to single out submarine-launched missiles as a particular class to be defended against when no active defense against other types of attack is provided. (I am ignoring here a technical complication concerning bomber

bases which would not change the fundamental character of this argument). If the U.S. does decide to provide active defense against nuclear attack, then it is much more effective to do so by intercepting missiles with ballistic missile defense (or "ABM" as it is often called) than by attempting to destroy submarines.³ Thus, mission (a) (as a case for ASW) does not appear to have high priority now or in the future.

Missions (b) and (c) are at present of much greater importance. There are however, two technical developments in prospect that are likely to reduce this importance very substantially, though not eliminate it. These are fast surface ships and large nuclear-powered cargo aircraft. Let us consider these.

Within recent years, a number of ships have been developed — so far rather small ones — that, by one means or another, interpose a layer of air between the hull of the ship and the surrounding water. Some of the terms used for different types of ships of this general kind include "ground effect" or "surface effect" machines, and "captured air-bubble" ships. The layer of air (which must be maintained by blowers) effectively reduces the friction on the hull and makes possible much higher speeds for a given propulsion power plant. Speeds of the order of 100 knots are likely to be feasible by the end of the century in medium-size ships, say, up to a few thousand tons. There appears to be no prospect of making submarines go at 100 knots, and, other things being equal, a relatively slow submarine would have greatly reduced effectiveness against 100 knot surface ships. Therefore, to the extent that naval vessels and surface transport ships of the future can travel at high speeds, the threat from submarines will be much reduced.

I am told that there will likely be weight limits to fast surface-effect or air-bubble ships, so that, for example, battleships and heavy carriers are unlikely to travel much faster in the year 2000 than they do today. They may well, however, be much less important. If small fast light ships constitute the backbone of the navy, then it will not be an easy backbone to attack with submarines.

3. See, for example, D.G. Brennan, "The Case for Missile Defense", *Foreign Affairs*, April 1969. This article does not specifically compare ASW with missile defense, but the general effectiveness of the latter is indicated.

Bulk cargo may or may not be carried in such fast ships, but there is in any event another possibility. The next generation of large transport aircraft (beyond the C-5A) is almost certain to be both larger and nuclear powered. A relatively modest supply of such aircraft could supply the logistic needs of the European theater in the (hopefully remote) event of another major sustained war there. I expect that by the year 2000, freight rates of giant nuclear aircraft will be economically competitive with tramp freighters but in any event they will be low enough so that logistic support by air of a major war in a remote theater will be completely feasible. The fact that the aircraft will be nuclear-powered would free them from dependence on fuel. (Conventionally-fueled cargo aircraft of the present era, when used to ferry freight on long runs, requires surface shipment of an amount of fuel comparable to the cargo weight carried, simply to return the aircraft to its starting point).

This development, which I believe is virtually certain, will therefore free nations from wartime dependence on sea lanes, even if ships remain competitive for peacetime traffic. That is to say, mission (c) will be of vanishing importance. This, in turn, will reduce to some extent the importance of mission (b), since an important role for the fleet — but not the only one — is mission (c) itself.

In summary, then, mission (a) is of minor importance (as an *ASW mission*, not absolutely) now and in the future; mission (b) is important now but will decline as more elements of the fleet high-speed surface-effect ships and as the problem of protecting sea lanes diminishes in importance; and mission (c) is very important now but will be of vanishing importance as giant nuclear-powered transport aircraft become available (and fast surface ships may also make some contribution here). Because of these trends, I doubt if the U.S. would be willing to pay even the dollar cost of maintaining a bottom-mounted ASW listening system by the year 2000, at least as a thing in itself, quite apart from questions of international treaties to demilitarize the sea-bed (there may be navigational or other peaceful applications of such systems that would motivate their continuation).

III

This points the way to an obvious potential compromise of the U.S. and Soviet approaches. One might have a time-phased treaty that called for an immediate prohibition of the emplacement of nuclear weapons, and called for complete demilitarization of the sea-bed by the year 2000. Whether or not this compromise will prove acceptable to either government concerned, much less both of them, remains of course to be seen.

RES NULLIUS DE FACTO THE LIMITS OF TECHNOLOGY

BY

Dr. JOHN P. CRAVEN *

*Chief Scientist, Strategic Systems Project Office, Department of the Navy,
Washington, D.C.*

Introduction

Any projection of the developing uses of the deep sea and the sea bed and the appropriate legal relationships which ought to be implemented, to assure peaceful development, is fraught with uncertainty. Any projection of the developing military uses of the sea and the sea bed is fraught, not only with uncertainty, but with the prospect that many will regard such a projection as repugnant. Certainly, a citizen of any peace seeking nation would hope that the exploration and exploitation of the deep sea and the sea bed could proceed without the need for any but the most minimal military concomitants. Against this hope is the reality, indeed the necessity, for sovereign powers to maintain military or quasi-military forces to protect rights legitimately acquired by treaty or by customary law and to carry out duties associated with these rights.

If the resources of the sea and the sea bed are to be exploited, then extensive commercial activity in areas and regions not now covered by international convention or treaty can be expected. It would be difficult to conceive how such development could take place unless under the protection of some authority, whether it be municipal, multinational or international. Upon such authority will devolve the necessity of providing

1. The views presented in this paper are solely those of the author and a specific disclaimer is made as follows: These views do not represent the current views of the Executive Department of the United States and are in no wise to be construed as representing an official position of the United States Government.

military protection of the particular enterprise. It is within this generalized context that this paper addresses the future military uses and requirements of the deep sea and the sea bed. The potential military uses cited are by no means limited to those which might be considered by the United States, but are broadly-based in the most speculative manner to allow for contingencies which might develop as the result of activity by any maritime nation. In order to make this prediction, one must assess the nature of the technology associated with potential major developments in the use of the sea, the rights which must be acquired to permit such use, the possible competitions and conflicts associated with the acquisition and use of such rights and the modifications of international law which might be required to accommodate the development.

I. *Characteristics of Sea Systems*

In a previous paper, the writer summarized the change in characteristics of sea systems which will result from modern technology. It is essential to the thesis of this paper that these characteristics be restated.

Prior to the development of nuclear power, of saturation diving, of underwater habitations and deep submersibles, the single most important feature in commercial or military systems was the constraints imposed by the free surface. From a military and strategic standpoint, this tie to the free surface resulted in the following constraints and opportunities:

a) Under certain conditions of wind and sea state, the sea system becomes inoperative and in physical peril, even with the best technology or projected for the future.

b) Under moderate or modest sea conditions, it is not possible to make a landfall at an arbitrary portion of the coast for transfer of personnel or cargo.

c) The speed of transit of displacement forms is limited by power considerations both through the "velocity cubed" law and by wave drag.

d) The system is frequently and unavoidably visible in the optical and electro-magnetic spectrum.

e) Large volumes and tonnages can be easily accommodated, limited however by draft and size of harbor.

f) The systems are accessible to aircraft or airborne vehicles.

In the future, however, the cited technological developments will permit systems to be designed and developed which do not see the free surface except perhaps at terminal points even as aircraft are not required to make occasional contact with the ground except at designated and designed air terminals. Such a divorce from the free surface would result in the following constraints and opportunities:

a) Operations would be essentially independent of the conditions of wind and sea or overlying ice.

b) It will be possible under most sea conditions to make a transfer of personnel and cargo along arbitrary stretches of the coast.

c) The speed of transit will still be limited by power considerations but will be essentially free of wave drag.

d) Large volumes and tonnages will be accommodated, limited in general by structural and ballast considerations.

e) The systems are or will be nearly invisible in the optical and electromagnetic spectrums.

f) The systems are or will be inaccessible to aircraft and quite invulnerable to surveillance or attack from the air.

Marked changes in the characteristics of sea systems are not however limited to those which result solely from submergence. The development of techniques of dynamic stabilization, the development of techniques and materials for construction of ships of extremely large draft, the development of vertical helicopter-borne transfer techniques, the development of offshore platforms and the development of the large stable platform have or will modify the constraints on surface systems as follows:

a) System survivability (but not necessarily operability) assured to actuarial satisfaction in all expected sea states.

b) Transfers of specialized cargos can be made without use of a conventional port or harbor.

c) Speed or transit of airborne or quasi-airborne craft (hydrofoils surface effects machines) limited by dynamic stability or structure.

d) Extremely large volumes and tonnages will be accommodated, apparently limited only by construction capability.

The effects of the developing surface technology are already evident in the commercial deployment of container ships, of large ore and scrap carriers of up to 150,000 tons in displacement, in oil tankers of up to 312,000 tons in displacement and in construction of offshore ore conveyors. They are, however, but fore-runners of other commercial systems which will appear when they become economically competitive (including the amortization of development costs). It is however economic competitiveness which dictates the direction of development and the prediction of the economically limiting technical factors is essential to an estimate of the use of the sea. Four examples are chosen which highlight markedly different regimes of ocean exploration: the recovery of oil, the recovery of hard minerals, the extraction of dissolved minerals, and the "ranching" of fish.

2. Recovery of Oil - Rights and Duties

It is the conventional wisdom that the recovery of oil will be confined to the continental margins. This conclusion has been predicated on the abundance of oil already identified on the continental shelf and the extension of current surface drilling techniques. Serious questions about current technology are now being raised which relate to the survivability of platforms, their interference with navigation and their potential pollution of harbors and beaches. The technological feasibility of drilling from installations on the sea bed and in the deep ocean has been granted, but the economic penalty has been estimated as excessive. It is the opinion of the writer that these estimates have overlooked an essential physical feature of oil which may well prove decisive in making deep ocean recovery attractive: simply that the density of oil is less than water. Unlike the recovery of dense minerals, there is a potential energy gain

in recovery of oil in deep water. This energy is equal to the depth of water and the density difference between the crude and sea water. For example, a crude of specific gravity of 0.95 recovered from a depth of 15,000 feet would have a pressure in excess of atmospheric at the surface of approximately 300 lb./sq. inch. In the event that gas is the recovered mineral, the pressure would be greatly in excess of this value. With this positive energy gradient, the problem of oil extraction in the deep ocean becomes one of location and access. Should the oil be located in the vicinity of islands or near the shore, a further economic cost-benefit may accrue. At the present time, the geologic prospect for oil in the deep ocean is uncertain. Over the major portion of the ocean floor, the relatively thin sediments and the absence of extensive folding certainly suggest that oil will not be distributed in deep water on a world-wide basis. On the other hand, the thickest and most folded sediments are at the outer edges of the continental margins, in the inland seas and in the vicinity of continental rises. Oil-bearing cores have already been found in water of 15,000 foot depth in the Gulf of Mexico. There is every reason therefore to expect some oil in deep water in ocean areas not covered by the Treaty on the Continental Shelf or proposed modifications thereto.

When such use of the deep ocean takes place, the international community will be confronted with at least two major problems associated with oil which have given rise to conflict situations or potential conflict situations in the land environment. These are: competitive draw-down of oil from a common geologic structure, and pollution resulting from blowout or other inadvertent or negligent loss of control of the field. In the first instance, past experience has demonstrated that maximum resource withdrawal occurs when the entire geologic structure is regulated as a unit. Some international mechanism should therefore be provided to insure that each producing field is under control of a single entity and that protective and enforcement mechanisms and powers be provided to preserve such established right. Obviously the identification and location of these structures, requiring, as it does, the expenditure of capital ought to confer some priority in determining subsequent rights in the field. If many private, national or super-national entities are involved in such exploration, then some mechanism

for protecting exploratory information and prospecting results prior to the establishment of a claim will be necessary in order to prevent conflict in establishing first rights in a particular field. It is equally true that a continued right in a particular field ought to be subject to some exploitation test even as sovereignty over an island requires recurrent and quasi-continuous exercise of sovereign rights and duties.

The second problem of oil spill or inadvertent release of oil raises many, as yet unresolved, problems of liability. Military or quasi-military forces will be involved in actions to contain the spill. In this instance, the right of the frailer under customary admiralty law to determine for himself the nature of his distressed situation and to be free to take actions to limit his own liability is in conflict with the desire of the affected party to take positive action to minimize his own damage.

Since such positive action is best taken at the source of pollution and since containment action in general impedes or prohibits access to the source, a basic source of conflict between the owner of the pollution source and the possessor of containment units is liable to exist. Early development of international principles concerning relative rights and duties in such situations is required.

These sets of problems suggest that de facto islands of jurisdiction will be associated with each oil field in the deep ocean. The size of such domains can be estimated by noting that oil-bearing structures are generally found in areas of from two to five miles in extent along the major axis of the geological anomaly and somewhat less in the transverse direction. Some measure of the total possible area of the ocean which might be involved in oil recovery may be had if it is noted that to date the United States has leased six million acres of offshore lands for oil exploitation and it estimated that the United States will lease not more than three million acres per year for the next ten years. If we multiply this by an order of magnitude for world use in the next decade, then approximately 300,000 square miles is an optimistic estimate of the area of the ocean for which jurisdiction for the purposes of recovery of oil would be required. This is less than $\frac{1}{4}$ of 1% of the total ocean floor. The density of drilling rigs and platforms will in turn be a very small fraction of the oil field area. One

may therefore summarize the long range oil field problem as one of vesting jurisdiction in isolated areas of the ocean, of the ocean, of providing security forces to maintain rights associated with that jurisdiction and maintaining containment units to prevent the spread of accidental spills or blowouts.

3. *Recovery of Hard Minerals -- Rights and Duties*

The second example chosen is that of the recovery of hard minerals. Many factors suggest that such exploitation will not take place for several decades. The principal reasons now advanced are:

a) The adequacy, if not abundance, of these minerals on land and

b) that the chemical form in which they are found in the ocean is sufficiently unique that those efficient procedures now developed for the reduction of land-mined ores will be inapplicable. As a result, processes which may be, at least initially, costly will be required. Nevertheless, many nations do not possess native supplies of basic minerals and, if proximity and politics become overriding factors, then earlier development than now anticipated may result. In any event, a heavy penalty is paid by the potential energy deficit which must be supplied to transfer the minerals from the bottom to the surface. The energy required, for example, to move a quantity of ore from the bottom to the surface in 20,000 feet of water is roughly the same as that required to move the same quantity several thousand miles horizontally on the surface of the water in a conventional ore carrier. This penalty could be partly overcome by employing the culm as ballast for exchange of potential energy in some gravity lift process or by the more extreme expedient of processing in place on the ocean floor. In the first instance, economic feasibility will require that the recovery be near an island or coast line or in the alternative from a floating platform. The large stationary or quasi-stationary platform in the open ocean now appears technologically feasible in sizes which are limited in the main by construction techniques. If employed in hard mineral recovery and proces-

sing, these platforms will be markedly different from surface ships, as we now know them. As a consequence, current law of the sea will be anachronistic with respect to such installations. For example, they will, in general, be unable to respond to the rules of the road and, as such, will pose a hazard to navigation. If it is not a requirement of the enterprise that they maintain fixed position, economics will dictate that they minimize power by drifting with alternating currents in the ocean. The precise position on these platforms will therefore not be indicated on charts as are islands and fixed buoys.

If bottom installations are employed as alternatives to, or in conjunction with, surface platforms, a new era in the use of the sea will result. The concept of territoriality in the sense we now know it on the continents will be the de facto situation for such facilities. The possibility of commercially feasible installations should not be dismissed lightly. Low cost, albeit negatively buoyant, structures capable of withstanding extremely high pressures can, in principle, be fabricated with reinforced concrete. Granting the limited size of such structures, once a penetration is made into bedrock or below permeable overburden, conventional mining techniques are all that is required to enlarge the structure to whatever size is desired. Vertical lift barges for transfer of men and materials can be made from syntactic foam (glass microballoons in an epoxy resin) which provide buoyancy to counterbalance the otherwise negative buoyancy of the lift devices. With the addition of nuclear power or even conventional power drawing atmospheric oxygen from the surface, then the limited processing of ores within the sea bed and prior to elevation to the surface is possible.

This speculation is not to suggest that recovery of hard minerals will in fact be accomplished in this manner, but merely to indicate that at least one technique for circumventing the major economically-limiting aspects of ocean mining can be described. Whatever the complexity of the ultimate operation, be it simple dredging from the surface or some form of the expensive and sophisticated installation herein envisioned, its characteristic will be one in which large, relative immobile units be employed on the surface, large, unmanned units or

machinery will be employed on the bottom, and large areas of the bottom will be stripped of both organic and inorganic material and, in some instances, repaced by detritus.

The two potential conflict areas cited for oil and gas do not exist in the instance of hard minerals because of their immobility. It may be that the major problem will be the mutual hazard of interference with commercial shipping or fishing. (this latter may be most troublesome since one of the curious anomalies of structures emplaced on the sea bed is the resulting attraction of the fish population). As with the case of the oil rigs in the Gulf of Mexico, navigational roads through the field will have to be designated. In any event some areas in which normal surface traffic is excluded appears to be the most desirable relationship for mutual safety. In order to insure such exclusion, it will be necessary to go beyond the mere designation on an international chart, but it will undoubtedly be necessary to mark the area with appropriate buoys and conduct frequent patrols.

Unlike oil, the size of the area will not be related to any localized geologic anomaly — particularly if the nodules are the prime source — but will be related to production rate and proximity to plant and platform. Rough estimates suggest that that areas of ten miles by ten miles would be typical. As in the case of oil, the total area under development even if the hard mineral industry in manganese, nickel and copper were to shift to the sea (which it will not) will be small in comparison with the total area of the ocean.

4. *Recovery of Dissolved Salts – Rights and Duties*

The third example is one about which much has been written and in which little has been done — the recovery of minerals from the dissolved salts in the seas and its complementary resource, the recovery of fresh water from sea water. In fact, very few major brine recovery plants have been in operation and these have been confined to localities having the combined peculiar characteristics of available low-cost power, access to sea water of high-brine content and proximity to industrial processes which require the particular mineral. The existence

of even a few of these installations highlights an unusual property right which may be claimed in selected area of the ocean. In its narrowest terms it is the right to insist that the ocean waters which flow into a given area be undiminished in brine content, and in its broadest context it is the right to insist that the ocean waters which flow into a given area be essentially free from undesirable pollutants. This type of problem is best illustrated by an example. The economic viability of the bromine extraction plant at Freeport, Texas, is highly dependent on the brine content of the waters of the Gulf of Mexico in that local region. A few years ago, natural erosion and sedimentation threatened to divert a substantial portion of the lower Mississippi to the extent that its major discharge would have occurred significantly to the west of its current outlet to the Gulf. Had this diversion not been prevented by massive engineering efforts, the brine content of the waters in the vicinity of Freeport, Texas, would have been reduced well below that required for economical bromine extraction.

While such examples will undoubtedly be few and will occur only when major new canals, waterways or major climate control projects are initiated, their mere existence highlights a unique and, as yet, unexplored set of rights in the ocean which might well be called ocean riparian rights. As previously stated, this is the right to be secure in specified areas of the ocean from the intrusion of a man-made or man-induced pollutants. There are quite a number of pollutants whose envenomation is not immediately obvious which can affect commercial enterprise in the sea. Acoustically-induced shock signals entering a fishing area can produce fish kills. Acoustic signals can also interfere with sea bed prospecting, with acoustically operated ocean sensors and with navigation and communication devices. Indeed, because of its long range propagation characteristics, acoustical emanations may be one of the most serious forms of commercial interference. Biological and ecological pollution, through introduction of new species, elimination of species, change in nutrients, is another possibility. A small scale example of this phenomenon has occurred in the Great Lakes where industrial pollution resulted in the population explosion of alewives, a highly undesirable fish. This population has, in turn, been reduced by the introduction of Coho Salmon

into an area where they had not previously been located. It is obvious from this example that the control of trophic level over extensive marine regions is possible and that such controls may work to the benefit or detriment of other users of the sea within the affected area.

More local effects can result from thermal pollution, discharge of chemicals, net trawls, drag lines, cables and pipelines, wrecks and physical obstructions and the generation of surface and subsurface waves. Except for these local effects, current law of the sea places little liability or inhibition on the generation of these changes to the marine environment nor does it permit active redress on the part of the injured party. It is a prediction that selected uses of selected areas of the sea for extraction of minerals for spawning of fish, for the conduct of scientific exploration, for recreation, for meteorological measurement, etc. will require the assertion of such "riparian rights", or usufructs over clearly delineated regimes or defined masses of water and these rights will and must be accompanied by appropriate policing activities.

5. *Fish Ranching – Rights and Duties*

This type of problem may become particularly aggravated when and if world fishing and fishery concepts are substantially altered. The suggestion of such alteration is itself unsettling since international customs and conventions now comprise a substantial corpus of well developed international law. This body of law is however still predicated on the concept that fish are "animus ferae" and as such are the common property of all until reduced to captivity. Such a concept is becoming increasingly unique in the modern world's production of food, and is in the long run defeating to maximum yield, to hybridization and selective breeding, and to the encouragement of investment in modification of the ocean environment for improved productivity. It is increasingly apparent that fish "ranching" is technologically feasible. Fish such as the Salmon who return unerringly to the spawning ground have by this natural trait created a unique opportunity for selective breeding. The identification of the thermal boundary conditions

which act as unequivocal fish fences, permits, or will permit the continuous location and tracking of the herd. Fur bearing mammals, such as seals and otters, are also peculiarly adaptable to the ranching function. Here the use of a marker or brand might even be technologically feasible. Should the world community recognize even for selected species a property right in the herd then a situation, not dissimilar to that of cattle on the open range, will obtain. In that instance, the rancher maintained a transient jurisdiction over the cattle per se and the immediate area in which grazing was taking place. Similarly in fish ranching, the herd may in fact migrate over substantial areas of the ocean, but the desired control will be limited to the locale of the herd and its temporal environment, the spawning grounds and perhaps the major feeding areas during growth and maturation. The herding function will involve protection against poaching or rustling, as well as protection against predators and pollution. As previously indicated, this latter function is itself a potential source of conflict since one man's predator may be another man's herd and one man's pollutant may be another man's livelihood.

6. *Generalized Rights*

With these few examples in mind, a few generalizations about the future rights in the ocean which nations will desire as a result of commercial exploitation of the sea and bed can be assayed as follows:

1) Substantially all of the sea bed will remain de facto res nullius even if the maximum projection of exploitation is realized.

2) Substantially all of the ocean volume and ocean surface will and can remain free and open sea under current conventions on the freedom of the seas without unduly restricting commercial exploitation of the sea and the sea bed.

3) Zones of jurisdiction on the sea bed with rights akin to those of real property will however be required; these islands having dimensions as small as that of an oceanographic

monitoring station or as large as an oil field or mineral recovery zone.

4) Fixed zones of jurisdiction on the free surface or in the water column will be required having dimensions as small as a fixed oceanographic monitoring buoy or as large as a fixed platform with refinery or mineral recovery facilities and associated support.

5) Slowly moving zones of jurisdiction associated with quasi-stationary buoys or large quasi-stationary platforms will be required.

6) Transient zones of jurisdiction defined by the movement of "domesticated" marine livestock will be required.

7) Riparian rights in selected, fixed or transient zones of the ocean will be required to insure that the quality of ocean water entering the selected zone is undiminished or unchanged in its environmental character and quality.

Associated with these new rights will be appropriate enforcement mechanisms.

7. Military Forces

The outlines of the types of military forces which will thus be required to protect these rights can be implied from the conflicts which may arise and the temporal and spatial characteristics of the rights. It is immediately clear that forces will be at most quasi-military and in the nature of security and police forces. Surveillance and patrol will be primary requirements. Consequently a high reliance will be placed on surveillance networks such as buoys, on aircraft and on high-speed patrol craft. Units will be required which are capable of responding to and minimizing damage and disaster. It is not too early to note the characteristics of a few such units. For example, air transportable booms, pumps and other collection devices will be required to contain oil spills from an uncontrolled platform, well, pipeline, or in the vicinity of a distressed tanker; air transportable deep submersibles for rescue, reconnaissance and salvage work will be required whenever and wherever deep-manned installations are involved; air transportable decompression chambers and diver transfer units will be required

whenever and wherever substantial swimmer operations are required. In addition the more standard capabilities to intercept, divert or arrest ships and vehicles engaged in prohibited activities will also be required.

Of paramount importance will be the legal framework under which these forces will operate. Certainly the legal *de jure* structure ought to match the *de facto* rights which will develop insofar as such rights can be codified and are subject to negotiation and treaty. The current trend of proposed international law does not appear to be moving in this direction. Insofar as the sea bed is concerned, proposals have been made which look to the extension of the continental shelf treaty seaward to increasingly deeper depths of exploitation, to geologically defined continental shelves or to defined shelves and territorial seas at specific distances from the coast lines. The most prominent of these proposals, that of Ambassador Pardo of Malta, looks to the internationalization of resources of the entire sea bed beyond the continental shelf. Less sweeping recommendations appear in the report of the United States Marine Sciences Commission. This recommends a rather narrow construct of the continental shelf and the establishment of an additional intermediate zone beyond. However all of these proposals have in common that their recommendations resolve the status of a great deal of territory which will be in fact *res nullius* for many decades to come. This is not without its difficulty. Since sovereignty, limited sovereignty or even a limited form of jurisdiction will vest in a national or supernational entity an attendant obligation to monitor and control within the limits of authority is implied. Such extensive patrol may not be technologically feasible or at least may be a luxury which few societies can afford. In the analogous case of land territories, a simple overflight on a clear day may be all that is required to detect major trespass. But even on the surface of the sea a truly mobile unit is difficult to locate and once submerged, its detection, classification and localization is a challenge to man's most sophisticated and expensive technology. The existence of jurisdictions which cannot be technically enforced is an invitation to violation when there is a major disparity between the benefit accruing to the trespasser and the harm to the trespasser.

8. *Alternatives*

It is therefore suggested that a viable alternative is the establishment of islands, or zones of jurisdiction in a manner analogous to the establishment of jurisdiction of actual islands in the ocean. At least the following criteria ought to be met for international acceptance:

a) That the area be of limited size and associated with a declared use of the sea or sea bed.

b) That the jurisdiction be limited, timewise, to the life of the exploitation and that active utilization take place during the time of the claimed jurisdiction.

c) That the area under jurisdiction be capable of being patrolled and that, in fact, is patrolled with a specified minimum frequency.

Under such a set of international rules or their equivalent, any "race for the ocean floor" would be automatically forestalled. Indeed, it is hard to conceive how any enterprise, be it private, municipal, multinational or international, would be impeded in its use of the sea or substantially denied access to any of the ocean resources for many decades to come. Nor is there anything to suggest in this arrangement that only the wealthy nations would be able to exploit the ocean, since cooperative and eleemosynary ventures on a national or international basis could clearly qualify for such a grant of jurisdiction.

In summary, the technology of the ocean in the foreseeable future is such that even with maximum exploitation of the ocean, the vast majority of the sea bed will remain *res nullius*. Current proposals for changing international law treat the sea bed as a homogeneous entity for purposes of defining various forms of limited sovereignty and jurisdiction. Such proposals will result in legal regimes which are at variance with the *de facto* use of the sea and the sea bed. A concept less at variance with this *de facto* use is that of vesting jurisdiction in clearly defined, fixed or transient areas of the ocean where an exploitability criteria is essential to the definition and a use criteria is essential to maintenance of jurisdiction.

THE MILITARY USES OF THE DEEP OCEAN FLOOR AND ITS SUBSOIL — PRESENT AND FUTURE

BY

Dr. JENS EVENSEN

Director, Legal Department, Royal Ministry of Foreign Affairs, Oslo

I. *Introduction*

1. This paper will be confined to an examination of the military uses to which the ocean floor and its subsoil have been put at present and to the foreseeable developments as to such uses. Legal and political references and evaluations will, consequently, be avoided to a possible extent.

No absolute distinction will be made between the deep ocean floor and the continental shelf, as the military uses to which they are put do not differ substantially. In the future one may perhaps foresee different developments for the two areas based on geological and practical differences. The legal political regimes, which may be established, may likewise lead to differences in military uses.

2. The use of the ocean floor and its subsoil for strategic purposes and, especially, the future uses thereof for such purposes add a new and dangerous dimension to modern strategy and to foreign politics.

Even the economic aspects relating to the exploitation of the vast natural resources of the deep ocean floor and its subsoil create new problems and pressures in the field of foreign politics. These aspects will of course have military implications, as the domination over the natural resources of the world have always had. The possibility of finding vast natural riches in the ocean floor might likewise increase the temptations and the pressures on the world powers to appropriate with sovereign rights the most promising area of the ocean floor, irrespective

of current world opinion. This might create new political and strategical situations, not unlike the scramble for colonial empires in the past, except that these new dangers for world peace and world stability would be many times as great.

These facts aside, inherent in the new strategic dimension is the danger of an escalation of the arms race to new vast areas of our globe, a development which in and of itself is highly undesirable and dangerous. For a shorter period of time the rearmament of the ocean floor might entail a brief advantage to one super-power and thus create a danger of a possible disturbance of the precarious balance of power between the super-powers with the ensuing grave threat to world peace. But the unilateral advantage of one of the powers would obviously be short-lived. It is naive to believe that there is such a technological gap between the super-powers or such flaws in their intelligence set-up that any temporary imbalance in the armaments race on the ocean floor would not be speedily remedied.

3. A balanced evaluation of the "blessings" of an armaments race on the ocean floor must necessarily lead to the conclusions that it would fail to produce any advantage to one of the power blocs for any substantial period of time; but on the contrary, represent vast unnecessary expenditures automatically spiralling the armaments costs up to unheard of levels and channeling the limited funds and resources of the world away from other more worthwhile purposes¹.

Other dangers and disadvantages are equally obvious. Strategic considerations would to an even greater degree than the economic motivations create pressures on the world powers to challenge the doctrine that the deep ocean floor and its subsoil are not open for appropriation by states.

Even without formal appropriation it is reasonable to expect that the military uses of a certain area of the ocean floor would take precedence over the peaceful uses thus creating difficulties for the economic exploitation of these areas. Although the areas to be used for such exclusive military purposes might be of limited size while the free areas of the ocean floor would

1. See i.a. *Towards a Better Use of the Ocean*, Stockholm, SIPRI, 1968, p. 125.

remain vast, it may perhaps be expected that the areas first to be taken for military uses might be those areas that would also offer themselves most easily to economic exploitation such as the mountain ranges and the mountain peaks of the oceans.

4. The use of the ocean floor and its subsoil for military purposes might likewise entail serious dangers for the traditional freedoms of the superjacent waters, navigation and fishing.

It has of course been maintained that one of the main advantages which the emplacement of arms or other military installations on or in the ocean floor has to offer is the cloak of secrecy with which such installations might be surrounded. Possibly this holds good for minor installations which can be constructed without major efforts in terms of work and equipment on the spot or rather on the surface.

In any event, military installations might prompt the owner state to fence off the superjacent seas from traditional use in order to protect and/or hide its military installations in the area.

Problems of frightening proportions would arise if nuclear armaments should be emplaced on or in the ocean floor. Aside from the increased danger of a nuclear holocaust in case of war, the emplacement of such weapons in the sea would always entail the danger of nuclear pollution of the world oceans with the ensuing dangers to the future existence of the human race. Such concern is not farfetched because experience has taught us time and again that although the technological achievements of man seem almost without bounds, they are at the same time burdened with flaws, unexpected weaknesses and errors that are at the same time frightening and human.

5. The importance which the great powers attach to the strategic possibilities of the ocean floor and its subsoil — including the continental shelves and the sea-bed of territorial waters — is demonstrated by the increased appropriations of funds for military oceanography and similar research. Such research is obviously not “exclusively for peaceful purposes”. On the other hand, research with such vast appropriations at its disposal may obviously contribute enormously to scientific and technological breakthroughs in relation to these areas of our

globe and might thereby contribute decisively to the peaceful economic exploration and exploitation thereof.²

The importance which the super-powers attach to the ocean environments with an increasing emphasis on the ocean floor and its subsoil has clearly and honestly been stressed in a number of official U.S. publications. Thus in a Report of the Panel on Oceanography, entitled "Effective Use of the Sea" — a White House publication — it is stated:

"Because of the possible increased emphasis in our strategic-defense capabilities in terms of the Navy's submarine-based missiles, and because this emphasis would only be well placed in the absence of any degradation of the submarines or of the enhancement of detection capability, the Navy must support a program which continuously explores all aspects of the ocean environment which conceivably could be exploited or utilized to allow continuous targeting of such submarines"³.

And the Panel sums up its views on the increasing strategic importance of the ocean floor in the following manner:

"In summary it is very possible that the kind of strategic offensive force we may wish to develop for the future will rely even more heavily on ocean-based systems than that which we now have. Such systems may very well require operations at a much wider range of ocean environment and for much longer times than at present. Thus, the need for oceanographic research and support of these weapon systems becomes even greater and will certainly have to encompass a wider problem area in development and maintenance of present submarine forces. These problems will range from ascertaining that the ocean-based systems cannot easily be compromised by an enemy's exploitation of some hitherto hidden effects of the ocean's environment to development of massive ocean engineering capabilities. It is likely that the Navy's involvement in oceanographic research to develop, support, and maintain our weapon systems will increase rather than decrease in the future and will include a more widespread range of problems than it currently does"⁴.

2. For this and other reasons the formulation used in the U.S.S.R. draft treaty of March 18, 1969, namely the prohibition of "the use for military purposes" of the ocean floor is preferable to a formulation reserving these areas "exclusively for peaceful purposes".

3. Effective Use of the Sea. Report of the Panel on Oceanography, President's Science Advisory Committee, Washington, G.P.O., June 1966, p. 32.

4. *Ibid.*, p. 33-34.

Though phrased in somewhat equivocal words, it is obvious that the essence of this statement is to recommend the use of the ocean floor and its subsoil for military purposes. This follows from the statement itself. It is equally obvious that an advisory panel in giving its recommendation to the president of one of the super-powers would shirk its duties if it failed to draw attention to the vast military potentials of the ocean floor. As long as convincing international agreements on disarmament of these areas have not been arrived at, the advisory panels and the military staffs of the world powers will more and more vehemently advise their respective governments to invest in these vast military potentials, whether the great majority of the peoples of the world disapprove of it or not.

6. Mr. Seymour Hersch gives the following figures from the U.S. budget showing the tremendously increased interest which the U.S. authorities pay to the military aspects of the ocean floor. In the early 1960's the appropriations of the Department of Defense for Oceanographic Research Programs were only a few million dollars. For the fiscal year 1966 the appropriations for such research had increased to some \$ 165 mill. In the fiscal year 1969 the U.S. will spend a total of some \$ 516 million for oceanographic programs. More than half of these appropriations — \$ 287 millions — will be spent by the Navy.⁵

We may safely assume that similar increases take place in the activities of the U.S.S.R., which has lately put enormous emphasis on strengthening and modernizing its navy, especially its submarine fleet. This necessarily entails an added emphasis on the possibilities of the ocean floor and its subsoil. The geographical position of the land territories of the U.S.S.R. would not detract from the strategic importance which that country will attach to the ocean floor, but obviously add to it. If the U.S.S.R. was sufficiently interested in placing nuclear weapons on Cuba, almost to risk the outbreak of a 3rd World War, it was not for the purely political reason to enhance the image of Cuba. The geographical advantage by having laun-

5. See Seymour Hersch, An Arms Race on the Sea Bed, " *War/Peace Report* ", August-September 1968, p. 8-9.

ching platforms in these southern regions also played a conspicuous role. Appropriate locations on the ocean floor might easily replace the possibilities which Cuba offered in this respect.

2. *Present Military Uses*

1. It follows from the very nature of the problems before us that it is difficult to ascertain fully and correctly to what extent the ocean floor and its subsoil have already been put to strategic uses. Equally difficult to ascertain is where to draw the line between military uses that are already a reality; uses that are in such an advanced stage of planning and construction that their existence may almost be considered a *fait accompli*; and future plans and dreams that may very well be realized in a not too distant future unless they may be avoided through the efforts of the governments of the world to reach agreement on disarmament of these regions.

In this context it should also be emphasized that the findings of the writer are based on published material only and on the conclusions which can reasonably be drawn from such material.⁶

2. It is an indisputable fact that the ocean floor and even its subsoil are to-day used to an increasing extent for military purposes. This is of course one of the reasons why the U.S. has proposed sea-bed arms controls that are conspicuously limited to the emplacement of fixed nuclear weapons or other weapons of mass destruction, or launching platforms for such weapons on or beneath the ocean floor. The U.S. has for the time being obviously seemed disinclined to accept a general prohibition of the "use for military purposes of the sea-bed and the ocean floor and the subsoil thereof".

In his report of March 1968 to the SIPRI Conference in Stockholm, professor Burke made an extremely interesting observation as to the importance of the strategic uses to which the

6. See i.a. the material mentioned in UN Doc. A/AC.135/28, 10 July, 1968, p. 1, note 1. Unfortunately, the writer does not know Russian. Therefore Russian texts have not been available to him.

ocean floor has been put. He maintained that the reasons why the great powers were able to reach an agreement on the non-military uses of the Antarctic (see the Antarctic Treaty of December 1, 1959) and on the non-military uses of the Moon and other celestial bodies (see Outer Space Treaty of January 27, 1964), were:

“because the major powers were not militarily involved in these regions and that the powers were heavily engaged in the use of the ocean, including the sea-bed for this purpose”⁷.

This explanation is perhaps somewhat too simple. But the reluctance of the world powers to meet the problems of the disarmament of the ocean floor and its subsoil openly and squarely indicates to what extent they already have vested interests in these areas. Or, as stated by Mr. Robert Baldwin, under-secretary of the Navy, in 1967 in connection with a Navy symposium on military oceanography:

“The plain truth is, of course, that modern oceanography is absolutely essential to national defense”⁸.

3. It is a well known fact that the ocean floor has for a long time been used for *peacetime installations* that in times of war may assume great strategic importance. The laying of telephone, telegraph cables and similar cables on the ocean floor is an established practice, a practice protected by customary international law as well as by international conventions. The advent of the telecommunication satellites have to some extent reduced the strategic importance of these peacetime installations although for many years to come they will render their invaluable service in the field of international communications in times of peace as in times of war.

It is unnecessary in this paper to devote more time to these traditional uses of the ocean floor, except in order to point out that these activities on the ocean floor have been accepted by customary rules of international law. It is equally important to point out that these uses do not entail any appropriation of the ocean floor by a national state, that these uses serve the

7. Towards a Better Use of the Ocean, *op. cit.*, p. 136.

8. Quoted after Hersch, *op. cit.*, p. 8.

international community as a whole, and that they are conceived and applied essentially for peaceful purposes.

The technical breakthrough has recently resulted in another group of peacetime installations on the ocean floor, namely those connected with the drilling for petroleum in marine areas. Up to now these activities have been confined to the sea-bed of territorial waters and to the continental shelves of a limited number of coastal states. But a tremendous development is foreseeable in this field in the near future, both with regard to waterdepths, distance from land and with regard to the importance of the finds made. The strategic importance of the ocean floor will of course increase proportionally. It should not be forgotten in this context that in recent wars the battle to occupy the oil-fields of the enemy was often a main strategic consideration.

In connection with the oil production at sea, petroleum technology has developed special techniques for the emplacement of petroleum installations on and in the ocean floor. The oil companies are able to accomplish well completions in water depths up to 200 meters. They have constructed underwater or surface production, storage and loading facilities that function well enough. They are able to lay pipelines and dig them into the ocean floor without too great difficulties. Some of the major oil companies have constructed mechanical robots and special types of diving bells etc. that are able to perform astonishing tasks of labor in considerable depths of water. Some of the oil companies have already advanced designs for underwater petroleum storage facilities excavated in the ocean floor.

The strategic importance of these peacetime activities is manifold. Aside from the strategic importance of petroleum and petroleum installations as such, it is obvious that the methods and techniques developed in connection with the petroleum activities at sea may be very useful and adaptable to the construction of purely military installations on, or beneath, the ocean floor.

4. Turning now to purely military installations on, or beneath, the ocean floor, mention must first be made of the traditional use of the ocean floor for the emplacement and anchoring of deep sea mines. Such mines are of course applied for

offensive as well as defensive purposes. Short of the arrival at an agreement on a total disarmament, it would hardly be realistic to assume that this kind of warfare will be abandoned in the foreseeable future. World War II led to numerous "refinements" in deep sea mining techniques which gave little or no consideration to the existing rules of international law concerning naval warfare.

The question of the application of deep sea mines in marine warfare has reached staggering proportions as a result of the possibility to use nuclear mines in the future. There is no doubt that such mines can easily be constructed if they are not already a strategic fait accompli. We can only hope that the world powers have sufficient common sense and self-restraint not to have installed such mines on the ocean floor already.

It is obvious that the installation of nuclear mines placed in strategical positions on the ocean floor could enter the armaments picture if the armaments race is let loose on the ocean floor. This possibility has inter alia been mentioned in U.N. Doc. A/AC. 135/28, p. 5. Such nuclear mines might be used for defensive as well as for offensive purposes. For defensive purposes the mines might possibly be of a limited size, also because they probably would be installed in the waters adjacent to the home country. Even so the danger of pollution would be ever-present.

On the other hand nuclear mines used for offensive purposes might by their very purpose be a much more dangerous weapon. Various theories have been advanced as to the possible use of such types of nuclear mines. Aside from the traditional task of destroying enemy ships it has been maintained that nuclear mines might be used for offensive purposes of terrifying proportions. Strategically located close to enemy shores, the detonation of vast nuclear mines might for example create enormous floodwaves. Such flood-wave attacks might be a paralyzing weapon if used against densely populated shorelines like the East coast shoreline of the United States or similarly densely populated shores in Western Europe or in Asia.

It must be hoped and even assumed that the possibilities of retaliation and the radiation dangers to which the use of such weapons would expose foes and friends alike, have prevented the installation of such mines on the ocean floor.

5. The advent of the nuclear age has also changed completely the strategic aspects of other types of traditional marine armaments. Especially the existence of nuclear powered and nuclear armed sub-marines have added new dimensions to marine warfare and warfare as a whole. Because of their capability to remain submerged for months at great water depths, these types of sub-marines have enhanced enormously the importance of concealed underwater military operations. It follows that the importance of the ocean floor for military purposes has increased vastly by this very fact.

The strategic advantages of nuclear-missiled sub-marines are many and obvious. The ocean affords maximum protection against detection and counter-attacks. The sub-marines are not stationary like land-based missile sites. Thus a surprise attack of the enemy would not be able to eliminate such submarines to the same extent as land-based missile sites. The distance to enemy targets is drastically reduced. In an article in *Time Magazine*, it is estimated that an attacking intercontinental missile from shore to shore would cover the distance Russia-New York or Chicago via the Arctic in some 30-45 minutes. A nuclear missile launched from a sub could cut this time to less than half with the vastly increased surprise momentum entailed therein⁹.

The reduced distance may also add to accuracy of hitting target. The reduced distance likewise increases the possibility of applying medium-range or short-range missiles thereby increasing the missile arsenal considerably.

U.S. sub-marines armed with the Polaris type nuclear warheads and similar types of U.S.S.R. sub-marines have become "a fundamental building block for strategic forces" as expressed in the previously mentioned Panel Report of 1966 to the U.S. President. And the Report continues:

"Indeed, a thought often expressed at the time was that ultimate nuclear stability would have both the U.S.S.R. and the United States equipped only with invulnerable Polaris forces and that neither side would have a ballistic missile defense for population centers. In that way the outcome of a nuclear exchange would be clear and unmistakable, and the possibility of a first nuclear strike even in critical times would be minimized"¹⁰.

9. *Time*, March 14, 1969, p. 22.

10. *Effective Use of the Sea*, *op. cit.*, p. 32.

The article in *Time* Magazine, mentioned earlier, informs us that 656 sub-marine borne offensive missiles of the Polaris type are deployed by 41 vessels. Three quarters of these Polaris missiles will be replaced by an improved version — the Poseidon missile — during the early 1970's. These new missiles will have so-called MIRV capability. The article contains the following frightening information about such missiles. They are:

“the newest thing in offensive missiles now under development by the U.S. ... The main innovation is that each missile will be able to carry several separate nuclear warheads — as many as ten in the sub-marine borne version ... Each warhead will be assigned to a different target. Thus MIRV would increase the nuclear punch severalfold without escalating the number of delivery missiles”¹¹.

As stated in the aforementioned 1966 Report to the U.S. President the effectiveness of a sub-marine based missile force is highly contingent on concealment dispersion, high mobility and very long patrol time.¹² These various factors create added interest to the application of the ocean floor and its sub-soil for strategic purposes.

It is a well known fact in this connection that the Polaris type sub-marines have the capability more or less to rest on the ocean floor for extended periods of time thus showing that they carry the embryo of other types of ocean floor launching platforms manned or unmanned. The above mentioned 1966 Report stresses some of the drawbacks of nuclear armed sub-marines in the following delicate manner:

“Moreover, a submarine-based missile force has some less-than-ideal characteristics. It is relatively expensive to operate compared to land-missile forces; and it is presently limited in warhead size. Consequently, the ocean-based missile force could conceivably take some totally new direction of development in the future which would hopefully combine many of the better characteristics of the land-based force: Less expensive, larger payloads; better command and control, with some of the characteristics of the submarine force; i.e., invulnerability. This does not imply that we will not also have an interest in developing missile-carrying

11. *Time*, March 14, 1969, p. 24.

12. *Effective Use of the Sea*, *loc. cit.*

submarines capable of operating at much greater depths than currently. Perhaps the ocean bottom would help conceal their presence and thereby make them even less susceptible to enemy counteraction”¹³.

In view of the heavy emphasis which the world powers have given to nuclear powered sub-marines with nuclear arms it must be considered a fact that short of total disarmament the chances are rather small that such nuclear weapons (and perhaps other similar types of mobile underwater launching devices as well) will be outlawed in the foreseeable future.

6. The appearance of the Polaris type sub-marines in the military arsenals of the world has had, as its side-effect, the emplacement of a new set of strategic installations on the ocean floor, namely the various types of tracking systems and other detection systems. Various installations serving as navigational or meteorological aids to sub-marines, as well as various counter measures against the detection systems, must obviously also be considered as established facts. These various systems and devices installed on the ocean floor were openly referred to during the debates in the U.N. Committees on the Peaceful Uses of the Sea-bed and the Ocean Floor¹⁴.

Though of first rate strategic importance, they may in and of themselves be considered rather innocent as far as military uses of the ocean floor are concerned, and some of them even useful for peaceful purposes. Their effects on the armaments race and the balance of power principle are not equally innocent. Thus, it has been maintained that a significant technological breakthrough which would develop a system of successful and continuous tracking of an opponent's sub-marine forces might have a considerably destabilizing effect on the power structure. Consequently, views have been voiced to the effect that the deep ocean floor should be declared “off limits” to detection and surveillance equipment. Or that, as part of a general regime of the deep ocean floor, detection and surveillance systems should be established or operated jointly

13. *Ibid.*, p. 33.

14. See also U.N. Doc. A/AC.135/26. For additional information see “*Hydrospace*”, March 1968, p. 16; *Effective Use of the Sea*, *op. cit.*, p. 31; *Towards the Better Use of the Ocean*, *op. cit.*, p. 114-116.

by the super-powers or by an international organ.¹⁵ Though idealistic and commendable, such proposals are hardly realistic. They seem to presuppose an atmosphere of conciliation and détente which does not reflect the present international situation.¹⁶

7. Finally mention must be made of one considerably less innocent use to which the ocean floor recently has been put by the military, namely the use thereof as testing grounds for nuclear weapons. It is well known that such nuclear tests have been undertaken by the U.S.A., the United Kingdom, the Soviet Union and France. The risk that other fledgling nuclear powers will do the same, is obvious.

The dangers inherent in such weaponry tests are evident and led the nations of the world to include in Article 1 of the Nuclear Test Ban Treaty of August 15, 1963, prohibitions to the effect that "no nuclear tests explosion or any other nuclear explosion" must take place "under water including territorial waters or high seas". The impact of these provisions is that the testing of nuclear weapons is forbidden on the ocean floor. It is perhaps more uncertain whether this prohibition also applies to underground explosion beneath the ocean floor. In the writer's opinion Article 1 of the Nuclear Test Ban Treaty should be interpreted in this manner. Such underground explosions should be considered unlawful both because of the wording of the article itself and because of the inherent danger pollution of the oceans if another interpretation is adopted.

Although a large number of states are parties to the Test Ban Treaty it should be noted that important exceptions exist. As examples, may be mentioned France and Communist China who both have refused to accede to the treaty and have even expressed a certain determination to continue such tests.

It follows, unfortunately, that use of the ocean and the ocean floor as testing grounds for nuclear weapons may still be considered very much a reality.

15. I.a. Towards the Better Use of the Ocean, *loc. cit.*x

16. A recent assessment of various surveillance devices has been made in Marine Science Affairs. Third report of the U.S. President to the Congress, Washington, G.P.O., January 1969, p. 85.

3. *Future Military Uses*

1. The future use of the deep ocean floor is almost limitless in view of the technical revolution of our times. Enormous as it is, this revolution is only in its infancy as far as the ocean floor is concerned. If not reasonably controlled and properly channelled, the future uses of the ocean floor may to a terrifying degree be of a military nature.

It is reasonable to assume that such development would start with the territorial water areas and the continental shelf areas of the ocean floor and its continuation into the continental slopes. Other areas that even today or at least in the very near future will lend themselves to such uses are the so-called mountain ranges and mountain peaks of the oceans. How the Mid Atlantic Ridge — a mountain range extending from the Antarctic to the Arctic — divides the Atlantic in two and likewise how mountain peaks are strategically located throughout the Atlantic is illustrated, *inter alia*, by the map "The Atlantic Ocean Floor", published by the "National Geographic Magazine", June 1968.

Similar formations are found in the Pacific. Suffice it here to refer to the previously mentioned article by Mr. Seymour Hersch where he refers to the following information contained in a Naval Institute publication.

In the Pacific, the extensive chains of sea mounts divide the Pacific Ocean into a significant number of basins which are now identifiable by the sea mounts which constitute Wake, Guam, the New Hebrides, the Fijis, the Gilberts, the Marshalls, the Ryukyus, the Kuriles etc. Even now, these islands are important elements in the strategic outer periphery of the Asian land mass. The occupation and utilization of the undersea portion of these strategic barriers will make even more effective the utilization of the outer islands as a commercial, political, and military balance to the mainland ¹⁷.

2. The military uses to which the ocean floor and its subsoil may be put even within a reasonably foreseeable future are so staggering that a discussion thereof easily lends itself to the criticism that it is a piece of science fiction.

17. Hersch, *op. cit.*, p. 22.

But in the 1966 report of the Panel of Oceanography previously cited, the following realistic assessment has been made:

(3) Employment of bottom-mounted installations and equipment (see secs. 4, 5).

Implementation of the national ocean program envisaged by the Panel requires use of the ocean bottom for positioning instrumentation and equipment for a variety of purposes, including emplacement of laboratories and test stations. Potential international legal problems involved in these operations appear to depend on precise locations employed, various characteristics of the equipment or installation and the specific assertion of national authority demanded over the area concerned. If equipment or installations (manned or unmanned) are to be emplaced within the ocean territory of other nations, including in this context the Continental Shelf, problems of the type already discussed under (1) above may be expected, as well as others¹⁸.

Actually U.S. oceanographic research has *inter alia*, proceeded along these lines. That U.S.S.R. efforts are not lagging too far behind must be assumed.

Easily available data inform us about some interesting recent developments in the U.S.A. in this sector. One aspect of the research efforts concentrates on developing deep submergence systems whereby human beings can live and work; perhaps even enjoy recreational facilities under heavy sea pressures. The sea-laboratory (Sea-Lab) project, *inter alia*, has as its object to extend man's capacity to live and perform work at great water depths up to almost 100 feet by 1972.¹⁹

One of the latest developments in this field is the Sea-Lab III which has reached its operational stage, although according to newspaper reports it showed certain minor constructional weaknesses during recent tests.

Another project described in the said second U.S. Report of the President is the "Deep Ocean Engineering Vehicle Project". The purpose is

to provide a research submersible which combines the long endurance of a nuclear power plant with the control and instrumentation

18. Effective Use of the Sea, *op. cit.*, p. 93.

19. See i.a. Marine Science Affairs — A Year of Plans and Progress. Second Report of the President to the U.S. Congress, Washington, G.P.O., March 1968 p. 92 ff. and the Third Report of the President, p. 86 ff.

developed for the DSRV (Deep Submergence Rescue Vehicles) rescue submersible ²⁰.

This mobile deep sea laboratory will carry a crew of 5 plus 2 observers and will be capable of operating at great range and water depths ²¹.

Another recent development in research vehicles with obvious strategic implications are the launchings in December 1968 of the two small research submersibles Autec I and Autec II. They are being built to operate at water depths up to 6500 feet ²².

Recent news on underwater research projects seem also to confirm that at least the U.S.A. may have developed a vehicle which may move around on the ocean floor proper on wheels or bands. In addition to their research capabilities such vehicles may be a first step in a new direction with regard to mobile nuclear weapons platforms ²³.

It is self-evident that the U.S.S.R. carry on similar researches and have similar devices at its disposal. The review "Hydrospace" ²⁴ contains for example descriptions of a new Russian research submersible, the AMS 200, a deep sea self-propelled "laboratory" with accommodation for two observers. It is able to operate at water depths up to 450 meters. A new underwater laboratory, the Sadbo 2, is also described in the article.

3. With these and other devices at their disposal the superpowers are at least capable of putting the ocean floor and its subsoil to a variety of new strategic uses.

Even with today's technology it is possible to construct supply depots for submarines or surface vessels in the more shallow areas of the ocean floor. It is for example already within our reach to establish fuel depots and similar types of depots on the ocean floor up to depths of about 5-600 meters. This might be of special importance for the Polaris type submarines.

20. *Ibid.*, p. 96.

21. *Ibid.*, p. 88.

22. *I.a.*, Marine Science Affairs. Second Report, March 1968, p. 154. Also "Under Sea Technology", January 1969, p. 31.

23. *I.a.*, U.N. Doc. A/AC.135/28, July 10, 1968, p. 5.

24. "Hydrospace", March 1968, p. 43-44.

It is likewise highly conceivable that the super-powers in the near future will be able to construct supply depots of a general nature for their nuclear power sub-marines in distant areas of the main oceans and even create underwater recreational centers for their sub-marine crews operating such sub-marines. Such installations might take the form of emplacements on the ocean floor, but they might also be excavated into the ground. Interesting information to this effect is found inter alia in an article by Dr. Carl Austin of the U.S. Naval Weapons Center, Cal.

He states:

The building of communities for oceanographic research ... is now within our grasp. Someday, and not a too distant day at that, we will see men and their families living and working beneath the oceans. The tools and technology exist today ²⁵.

Such installations could increase immensely the operational efficacy of nuclear sub-marines especially those operating far from their home base. It has also been alleged that such ocean floor depots and facilities would add to the secrecy with which these sub-marines could operate ²⁶.

4. More dangerous are the prospects of having nuclear weapons emplaced on permanent or semi-permanent launching platforms or sites on, or beneath, the ocean floor. That such speculations are not farfetched, is demonstrated by the frankness and frequency with which such plans are discussed even in official documents. In the previously mentioned 1966 Report by the Panel on Oceanography, the following development is described:

Such developments may, for example, take the form of missiles of Polaris' size or even considerably larger placed on relatively shallow underwater barge systems on the Continental Shelf in a way which conceals their location and requires the system to move infrequently so that the potential of its being tracked by motion-generated noise is minimized. In addition one might consider a slightly mobile ocean-bottom system which

25. CARL AUSTIN, Rock Site in a Way into the Sea, "Sea Frontiers", November-December 1967, Quoted after Hersch, *op. cit.* p. 21-22.

26. U.N. Doc. A/AC.135/28, July, 10 1968, p. 6.

creeps along. Systems of this kind, if they are ever to be realized, will require different kinds of marine engineering research from that which produced the current submarine-based force. Such systems can involve much larger missiles, might require underwater maintenance by personnel also located underwater, might entail development of new kinds of emplacement gear for positioning missiles, might necessitate new kinds of detection and survival equipment to prevent attacks on the placements, and so on²⁷.

The construction of underwater sites excavated into the ocean floor in strategically situated underwater mountain peaks is also a distinct possibility and have perhaps even reached advanced stages of preparation. Dr. Austin in the aforementioned article gives details as to the advanced stage of planning of such missile sites excavated in the subfloor rock.²⁸ Dr. Robert Frosch, U.S. Ass. Secretary of the Navy stated in a paper on military uses of the sea that:

Future design on sea based deterrents following Polaris/Poseidon may take many forms. Underwater silos, for example, are a possibility²⁹.

5. From one point of view such installations might offer various strategic advantages.

In terms of economics sea-bed missiles might be less expensive to produce and maintain than missile-carrying sub-marines. They might of course be capable of storing any number of missiles and missiles with larger payloads. As compared to land based sites such underwater installations might be considerably less vulnerable to nuclear attacks. The shock effects of a nuclear explosion would be less because of the protective mantle of the ocean itself. It might likewise be easier to keep the exact position of an underwater missile site a secret than similar sites on land.

Another alleged advantage is that nuclear missile sites in densely populated areas like for example the East Coast of the U.S.A. in times of peace as in times of war expose the sur-

27. Effective Use of the Sea, *op. cit.* p. 33.

28. See note 23. Also "Ocean Science News", vol. 10., No. 3, January 19, 1968, p. 1-2.

29. Frosch, Military Uses of the Ocean; in: *Papers presented at the Second Conference on Law, Organisation and Security in the Use of the Ocean*, Columbus, Ohio State University, Press, 1967, p. 4.

roundings to obvious dangers. Such dangers might to some extent be reduced by moving the missile sites out to a comfortable distance at sea. This argumentation figured prominently in the discussions which the proposed construction of anti-ballistic missile sites i.a. in the Boston area recently created in America newspapers.³⁰

It is equally obvious that compared to land based sites underwater missile installations might move the line of attack and defense much closer to enemy territory. This might increase fundamentally the surprise momentum of atomic attacks and might likewise theoretically make an atomic defense shield installed on the ocean floor close to the shores of the enemy, more effective.

By moving the missile sites closer to enemy territory by using underwater installations the arsenal of atomic missiles might also be vastly increased as medium range and short-range missiles could be used to a wider extent for offensive and defensive purposes.³¹

From a defense point of view it has also been alleged that the possibility of intercepting nuclear missiles over the ocean would be preferable to such interception over heavily populated areas where the nuclear detris from the destroyed attacking missile might create almost as much havoc as a direct hit by the nuclear warhead itself.

In general, the use of the ocean floor for missile sites might enlarge and even totally change the geographical aspects of an atomic war. With the whole ocean at one's disposal the installation of missile sites would not be confined to the given land areas of a country. With the ocean floor at their disposal the power blocs might — almost without geographical limitation — surround each other with missile sites for offensive as well as defensive purposes.

30. See, *i.a.*, U.N. Doc. A/AC.135/38, July 10, 1968, p. 4-5.

31. *Ibid.*, p. 5. Also Hersch, *op. cit.*, p. 4.

4. *The proposals by U.S.S.R. and the U.S.A.
as to future military uses of the ocean floor and its subsoil*

1. It seems to follow from the foregoing and from other urgent considerations as well that any extensive re-armament of the ocean floor, and especially the installation of nuclear arms thereon, must be avoided. It is untenable to assume that such re-armaments would create any additional safety for one or the other of the power blocs — let alone for the world — for any length of time. On the contrary the obvious result would be a frantic escalation of the armaments race leaving none of the world powers any safer and the world as a whole more exposed and insecure. The two super-powers seem to have accepted these facts although they may already have serious vested interests in these areas.

2. The two draft proposals namely the U.S.S.R. "Draft Treaty on Prohibition of the Use for Military Purposes of the Sea Bed, the Ocean Floor and the Subsoil thereof" presented in March 1969 and the American "Draft Sea Bed Arms Control Treaty" presented 1969 and the American "Draft Sea Bed Arms Control Treaty" presented to the 18-Power Conference in May 1969 throw some light on the possible uses for military purpose of the ocean floor and its subsoil that would be permitted in the future. It is outside the scope of this paper to enter into any detail on this point. It should, however, be noted that there is a distinct difference in approach between the two proposals.

3. Article 1, par. 1 of the U.S.S.R. proposal seems to contain an absolute prohibition of any military uses of the sea-bed, ocean floor and the subsoil thereof outside the territorial waters of a coastal state limited to 12 nautical miles. It applies the term "use for military purposes" which is rather broad and not altogether clear. It seems to comprise military bases and installation of any nature — including surveillance, tracking and detection devices — but also any type of military manoeuvres or activities on the ocean floor or its subsoil. Whether it also is meant to comprise scientific research for military purposes or with military equipment is not clear. Nor does

it seem clear whether the article intends to prohibit the temporary stationing of sub-marines on the ocean floor. As a whole the proposal must perhaps be considered somewhat unrealistic in the present circumstances.

The second paragraph of Article 1 expressly prohibits certain types of military uses such as "objects with nuclear weapons", "other types of weapons of mass destruction", the construction of "military bases, structures, installations, fortifications and other objects of a military nature". This second paragraph of Article 1 does not make the meaning of Article 1, par. 1 any clearer.

Whatever be the exact contents of Article 1 of the Soviet proposal, the express purpose has been stated to be to prevent as much as possible military uses of the ocean floor and its subsoil in the future.

4. The American Draft Treaty put forward in May of this year, is a follow up of the U.S. draft resolution presented in 1968 to the Ad Hoc Sea-bed and Ocean Floor Committee. This draft recommendation urged the conclusion of a verifiable and effective agreement that would prevent the emplacement of weapons of mass destruction on the ocean floor.³²

The Draft Treaty is rather restricted in its scope. First it is limited to prohibition of the emplacement of nuclear weapons and other mass weapons only. It is further restricted to "fixed" installations of such weapons. This draft would leave states with wide possibilities to use the ocean floor and its subsoil for military purposes in the future. It would also permit the use of nuclear armed sub-marines. The reference to "fixed" installations makes the interpretation of draft Article 1 rather difficult. This reservation might make the prohibitions in Article 1 almost meaningless if the term "fixed" was taken in a narrow sense of the word. Would for example a launching platform of the Sea Lab III type which is construed to be easily removable be considered a "fixed" installation? Or a contrap-

32. See U.N., Gen. Ass., Off. Rec. Twenty-third session, Report of the *Ad Hoc* Committee to Study the Peaceful Uses of the Sea-Bed and the Ocean Floor Beyond the Limits of National Jurisdiction (doc. A/7230), New York, September 1968, p. 54.

tion that could move, although with difficulty, on the ocean floor by its own means?

5. It would be highly premature and even impossible to draw any conclusions from these two purely preparatory Draft Treaties as to what military uses of the ocean floor would be lawful in the future.

The fact that both super-powers have submitted Draft Treaties as to restrictive rules of law, seem to indicate that in the future the ocean floor and its subsoil will not be left open for an armaments race, but will hopefully restrict to a considerable degree the military uses to which the ocean floor may be put.

SUMMARY OF DISCUSSION

WORKING GROUP I

Possible Military Uses of the Sea-Bed.

One of the rapporteurs pointed out that at present one may speak of only two possible uses of the sea-bed for military purposes, i.e.:

- implanting anti-submarine weapons systems as e.g. anchored mines;
- implanting underwater surveillance systems.

Possible future military uses would depend on the regime of the sea-bed which may be established. If it is based on the principle of national appropriation, the question of defense of these areas will arise, similarly as in the case of other parts of national territory. This would include, first of all, control of access in a way analogous to the air access zones. In the longer run one may envisage broader projection of military power of states to the sea-bed, including storage of nuclear weapons and extension of the "Polaris technique" to the sea-bed. These bottom-based nuclear systems might be used against surface targets and their use in anti-submarine warfare as well as against other undersea installations would be also quite likely.

Likewise, non-nuclear weapons such as torpedo-like weapons might be used against undersea targets; however, use of this type of weapon against surface targets is not conceivable.

One may also envisage development of various kinds of surveillance of navigation systems. These, however, may have peaceful as well as military applications. Drawing a dividing line between these two possible applications may create difficulties in negotiating a future treaty.

An international lawyer drew attention to the fact that besides difficulties in drawing a dividing line between peaceful and military applications of some devices, there exists a confusion about peacetime and wartime uses. He asked for a clarification which military uses pertain only to wartime and which ones only to peacetime, or to both.

In reply to this question it was pointed out that e.g. deployment of nuclear mines is quite unlikely in peacetime. Also deployment of nuclear-weapons systems directed against surface targets is unlikely in peacetime; however, it is not impossible at all — if denuclearisation of the sea-bed is not achieved. The speaker added that while discussing possible military uses of the sea-bed one usually thinks in terms of peacetime. Among the military uses of the sea-bed which pertain mainly to peacetime, the deployment of listening underwater devices should be mentioned first of all. Their main mission is to protect shipping, and for technical reasons they must be deployed in the period of peace since this requires time which may be lacking if war has already broken out.

With reference to one of the papers presented to the Symposium a question was raised whether it would be correct to forecast the decline of sub-marines with the development of very high-speed surface units. An opinion was expressed that in some areas of inevitably high concentration of traffic, as straits and areas close to the ports, the density of traffic reduces the advantages of high speed and makes such high-speed surface units vulnerable to attack by submarines.

This view was shared by another participant who added that sub-marines are not chasing ships and may just wait for targets in suitable places. Moreover, quick torpedoes may compensate the difference of speed between sub-marines and future high-speed surface units.

One of the rapporteurs said that insofar as the concentration of sea-going traffic in the port areas is concerned, any possible future regime of the sea-bed would not introduce any new element. These areas are within national jurisdiction and the problem of their protection is always there, whatever the regime of the sea-bed beyond the limits of national jurisdiction and whatever the technical characteristics of the future vessels. He also did not think that passage through straits raises any

particular problem. However, he stressed that he did not mean that the effectiveness of submarines will be reduced in the future completely — to the zero point.

*Present Military Regime of the Sea-Bed
and the Contemplated Area of Demilitarization*

One participant pointed out that there must be clarity in the discussion regarding the area which is under consideration — does it extend only beyond the limits of national jurisdiction, or does it also include the continental shelf. In this connection he drew attention to the fact that both the U.S. and the Soviet draft treaties provide for measures to be taken beyond certain numerically specified limits, without dwelling on the question of whether or not the area involved is under the national jurisdiction.

Four speakers — although in different ways — expressed the view that under existing international law the continental shelf constitutes a part of the sea-bed of the high seas. As such, it is open for all states for various purposes — except those reserved for the coastal state — and this goes also for the military uses.

One of them stressed that the Convention on the Continental Shelf does not grant to the coastal states any exclusive or specific rights in this area with respect to military uses, and formally it remains open for military activities of all states — whether coastal or non-coastal. He was afraid that putting the coastal states in a privileged position in this respect might result in the consolidation of sovereignty on the continental shelf, contrary to the concept of the Geneva Convention which provides only for sovereign rights of the coastal state for certain specific purposes. With reference to a paper contemplating the need to defend peaceful economic activities which are developing on the continental shelf, the speaker was of the opinion that this would hardly require deployment of military systems on the sea-bed.

One participant raised the question whether the Convention on the Continental Shelf directly allows for military activities on the continental shelf.

In this connection another speaker pointed out that some kind of military activities are already being carried out on the continental shelf and this is not precluded by the Geneva Convention. Should the opposite interpretation be correct, some states would probably have not acceded to the Convention.

Another participant remarked that the question is not whether military activities on the continental shelf are allowed or not, but whether a coastal state may or may not claim exclusive rights with respect to military activities on the continental shelf. Two speakers clearly expressed the view that under the existing law no state may claim exclusive rights in this respect.

Another participant, however, felt that the existing law may be interpreted in such a way that if the military activities of other states interfere with the exclusive right of exploration and exploitation of resources, enjoyed by the coastal state, the latter is entitled to prevent such activities of others on its own continental shelf.

An international lawyer expressed the view that for the purpose of the future regulation of the military uses of the sea-bed three areas should be distinguished:

- the sea-bed of the territorial waters;
- the continental shelf;
- the area of the sea-bed beyond the continental shelf.

The speaker felt that while in the latter area the military uses should be absolutely prohibited, certain minimum of military activities should be permissible on the continental shelf.

Another international lawyer, however, was of the opinion that what is relevant is not the division between the continental shelf and the area beyond but the limits of national jurisdiction. He was pre-occupied by an eventuality that the opposite approach would be discriminatory against states with no or narrow continental shelf. He was also of the opinion that drawing a boundary of national jurisdiction, based on the distance-from-the-coast criterion, would eliminate this danger.

Two other speakers opposed this view on the ground that there might exist different boundaries for different purposes: one — for economic purposes, and another — for military

purposes. One of the speakers added that one cannot help the differences between the natural environment of different states. E.g., some states are protected by mountains or rivers while others are not; even in case of one country the continental shelf may be of different width in different areas (the United States has big continental shelf in the Atlantic but almost none in the Pacific).

Another participant suggested that the sea-bed beyond the territorial waters or the sea-bed beyond a numerically specified limit might be envisaged as an alternative. However, he was of the opinion that future provisions regarding military activities on the sea-bed should in any case apply to the continental shelf — with possible concessions in favour of the defence activities of the coastal state.

General Principles and Criteria of a Future Military Regime of the Sea-Bed

One participant felt that there must be clarity in the discussion regarding following two sets of problems:

- first, the scope of the contemplated prohibitions;
- second, the time for which they would be valid.

On the first point the speaker raised the question of possible distinctions between offensive and defensive military uses (such as deployment of detection devices, laying cables for military purposes, etc.). He was sympathetic towards any attempt at drawing such a dividing line. At the same time, he felt that sometimes this may be difficult and he was not sure whether such a distinction would serve any useful purpose insofar as the question of demilitarisation of the sea-bed is in view.

On the second point the speaker made a distinction between three periods: peacetime, wartime and intermediate period (when a threat of war makes it necessary to take some preparatory steps) — and raised the question whether a future treaty should be respected also in wartime as e.g. the Geneva Protocol

of 1925 on the prohibition of use of chemical and bacteriological weapons. He believed that it would not be diplomatically wise to include in the future treaty a clause abrogating its binding force in wartime but some form of a renunciation procedure might be envisaged.

Another participant believed that making a distinction between offensive and defensive military uses would be helpful in defining the scope of military prohibitions. At the same time he proposed an additional criterion of distinction between prohibited and allowed military uses of the sea-bed, namely the criterion of distinction between temporary (occasional) and permanent use.

One international lawyer suggested that distinction should also be made between military activities which involve weapons and those which do not. He also expressed doubts if prohibition of the latter category is now feasible.

Another participant expressed the view that the question of the prohibition of the military uses of the sea-bed is the central problem of a future regime of the sea-bed. He deplored that at the Geneva Conference on the Law of the Sea (1958) a proposal for the prohibition of military bases and installation on the continental shelf, submitted by Bulgaria and India, and supported by the Soviet Union, was not adopted. He also noted with sympathy the opinion that in the future full demilitarisation of the sea-bed might become more attractive to the Western countries.

The view was also expressed that it might be easier to reach an agreement on a wide demilitarisation of the sea-bed before there are some vested military interests, having in mind that weapons systems are not likely to be implanted on the sea-bed in the next few years.

Another participant felt, however, that from a certain point of view it may be said that it is already too late now.

With reference to the opinion that the U.S. objections to the Soviet position on the demilitarisation of the sea-bed are not likely to be very long-lasting, the question was raised whether this may be true also with respect to other states, i.e. those which cannot afford to deploy the ABM-defence systems.

One rapporteur was of the opinion that — in general — this question may be answered in the affirmative. The opposite

might be true in certain specific cases but thus far no such case can be referred to.

The question arose as to whether the Working Group should express itself in favour of the principle that the area in question should be used "for peaceful purposes only" or rather in favour of the principle that "the use of the area in question for military purposes should be prohibited". Some members of the Working Group referred to a difference between those two formulations, and one of them proposed to agree that no nuclear weapons and other weapons of mass destruction, and no military bases and fortifications should be emplaced on or affixed to the area in question.

A navy expert felt that what should be set forth as an aim with respect to military activities on the sea-bed is the control of armaments.

The following opinion appeared in the report of the Working Group: "No military bases, fortifications or similar installations should be established on the sea-bed of the deep-sea area; no nuclear weapons or other weapons of mass destruction should be emplaced on it, implanted in it, or affixed to it, and no such weapons especially designed for the use on the sea-bed should be deployed thereon".

One participant expressed the hope that, while an agreement on complete demilitarisation of the sea-bed is probably not early forthcoming, it would be possible to reach an agreement on something more than just the prohibition of emplacement of nuclear weapons and military fortifications on the deep-sea area.

Some participants also felt that the prohibition of the military bases and fortifications on the sea-bed should extend to all types of military installations (see *infra*).

Specific Problems of a Future Military Regime of the Sea-Bed

Several questions, besides the question of the proposed area of demilitarisation were submitted for a more detailed discussion, namely:

1) prohibition of nuclear weapons and other weapons of mass destruction;

- 2) prohibition of other weapons;
- 3) prohibition of military bases, fortifications, and possibly other military installations;
- 4) prohibition of military manoeuvres and of weapons testing;
- 5) use of military personnel;
- 6) inspection and control;
- 7) international agency supervising compliance with provisions on the demilitarisation of the sea-bed beyond certain limits.

Ad 1. It was said that of all weapons of mass destruction only nuclear weapons could be used on the sea-bed and speaking also about "other weapons of mass destruction" is intended only to retain the usual wording. The speaker felt that there seems to be general agreement that these weapons should be absolutely prohibited on the sea-bed.

An opinion was also expressed that the prohibition of nuclear weapons on the sea-bed should include also the prohibition of use of sub-marines equipped with nuclear missiles.

According to another opinion, the demilitarisation of the sea-bed may not include the prohibition of the nuclear-missile sub-marines since those are not the sea-bed system. Normally, they are not resting on the sea-bed; if it becomes necessary, this means disaster and becomes quite a different problem. The U.S. draft treaty is so worded as to exclude from its provisions sub-marines, only occasionally resting on the bottom of the sea but generally cruising. In reply to a specific question, the speaker said that the cruising depth of the nuclear-missile sub-marines reaches 1,200 feet and that occasionally they may go down to the depth of 2,000 feet.

Ad. 2. Problem of prohibition of conventional weapons on the sea-bed was regarded by one speaker as slightly more difficult. He thought that perhaps these weapons should be permitted on a state's own continental shelf.

Ad 3. In connection with the question of prohibition of military bases, etc., reference was made to the Treaty on

Antarctica and to the Outer Space Treaty — both containing clear provisions prohibiting military bases and fortifications in the respective areas of their application. The speaker felt that this solution should be adopted also for the sea-bed.

The question arose what is meant by “military bases and fortifications” and one of the rapporteurs expressed the view that this is an extensive description involving permanent occupation of a portion of the sea-bed by people and weapons systems, and does not include small installations. This view was shared by another rapporteur. One of the rapporteurs, however, was of the opinion that also “constructions” should be prohibited — together with “bases and fortifications”.

Another participant said in this connection that he would not even oppose inclusion of “installations”, if it is clearly provided that such a prohibition does not include listening and monitoring devices. These are of purely defensive character, and — moreover — might be also useful for civilian purposes. He felt that such category of military installations other than weapons or bases and fortifications, should be allowed as an exception.

The importance of listening devices for verifications and checking was stressed also by another member of the Working Group.

A suggestion was made to express the opinion that “bases, fortifications, and other similar installations” should be prohibited in the area in question, but some other participants advocated prohibition of all installations.

One of the rapporteurs was asked on what basis one may assert that the Soviet Union is less dependent on submarine listening devices than the United States.

His opinion on the Soviet Union’s lesser dependence on the listening devices has been based on three factors:

- strictly classified access to the data on the deployment of the Soviet military systems;

- lesser interest in keeping open the sea lanes beyond the Eurasian coast, since the Soviet Union is not likely to be involved in a protracted land war outside the Eurasian continent;

- the Soviet willingness to prohibit all military activity on the sea-bed, including the listening devices, from which

one may deduce that they are less interested in and less dependent on them.

Ad 4. On the question of military manoeuvres it was recalled that they are prohibited under the Treaty on Antarctica and under the outer space Treaty. It is difficult to see any sense at all in the military manoeuvres on the sea-bed, except perhaps in connection with surface exercises. But the speaker felt that in any case military manoeuvres on the sea-bed should be prohibited.

As for the testing of weapons — not only nuclear ones — one speaker recalled the respective provisions of the Treaty on Antarctica and of the outer space Treaty, which are prohibitive. He did not see any need for testing weapons on the bottom of the sea; however, he felt that on this matter the option should be left open for the moment.

One speaker raised the question whether the possible testing of nuclear weapons in the subsoil of the sea-bed should be regarded as underwater tests which are prohibited under the Test Ban Treaty, or rather as underground tests which are not prohibited under the said treaty. He was of the opinion that the answer to this question should be based on that provision of the Treaty which prohibits causing radioactive contamination beyond the territory of the testing country and, if possible nuclear tests in the subsoil of the sea-bed are likely to produce contamination of the environment they should be regarded as prohibited under the said provision of the Test Ban Treaty.

One of the rapporteurs mentioned in this connection that it is technically possible to carry out nuclear weapons tests in the subsoil of the sea-bed in such a manner that radioactive contamination would be contained. But regardless of this fact, he felt that it should not be difficult to reach an agreement on banning nuclear tests in the subsoil of the sea-bed.

Ad. 5. It was recalled that the provisions of the treaty on Antarctica and of the outer space Treaty are permissive with respect to the use of military personnel.

Ad 6. It was pointed out that the problem of inspection on the sea-bed is essentially the same as on the land areas. The

touchy question involved is to what extent control should be extended over the civilian activities to dissipate possible suspicions, and whether and to what extent a degree of control over civilian activities might be acceptable to states.

An international lawyer indicated that there might be two kinds of inspection: reciprocal inspection and international inspection. The former one might be arranged for without any international body but the latter one seemed preferable to the speaker.

Attention was also drawn to the fact that there is a difference between the United States draft treaty on the denuclearisation of the sea-bed and the Soviet draft treaty on the demilitarisation of the sea-bed insofar as the proposed system of inspection is concerned. The former seems to envisage freedom of the parties to observe another party's activities on the sea-bed, while the latter appears to envisage an inspection similar to that provided for in the Outer Space Treaty.

In this connection one international lawyer pointed out that no inspection is provided for also in the space *sensu stricto*. Thus, the difference seems to be rather a terminological one.

Another international lawyer also recalled that in the outer space treaty the inspection is provided for on celestial bodies only. He was, however, of the opinion that lack of any provision for control with respect to outer space does not mean that the signatories ignored the problem. This is to be understood rather as an implication that they decided to rely in these matters on the national means of observation and control, which do not require any specific treaty provisions. This pattern may be also adopted with respect to the sea-bed, if only technically feasible. But whatever might be the concept of control adopted the speaker did not believe in any viable agreement which would not allow any means of control. According to him the Antarctic treaty and the Outer Space Treaty seem to lead to the following conclusion regarding pattern of inspection and control followed heretofore, namely:

— if there is a provision for complete demilitarisation (as in Antarctica or on celestial bodies), an appropriate inspection procedure is also spelled out;

— if only partial demilitarisation (e.g. denuclearisation only) is provided for (as in outer space proper), no procedure

of inspection or control is established, and signatories rely upon their national means of observation and control.

This pattern might provide for some useful analogy also with respect to the sea-bed.

One of the rapporteurs concurred with this interpretation of control in space and pointed out that the U.S. draft treaty on the denuclearisation of the sea-bed is drawn up along the same lines — only in more specific terms. Visits are not contemplated. The draft treaty provides only for observation.

Ad 7. The question was raised, whether the contemplated international machinery to deal with the problems of the sea-bed beyond the limits of national jurisdiction should also have a competence to deal with the military aspects of the problem and to supervise compliance with relevant treaty provisions. If so, it might, in case of non-compliance, intervene with the U.N. Security Council.

Another speaker felt that this function may be entrusted to a sea-bed agency or to a disarmament agency.

The opinion was also expressed that the task of supervising compliance with military clauses regarding the sea-bed, together with enforcement provisions, should be exclusively with a disarmament agency.

One of the rapporteurs felt that one may not exclude a possibility that an agency administering the economic uses of the sea-bed may have some occasions to make use of surveillance devices.

Two participants saw good points in each of the suggestions made, and felt that it might be possible to find out some compromise pattern.

WORKING GROUP II

Possible Military Uses of the Sea-Bed

A navy expert noted that from the technological point of view it is possible to place installations in the deepest parts of the ocean floor. According to him, it is a matter of only few years before this technique can become operational on a wide scale. Question of transfer of people between submerged devices is slightly more difficult but the U.S. Navy has already got an experimental rescue device which allows for that. The speaker believed that in a decade it would be possible to place manned installations on the ocean floor if there are pressing reasons.

An international lawyer raised the question if fixed missile sites on the sea-bed would not be less expensive than missile equipped submarines.

The navy expert was of the opinion that this question should be answered in the negative. The cost of mobility on the sea is so low, and the advantages which mobility provides for are so great, that he could not see any need for fixed missile installations on the sea-bed except, perhaps, in some very unusual circumstances which he was even not in a position to define. He admitted that the sea-bed offers exceptional opportunities for hiding. But he personally thought that the ocean itself is good enough for this purpose, and the bottom of the sea adds little advantage in this respect while raising the costs involved. Consequently, he believed that, from the strategic point of view, those who thought that they must have effective strategic weapons systems at their disposal could certainly live with the prohi-

bition of fixed strategic weapons on the sea-bed. Such a prohibition would not affect the concept of security.

A geographer drew attention to the fact that the nuclear missile sub-marines may rest on the bottom of the sea and stay there for long periods. He also thought that in the future it might be possible to build sea-bed bases for such submarines.

The navy expert said that experimental, nuclear-powered submarines supplied with wheels for moving on the sea-bed are already in existence. They are of a scientific character and are not militarily equipped.

The following opinion appeared in the report of the Working Group:

“ There is a growing concern for the military developments that have already taken place; with the advancing of technology, the prospect of using the sea-bed for military purposes has greatly increased in general; that — in this connection — any advancement in this field will mean shrinking of the areas available for the peaceful exploration, exploitation, and scientific research ”.

*Present Military Regime of the Sea-Bed
and the Contemplated Area of Demilitarisation*

An international lawyer pointed out that the area which comes under the discussion on the military aspects of the problem is different from that which was discussed in the context of economic uses. In the latter case the area beyond the limits of the continental shelf (in whichever way defined) was in question; while the area under the present discussion does also include the continental shelf beyond the territorial waters.

A navy expert noted that the Geneva Convention on the Continental Shelf is silent about military uses. In particular, it does not give any exclusive sovereign rights to the coastal states in this respect.

The international lawyer shared the view that the Geneva Convention has no bearing on the military activities on the continental shelf.

Another international lawyer and a marine biologist stressed that the coastal states have exclusive sovereign rights on the continental shelf only with respect to exploration and exploitation, and that, otherwise, the sea-bed beyond the territorial waters is open to all.

Another participant raised the question whether it may be said that no provisions of law, except the principle of freedom of the high seas apply at present to the military activities on the sea-bed; and — in particular — whether it may be said that nuclear-missile sub-marines are allowed under the existing law.

A navy expert noted in this connection that the only existing limitation of the military uses of the high seas relates to mines, and that fixed installations on the sea-bed would be permissible under the existing law.

Another participant noted that some limitations of the military activities on the sea-bed are also stemming from the nuclear test ban treaty.

These views were shared by an international lawyer who added that the present law does not prohibit the use of the nuclear-missile sub-marines.

Some participants referred to the draft treaties on the limitation of armaments on, or demilitarisation of the sea-bed, submitted to the 18 Nation Disarmament Committee in Geneva respectively by the United States and the Soviet Union. The speakers noted that, according to the U.S. draft, the measures contemplated therein should be undertaken in the area of the sea-bed beyond the threemile distance from the coast, while according to the latest version of the Soviet draft, the measures proposed there should be undertaken in the area of the sea-bed beyond the twelve mile distance from the coast.

One of the speakers believed that this difference of only a few miles should not present any serious difficulties in delimiting the area which should be subject to military restrictions.

The following opinions appeared in the report of the Working Group:

“ that the present legal regime of the sea and the sea-bed, though it may provide for some restrictions of military activities, does not provide explicitly for the prohibition of the use of nuclear missile sub-marines and other military activities;

“ that the Geneva Convention on the Continental Shelf provides only for exclusive rights of the coastal states with respect to exploration and exploitation of natural resources ”.

“ that proposals submitted in the 18 Nations Disarmament Committee in Geneva should be taken as a basis for delimitation of the area submitted to military restrictions ”.

General Principles and Criteria of a Future Military Regime of the Sea-Bed

Referring to the draft treaties submitted by the United States and by the Soviet Union to the 18 Nation Disarmament Committee in Geneva, one participant noted that the U.S. proposes to prohibit only fixed nuclear weapons as well as military bases and fortifications on the sea-bed while the Soviet Union proposes to prohibit all military activities there.

Another participant said that the goal should be the demilitarisation of the sea-bed and it should not be substituted by mere arms control.

A navy expert expressed the opinion that while discussing the question of military regime of the sea-bed, one should look beyond the field of immediate concern of international community. He believed, accordingly, that a future military regime of the sea-bed should not be shaped with only strategic weapons in mind. Such an approach would be likely to create an embarrassing situation in which desirable uses of tactical weapons would be restricted or inhibited. He thought that the developing uses of the sea might lead to situations in which localised forces are required. Everyone may be bound to use force if there is a conflict over the established regime. And, consequently, appropriate rules should exist for weapons which may be used. The areas over which conflicts may arise will be very definitely localised, and they may vary depending on the resources concerned (oil, hard minerals, fish),. This gives an idea of the military forces which may be required, such as patrol and monitoring forces (in the vicinity of installations). The importance of monitoring forces both in strategic and tactical areas should be particularly stressed. Existence of such forces is

desirable and inevitable. But if it is admitted that local monitoring is advisable, the following two questions arise:

— that of permissibility to have means of exerting force if defence of installations is necessary;

— that of permissible level of the forces used.

The speaker believed that no situation in the sea-bed developments may lead to the need of using weapons of mass destruction, but the tactical situations should not be overlooked. Consequently, one should be very careful on the question of absolute prohibition of military uses of the sea-bed. The speaker warned against the mistake of prohibiting by treaty some weapons, which not everybody is ready to renounce, as was the case in the twenties.

Another participant believed that the concept of tactical weapons on the sea-bed is too narrow and the discussion should concentrate more on the strategic problem of total renunciation of the military uses of the sea-bed. He raised the question whether granting leases on the sea-bed must result in the need of defence measures on the sea-bed around the areas in question.

In reply to this question, the navy expert indicated that the crucial problem is whether all nations would subscribe to an international regime and respect it. Otherwise, conflicts may easily arise. He referred to the experience of the U.S. vessels on the surface of the sea off Peru, where embarrassing situations involving use of force have developed because of the competing interpretations of international law. He added that the patrol craft he had in mind would be of a "demersal" type — and not the surface craft.

A marine biologist added that force may be needed not necessarily in case of an international conflict but also in case of offences committed by individuals not authorised by any state — just as police is needed within a state.

Another participant felt that the general aim should be to expand the area of the sea-bed available to peaceful uses and, accordingly, to restrict the areas available for military uses — if possible, even to eliminate them altogether. This may sound idealistic but the speaker believed that the quest for peace requires of people to be little idealistic.

An international lawyer was of the opinion that if the armaments on the sea-bed are left unprohibited, they will almost certainly start and develop on an ever increasing scale. This process should be prevented by an appropriate international regime providing for partial or total prohibition of the military uses of the sea-bed. The total prohibition should be the aim, even if it may be reached only by stages. The speaker added that all major military powers, including China, should become parties to an appropriate international arrangement. According to the speaker, the non-participation of China would probably make any international arrangement on disarmament illusory. But, similarly, the non-participation of small states may also be used by the bigger ones as an excuse for non-compliance. Reference was further made to the proposal submitted by Canada in the 18 Nations Disarmament Committee in Geneva, according to which a zone should be established where only defensive means might be emplaced on the sea-bed.

Another international lawyer felt that participation of *all* states is not necessarily a precondition to any international arrangement regarding disarmament on the sea-bed, though — undoubtedly — it would be desirable. He was of the opinion that one should avoid pronouncements compromising the demilitarisation of the sea-bed in general, if not adhered to by all states; one should not exclude a possibility of agreements between a certain number of states only.

This point of view was shared by another participant who believed that the participation of all states is not absolutely necessary to make an international agreement effective. But he felt that major powers should become parties to it.

Still another international lawyer expressed the view that adherence of China to an agreement on the limitation of armaments on the sea-bed is compelling but not likely. He raised the question of whether the remaining parties could not reach a workable agreement prohibiting the emplacement of nuclear weapons on the sea-bed, based on an assumption that China would not have such a capability for some time to come. Such an agreement might provide for an escape clause should the opposite be the case. Passing to the scope of a future agreement, the speaker believed that an agreement banning nuclear missile sub-marines could be only reached as a part of a much

wider disarmament arrangement. He did not think it sensible to single out sub-marines from other navy or nuclear systems which would remain allowed.

This point of view was shared by the next speaker who felt that sub-marines should be excluded from the discussion on the sea-bed since they are the high seas system. Otherwise, the discussion should also include surface ships. The only problem with sub-marines pertaining to the sea-bed, is their resting on the bottom of the sea. Referring to the distinction between offensive and defensive military uses as a possible criterion for defining the scope of prohibitions, the speaker felt that a detection system may be undoubtedly qualified as defensive but that, otherwise, it would be hardly possible to draw a dividing line between offensive and defensive systems. This is true for the sea bed to the same extent as it true for land.

Referring to remarks implying separation of the sea-bed from the high sea for the purpose of discussion, a navy expert noted that such a separation was valid for a long time in the past. In this context he recalled the legal situation of a sunk ship under the *Consolato del Mare*. This separation, however, disappeared, according to the speaker, and the salvability of ships at present seems to serve as a good example of unity of the high seas and the sea-bed as a continuous field of operation. On the question of distinction between defensive and offensive systems he said that attempts were being made to arrive at a theoretical definition of defensive weapon, based on the criteria of the range dependency and of non-deployability.

Another participant raised the question of interpretation of the formula, according to which the area under discussion should be "used exclusively for peaceful purposes". Is this to mean that the products extracted from the sea-bed, e.g. oil, should be also used for peaceful purposes only, and does the same apply to the scientific data collected on the sea-bed? He suggested that for the purpose of defining the scope of the prohibitions of military uses of the sea-bed, a distinction should be made between the military activities resulting from the principle of freedom of the high seas, and such military activities which are intended for protection of the peaceful activities on the sea-bed.

It was also remarked that there exists an interrelation between the bottom of the sea and the superjacent waters, e.g. anchoring. In this context a question was raised whether a demilitarisation limited to the sea-bed is sensible. Demilitarisation of the whole marine environment would be ideal.

Number of speakers expressed the view that a new international arrangement and a new instrument are needed to establish future regime of the sea-bed with respect to military uses, and in this connection references were made to the draft treaties submitted by the United States and by the Soviet Union to the 18 Nation Disarmament Committee in Geneva.

The following opinions appeared in the report of the Working Group:

“ that the continental shelf and the area beyond it are to be used exclusively for peaceful purposes;

“ that a total prohibition of military uses of the sea-bed, though not realistic at this stage should be one of the goals; while it was suggested by some others that total prohibition was not feasible;

“ that new arrangements, based on general agreement, are needed to establish the future regime of the military uses of the sea-bed, in order to secure peaceful and orderly exploration, use, and exploitation of the sea-bed;

“ that the scope of weapons, whether tactical or strategic, has become wider, and these factors should not be neglected when drafting an international regime of the sea-bed with regard to military uses;

“ that the use of weapons systems in the superjacent waters and of sub-marine weapons cannot always be separated from the uses of the sea-bed;

“ that all states should be invited to take part in an international regime of the military uses of the sea-bed, so as to make it really effective ”.

Question of Inspection and Control

One participant raised the question whether it is necessary to have control and inspection devices on the bottom of the sea, and whether the surface policing forces — perhaps of

an international character — would not be sufficient to ensure compliance with a future military regime of the sea-bed.

A marine geologist referred to a series of undersea explosions of a volcano off Japan in 1949 (or 1950) and pointed out that it had been possible then to locate the place and to establish the exact time of explosions only due to the use of underwater methods. This would be impossible by surface methods only.

A navy expert added that for all purposes which require a precise location of an object it is absolutely necessary to have a detecting device with a fixed position, consequently — one attached to the sea-bed, and not floating on the surface of the sea.

A marine biologist remarked that listening devices on the sea-bed may play an important role also in detecting and identifying fish.

An international lawyer, while stressing that any international agreement on a military regime of the sea-bed must include international control, expressed some doubts as to whether an effective international control of the sea-bed is possible.

Doubts about the effectiveness of surveillance devices with respect to the sea-bed were also voiced by two other participants.

A navy expert was of the opinion that no legal regime can operate with 100% certainty. Relying on detection systems on the sea bottom would be a hopeless task, taking into account the rate of a detailed search for a non-cooperative target on the sea-bed. With the present techniques this rate is calculated for 1 sq. mile per day. Under very favourable conditions this rate may become a few sq. miles per day. Neither is listening system certain in 100% but it may allow for creating some barrier lines. The speaker felt that control and inspection system must not necessarily be 100% watertight but must provide for a realistic probability of retribution to offenders. The best analogy — he thought — has been the situation with overflying foreign countries without authorisation.

An international lawyer raised the question whether monitoring on the sea-bed must necessarily involve an international

agreement for inspection and control, and whether this could not be done by national means.

The navy expert remarked in this context that the only alternative to an international arrangement for inspection would be an intelligence gathering and analysis. Both seemed to him extremely difficult with respect to the sea-bed. However, he would prefer not to see the world relying on espionage to ensure observance of arms control agreement with respect to the sea-bed. Consequently, the problem of inspection must be resolved before the complete and effective demilitarisation of the sea-bed can be reached.

A marine biologist expressed the view that, since the area under discussion is outside national jurisdiction, it may be possible to draw an analogy from the law of piracy in order to solve the question of measures against violations. No international arrangement for inspection would then be required and everybody would be entitled to take appropriate measures against violators.

According to an international lawyer, the argument that the area in question is beyond the national jurisdiction works also another way, namely: the motives for resisting inspection — whether national, or international — become less compelling. Still, he was not certain about the effectiveness of any inspection system on the sea-bed, and about a technical feasibility to check up violations. If this is not possible, he would wonder about the usefulness of entering into an agreement on arms limitation on the sea-bed.

Another participant expressed doubts whether in this particular case an international control would be better than a national one, since anyway practically only two countries possess technological capabilities to take advantage of any right of access or supervision. According to him, the control arrangement in this case should be based on two principles:

- international character of the area in question;
- reciprocity of the major powers directly involved.

WORKING GROUP III

Possible Military Uses of the Sea-Bed

A physicist noted that there is a strong trend towards deploying military systems at ever greater depths. This offers the advantage of almost perfect hiding — it is hardly possible to detect devices placed on the bottom of the sea at great depths.

Another participant pointed out that distinction should be made between two categories of military systems:

— weapons which may be emplaced on or used from the sea-bed;

— other devices serving military purposes, first of all — military communications and detection.

Insofar as the category is concerned, the speaker said that he was unaware of any immediate plans to put weapons — especially, weapons of mass destruction — on the sea-bed. On the other hand, sub-marines equipped with ballistic missiles are a very important element of deterrent forces on both sides. It would be very difficult for either of them to renounce these forces, and this, probably, would be not in the interest of maintaining peace. Naturally, there is a long-range problem of proliferation of such sub-marines. The speaker thought that the world strategic situation would become very dangerous if more than two countries possessed such sub-marines.

In connection with the second category of devices the speaker indicated that the underwater sound is the only way to detect submarines at great distances, and that this system works in deep waters better than in shallow ones — on the

slope better than on the shelf. He believed that no marine power would be content with having no possibility to install such listening devices on the sea-bed.

It was also noted that already now sub-marines can rest on the sea-bed. Moreover, some developments suggest that new types of mobile weapons systems — capable of moving both in the water and on the sea-bed may be, or will be — or, even, are being — developed. On the other hand, such systems would be expensive, and the question arises whether it is worthwhile to develop them. The speaker added that the attractiveness of the sea-bed from the strategic point of view is a fact — the existence of nuclear installations on the sea-bed would divert any first strike from the inhabited areas. Such installations, however, if permanently affixed to the sea-bed, would be inferior to mobile ones.

An international lawyer noted that, thus far, the military installations on the sea-bed are of purely defensive nature. Resting of sub-marines on the bottom of the seas is only incidental.

Present Military Regime of the Sea-Bed and the Contemplated Area of Demilitarisation

One speaker pointed out that under present circumstances states are concerned with their security, and this is certainly a legitimate interest. Accordingly, states undertake security measures in all accessible environments, and the extension of such activities to the sea-bed would be a natural course of events. The question arises whether it is possible to stop this process, and to do this in a credible way.

An international lawyer added that the high seas have been always considered as a war theater open to everybody. But now, hostilities in the superjacent waters would affect the situation on the sea-bed as well.

It was also said that coastal states have sovereign rights on the continental shelf only with respect to specific purposes. A coastal state may also undertake military activities on its continental shelf — since such an activity is not prohibited

— but it cannot do that to the exclusion of others. Continental shelf is free for military activity not only on the part of the coastal state. This may pose serious security and political problems, but legally it is so.

An international lawyer expressed the view that total incorporation of the continental shelf in the sphere of sovereignty of the coastal state would be contrary to international law. But he also felt that placing military installations on somebody else's continental shelf would not be in accordance with the Geneva Convention on the Continental Shelf. A new treaty should explicitly exclude such possibilities.

Another international lawyer was of the opinion that a coastal state may prohibit the military activities of others on its own continental shelf on the ground that such activities interfere with the economic exploration and exploitation of the area involved, which is the exclusive right of the coastal state. This, indirectly, the provisions of the Geneva Convention on the Continental Shelf are leading to the prohibition of use of the continental shelf by non-coastal states also for purposes other than exploration and exploitation of natural resources.

One participant suggested that the area subject to military restrictions should include the sea-bed beyond the limits of 12 miles measured from the low water mark. The speaker argued that the territorial sea of over 80 states is that wide, but he advocated the 12-mile limit as a numerically defined line — regardless of whether or not this coincides with the limit of territorial sea of a given state. He furthermore indicated that the demilitarisation of the sea-bed beyond the suggested limit would not interfere with the recognised exclusive rights of states with respect to exploration and exploitation of the continental shelf.

General Principles and Criteria of Future Military Regime of the Sea-Bed

The question of interconnection between the regime of the civilian economic uses of the sea-bed and the regime of its use for military purposes was raised.

According to one opinion, the question of the future regime of economic uses of the sea-bed depends on the way the problem of military uses of the sea-bed is solved.

According to another opinion, although the military uses of the sea-bed are a conditioning factor, it might be possible to a certain extent to separate the question of civilian uses from the question of military uses and vice versa.

One participant stressed that the question of compatibility between the military uses of the sea-bed and an international regime for its civilian uses must be answered. He referred to the two opposing views:

— one, according to which seas have been used for both civilian and military purposes for thousands of years, and the same situation may be extended now to the sea-bed;

— another, according to which an ever more extensive use of the sea-bed for military purposes would jeopardise its use for civilian purposes - at least partly.

He recalled furthermore that all delegations in the United Nations have been of the opinion that the sea-bed should be reserved exclusively for peaceful purposes, and that the details of a possible treaty to this effect should be negotiated within the Eighteen Nation Disarmament Committee in Geneva.

An international lawyer, pointing to an interdependence between the sea-bed and the superjacent water column, expressed the opinion that if the interests of economic exploitation of the sea-bed are recognised as ones of primary importance, one should give a thought to the total demilitarisation of the marine environment, including the high seas. He added, however, that he himself did not see any tendency in this direction.

An expert on armaments and control noted that the use of surface and sub-marine weapons cannot always be separated from the use of the ocean floor.

A natural scientist believed that such a separation is never possible at all, as long as sub-marines are not eliminated.

A navy expert felt that such a separation may be sometimes possible in the physical context, and that it would be desirable in the legal context.

Another participant admitted that there is an increasing inter-penetration between the sea-bed and superjacent waters,

and also an increasing inter-penetration between civilian and military uses of the marine environment. Referring to his earlier statement, in which two opposing views on this question were presented, the speaker said that, according to his personal belief, not all military devices (e.g. listening devices) are prejudicial to the civilian regime of the sea-bed.

A physicist noted that while the civilian uses of the sea have as a rule no bearing on the sea-bed, the military uses of the sea have a tendency to affect the situation on the sea-bed as well.

One international lawyer expressed the opinion that all objects and installations on the sea-bed, serving military purposes, and not only nuclear weapons and other weapons of mass destruction, should be prohibited. He referred to the Nineteenth Report of the Commission to Study the Organisation of Peace ("The United Nations and the Bed of the Sea"), which also goes beyond the prohibition of nuclear weapons and other weapons of mass destruction. He admitted that the question how to combine the principle of freedom of the high seas with demilitarisation of the sea-bed is a difficult one, but he believed that it could be finally resolved by an international agreement which would thus establish an exception to the regime of the high seas. He suggested that the Working Group might pronounce itself generally in favour of the prohibition of military uses of the sea-bed beyond the limits of national jurisdiction even if there are divergencies of opinions as to the specific measures which should be taken to this effect.

Another participant submitted that the Working Group might reaffirm that the sea-bed beyond the territorial sea should be used exclusively for peaceful purposes. He recalled that there was a general agreement on such a statement within the United Nations without elaboration on the exact meaning of "peaceful purposes".

He was also of the opinion that, subject to the solution of the verification problem, the scope of military restrictions should be as wide as possible, and should apply to as wide an area as possible. He would even think of the complete prohibition of all military uses of the sea-bed up to the outer limit of the 3 mile coastal zone. This would serve the general interests of mankind. However, the question arises whether this is feasible.

A natural scientist remarked that the term "peaceful purposes" should be construed as allowing the use of submarine detection devices to ensure peace and security. Otherwise, the formula would be hardly acceptable. But he did not exclude that these devices might be internationally controlled.

One participant felt that the report of the Working Group might include a statement to the effect that reasonable economic exploitation of the sea-bed is incompatible with military uses not only of the sea-bed but also of the superjacent waters. However, according to another opinion such a statement in the Working Group report was not deemed necessary.

Question of Control and Organisational Arrangements

An opinion was expressed that major powers may prefer to insulate the sea-bed from arms race, if this could be made credible. However, the question of verification is a difficult one. Would an arrangement based on the pattern of Antarctica be sufficient in view of the fact that the sea-bed environment is quite different? The speaker felt that if the major powers conclude that it is not worthwhile to develop military activities on the sea-bed, and if — on the other hand — it proves difficult to find a satisfactory answer to the question of inspection, it may happen that the international regime established for the sea-bed may provide a framework for the solution of this problem as well. And this is another argument in favour of an international regime for the sea-bed, and against the flag state approach. Only an international regime is capable of establishing order in this new area of human activity. Monitoring devices on the sea-bed are necessary for ascertaining that the sea-bed is not used for military purposes, but they should be placed under the authority of an international organisation. The question arises whether the major powers would be willing to entrust such tasks to an international agency. The speaker was of the opinion that this is likely to happen only in the last resort, i.e. if all other possibilities to create credible assurances are exhausted without yielding result. He indicated that the problem of control involves three elements: verification, inspection, and

enforcement — and believed that all these questions must not necessarily be settled in the same way.

An international lawyer noted that the question of control involves not only location of possible violations but, first of all, their identification.

Another international lawyer expressed the view that Antarctica and outer space do not offer any suitable pattern to be followed with respect to inspection on the sea-bed.

According to another opinion, a control arrangement for the sea-bed — although certainly not identical with those in Antarctica or in outer space — may, nevertheless, be similar.

Reference was also made to the draft treaty submitted by U.S. senator Pell, which provides for keeping all the installations on the sea-bed open to other parties on the basis of reciprocity. Inspection would take place upon decision taken in the Security Council of the United Nations.

PART V

SCIENTIFIC RESEARCH ON THE SEA-BED
AND ITS REGIME

THE LEGAL REGIME OF SCIENTIFIC RESEARCH ON THE SEA-BED

BY

Dr. LEO J. BOUCHEZ

Reader in International Law, Utrecht University, Utrecht

1. *Introduction*

It is necessary to distinguish between two different types of scientific research: (1) fundamental research which is subject to open publication; and (2) scientific research undertaken primarily for specific practical purposes, such as the exploration and exploitation of natural resources of the sea-bed and subsoil¹. The results of the second type of research are as a rule not published openly, but have been frequently traded or exchanged in a *quid pro quo* deal between sea-bed explorers. In this study the terminology "scientific research" covers fundamental research as well as scientific research for specific practical purposes, unless explicitly stated otherwise, while the terminology "fundamental research" refers to research subject to open publication.

As regards scientific research concerning the sea-bed and subsoil or at sea-bed level the following distinctions should be made: (1) scientific research concerning the sea-bed and subsoil for the purpose of exploring and exploiting its natural resources; (2) fundamental research concerning the sea-bed and subsoil; (3) scientific research undertaken for specific practical purposes, having no relationship or at least no direct relationship with research concerning the sea-bed and subsoil, physically carried out on the sea-bed; and (4) fundamental research,

1. See W.T. BURKE, *International Legal problems of Scientific Research in the Oceans*, Ohio State University, Columbus, Ohio 1967, pp. 1-2; also U.N. Gen. Ass., Off. Rec., Twenty-third session, *Report of the Ad Hoc Committee to Study the Peaceful Uses of the Sea-Bed and the Ocean Floor Beyond the Limits of National Jurisdiction*, (doc. A/7230), New York, September 1968, p. 47.

physically carried out on the sea-bed, but having no relationship with research concerning the sea-bed and subsoil. As regards the kind of research mentioned *sub* (3) and (4), attention is to be drawn to, for example, testing of submarine equipment physically undertaken on the sea-bed.

The most important type of scientific research carried out on the sea-bed for merely practical reasons is such research which is directly connected with the exploration of mineral resources. This research is to be submitted to a system of legal rules governing the exploration and exploitation of minerals. In this respect it is not surprising that in the mining legislation of many countries this research may be carried out on the continental shelf only after reconnaissance and/or exploration licences have been granted by the coastal State. However, fundamental research, being in the interest of mankind, should be subject to a more liberal regime.

Finally, some observations have to be made in regard to the area of the sea-bed where scientific research will be undertaken. In this respect it is necessary to distinguish between (1) the sea-bed of maritime internal waters, (2) the sea-bed of the territorial sea, (3) the continental shelf, and (4) those areas of the sea-bed of the high seas which do not come under the legal regime of the continental shelf and which will be referred to here as the deep sea area or ocean floor. By maritime internal waters is to be understood those parts of the coastal waters situated inwards of the baseline off which the territorial sea is to be measured. Here, reference is to be made to the application of straight baselines in the case of bays and in coastal areas where a particular geographical configurations exists, like for example coastal archipelagos. Special provisions governing the application of straight baselines have been laid down in Articles 1 and 7 of the Geneva Convention on the Territorial Sea and Contiguous Zone (1958). The sea-bed and subsoil of the maritime internal waters and the territorial sea fall under the full sovereignty of the coastal State. Accordingly, permission of the coastal State is always required for scientific research on the sea-bed of these coastal waters.

In accordance with Article 2 of the Geneva Convention on the Continental Shelf a coastal State has sovereign rights over the continental shelf for the purpose of exploring it and

exploiting its natural resources. As regards scientific research of the continental shelf, a special provision has been laid down in Article 5, Paragraph 8 of this Convention. Pursuant to this provision the consent of the coastal State is to be obtained in respect to any research.

As far as scientific research on the deep sea-bed of the ocean floor is concerned, no provision was made in 1958. It is not even clear from the definition of the legal continental shelf concept where the continental shelf ceases to exist and the deep-sea area commences. This vagueness flows from the criterion of exploitability contained in the legal definition of the continental shelf. Nevertheless, as it appears from the opinion of the majority of States expressed during the 1967 United Nations debates in the legal regime of the ocean floor, the legal concept of the continental shelf is not to be considered as including the large areas of the ocean floor². This was also the view taken by the International Court of Justice in its decision of February 20, 1969 on the North Sea Continental Shelf Cases between the Federal Republic of Germany, on the one hand, and Denmark and the Netherlands on the other hand, when it submitted that a natural limitation recommends itself where, physically, the continental shelf begins to merge with the ocean depths³.

Following these preliminary observations, the legal regime for scientific research on the continental shelf and on the deep sea-bed of the ocean floor will be discussed in the three subsequent paragraphs.

2. *Scientific research on the continental shelf*

At the outset it has to be observed that in pursuance of Article 2, Paragraph 1 of the Geneva Continental Shelf Convention, scientific research primarily undertaken for the purpose of exploring the sea-bed and exploiting its natural resources comes under the sovereign rights of the coastal State and re-

2. See U.N., Gen. Ass., Off. Rec., Twenty-second session, First Committee, doc. A/C.1/PV.1515-1526, 1524-1530, 1542-1544.

3. I.C.J., *Reports of Judgements, Advisory Opinions and Orders*, 1969, p. 31.

quires, accordingly, the consent of the coastal State. The same view is embodied in the off-shore mining legislation of the coastal States.

As regards fundamental research of the continental shelf, it is worth drawing attention to the attitude of the International Council of Scientific Unions (ICSU), which is a non-governmental organization for *ad hoc* consultation with ECOSOC and which enjoys consultative status with UNESCO. In April 1954, the Bureau of the ICSU adopted a resolution on the draft articles on the continental shelf proposed by the International Law Commission during its fifth session⁴. In this resolution it was asserted that fundamental research of the continental shelf by any nation, carried out with the intention of open publication is in the interest of all. Furthermore, the hope was expressed that the General Assembly would amend the draft articles before they would become law so as to ensure that fundamental research at sea may proceed without vexatious obstructions. The resolution was transmitted by UNESCO to the United Nations by letter dated May 21, 1954. The ICSU resolution was endorsed by the International Union of Biological Sciences in its resolution adopted for that purpose in April 1955⁵.

In the final report of the International Law Commission on the law of the sea of 1956 no provision was laid down concerning fundamental research on the continental shelf. However, in its commentary on Article 68 of its draft dealing with the nature and scope of the continental shelf rights of the coastal State, the International Law Commission referred to the anxiety caused in scientific circles by its previous 1953 draft proposals. In this commentary the International Law Commission made clear that this anxiety was unjustified as far as research carried out in superjacent waters was concerned, since the freedom to conduct research in these waters, being part of the high seas, is in no way affected. In the opinion of the International Law

4. U.N., Gen. Ass., Off. Rec., Eighth session, *Report of the International Law Commission Covering the Work of Its Fifth Session, 1 June-14 August 1953*, (doc. A/2456), New York 1953, p. 12-17. In these draft articles no provision was made on fundamental research of the continental shelf.

5. U.N., Gen. Ass., Off. Rec., doc. A/CONF. 13/28, 13 January 1958, p. 4-5.

Commission, the coastal State is not entitled to prohibit scientific research in the waters of the high seas. In this case the consent of the coastal State will be required only for research relating to the exploration and exploitation of the sea-bed or subsoil. Furthermore, the International Law Commission submitted that it is to be expected that the coastal State will only refuse its consent *exceptionally*, and in cases in which it fears an impediment to its exclusive rights to explore and exploit the sea-bed and subsoil⁶.

From the commentary made by the International Law Commission it is perfectly clear that permission of the coastal State is required for scientific research concerning the continental shelf, whereas it is not required for scientific research of the superjacent waters. The position taken by the International Law Commission that such permission will be withheld only "exceptionally" reflects a rather optimistic view because no provision has been proposed which defines the circumstances to which the term "exceptionally" refers.

Before dealing with the provision laid down in Article 5, Paragraph 8 of the Geneva Convention on the Continental Shelf, the proposals made by several States during the Geneva Conference of 1958 deserve some further consideration. As to the nature and scope of these proposals the following distinctions are to be made: (1) fundamental research of the continental shelf is in principle free; (2) fundamental research is free, if certain conditions have been fulfilled; (3) fundamental research depends upon the coastal State's consent, without specifying under what circumstances the coastal State has to grant or may refuse its permission; and (4) fundamental research depends upon the coastal State's consent, be it that this consent may not be withheld if certain conditions have been fulfilled by those who wish to carry out research.

As regards the approach mentioned sub (1), the proposals made by Panama on March 10, 1958, and Denmark on April 1, 1948, deserve consideration. These two proposals were

6. U.N., Gen. Ass., Off. Rec., Eleventh session, *Report of the International Law Commission Covering the Work of Its Eighth Session*, 23 April-4 July 1956, (doc. A/3159), New York 1956, p. 42-43.

intended to amend Article 71, Paragraph 1 of the 1956 draft of the International Law Commission which reads:

The exploration of the continental shelf and the exploitation of its natural resources must not result in any unjustifiable interference with navigation, fishing or the conservation of the living resources of the sea ⁷.

In the Panamanian proposal it was suggested to add to this paragraph the following phrase: "or the free pursuit of disinterested scientific investigation by any country or qualified scientific institution, provided that in the latter case the said country or institution undertakes to make public the results of its investigation" ⁸ Neither from this wording nor from the debates at the Geneva Conference is it entirely clear whether the scientific investigation here referred to includes fundamental research of the continental shelf or is restricted to fundamental research of the superjacent waters. If the latter interpretation is correct, the Panamanian proposal corresponds entirely with the view of the International Law Commission ⁹, while the former interpretation implies a substantial amendment of this view. According to the Danish proposal the following phrase should be added to Article 71, Paragraph 1: "nor in any interference with fundamental oceanographic and other scientific research carried out with the intention of open publication" ¹⁰. From the explanation given by the Danish delegate it follows without doubt that the fundamental research mentioned here comprises also research concerning the sea-bed, but not research extending to the subsoil. The Danish proposal proved to be more successful than the Panamanian since the former was adopted in the Fourth Committee by 25 votes to 20, with 10 abstentions, whereas the latter was rejected by 28 votes to 3, with 24 abstentions. Consequently, Article 5, Paragraph 1 of the Geneva Convention on the Continental Shelf reads:

The exploration of the continental shelf and the exploitation of its natural resources must not result in any unjustifiable interference with

7. See note 6.

8. U.N., Gen. Ass., Off. Rec., doc. A/CONF.13/C.4/L.4.

9. See note 6.

10. U.N., Gen. Ass., Off. Rec., doc. A/CONF.13/C.4/L.49; also *United Nations Conference on the Law of the Sea*, Off. Rec., vol. VI, Fourth Committee, 1958, p. 82, paras. 14 and 19.

navigation, fishing or the conservation of the living resources of the sea, nor result in any interference with fundamental oceanographic or other scientific research carried out with the intention of open publication.

The approach mentioned *sub* (2) was embodied in the original Danish proposal of March 17, 1958¹¹. Here it was suggested that the coastal State may not interfere with fundamental research on the physical characteristics, geology or biology of the sea-bed and subsoil of the continental shelf outside the territorial sea, provided that such research would be carried out (a) with the intention of giving due publicity to the results obtained and (b) that the coastal State would be enabled to follow the investigations through qualified observers. However, this proposal was withdrawn at the 23rd meeting of the Fourth Committee on March 28, 1958, and replaced by the proposal referred to above.

The approach mentioned *sub* (3) was expressed in the proposal made by Indonesia. In this proposal it was suggested to add a second paragraph to Article 68 of the draft of the International Law Commission, reading as follows:

Scientific research of the continental shelf should be given high priority and undertaken with the consent of the coastal State.

Although the interest of scientific research of the continental shelf has been recognized in this proposal, the applicant is completely at the mercy of the coastal State since this State has discretionary power to give or to refuse its permission for fundamental research of the continental shelf. This implies that even for fundamental research of the continental shelf undertaken in the superjacent waters the coastal State's consent is required. On the other hand, research physically carried out on the sea-bed for purposes other than scientific investigation of the continental shelf is not covered in this proposal.

The approach mentioned *sub* (4) was reflected by the proposals made by Iran and France, respectively, on April 1, 1958. Starting-point of these proposals is that for scientific research on the continental shelf the coastal State's consent is required. Moreover, it was submitted in the Iranian proposal that the coastal State shall grant permission to carry out on the continen-

11. U.N., Gen. Ass., Off. Rec., doc. A/CONF.13/C.4/L.10.

tal shelf any kind of fundamental research having a purely scientific objective, provided that: (a) the permission for scientific research has been applied for by an appropriate and qualified institution; (b) the applicant has given a full description of the nature and scope of the research work contemplated; (c) the coastal State will be given the opportunity to participate in the research project or to nominate observers to follow such work; and (d) the observations made, the data obtained and all conclusions derived from the scientific research shall be published¹². In other words, the Iranian proposal boils down to the following position: the coastal State's permission is always required for fundamental research on the continental shelf but *shall* be granted if the applicant fulfils certain explicitly mentioned conditions. The French proposal reads as follows:

The consent of the coastal State shall be obtained in respect of any research into the soil or subsoil of the continental shelf. Nevertheless, the coastal State shall not normally withhold its consent if the request is submitted by a qualified institution with a view to purely scientific research into the physical or biological characteristics of the continental shelf, subject to the proviso that the coastal State shall have the right, if it so desires, to participate or to be represented in the research, and that in any event the results shall be published¹³.

The French proposal contains partly some elements of the Iranian proposal and partly reflects the views expressed by the International Law Commission in its commentary on Article 68 of its 1956 draft. The French proposal corresponds with the Iranian proposal in the following respects: (a) that the application for fundamental research should be made by a qualified institution; (b) that the coastal State should have the opport-

12. U.N., Gen. Ass., Off. Rec., doc. A/CONF. 13/C.4/L.50. The Iranian proposal reads: "Notwithstanding the provisions of article 68, and in the interest of scientific progress, the coastal State shall, at the request of appropriate and qualified institutions, permit them to carry out on the continental shelf any kind of fundamental research having a purely scientific objective, provided that:

a) The institution concerned shall in its application to the coastal state give a full description of the nature and scope of the research work contemplated, that

b) The coastal state may choose to participate in such research work, or to nominate observers to follow such work, and that

c) The observations made, the data obtained and all conclusions derived therefrom shall be published".

13. U.N., Gen. Ass., Off. Rec., doc. A/CONF.13/C.4/L.56.

unity to participate in the planned fundamental research; and (c) that the research results should be published. The French proposal coincides with the position taken by the International Law Commission as regards the submission that the consent of the coastal State should normally be not withheld. The substantial difference between the French and Iranian proposals is that the latter implies consent of the coastal State if certain conditions have been fulfilled, whereas, in essence, the former leaves it entirely to the discretionary power of the coastal State to consider whether exceptional circumstances justifying a refusal of fundamental research are present. Premising of the coastal State's consent, the Iranian proposal is to be preferred, since the fulfilment of certain conditions by the applicant would result automatically in the obligation on the part of the coastal State to grant its permission. Perhaps this is one of the reasons why many States were not in favour of the Iranian proposal which ultimately has been rejected by 26 votes to 4, with 24 abstentions. In this connection it is worth quoting the delegate of Yugoslavia who stated at the 29th meeting of the Fourth Committee that he preferred the French proposal, but would also be prepared to support the Iranian proposal provided that the word "shall" in its first sentence were replaced by "may"¹⁴ The French proposal, being more attractive for coastal States, was adopted in the Fourth Committee by 30 votes to 17 with 6 abstentions. The vote taken on this matter in the plenary session finally resulted in the adoption of the French proposal, be it with some changes in the wording of the first sentence. The first sentence as finally laid down in Article 5, Paragraph 8 of the Geneva Convention on the Continental Shelf reads:

The consent of the coastal State shall be obtained in respect of any research concerning the continental shelf and undertaken there.

The second sentence remained unchanged.

3. *Evaluation of the scientific research provisions of the Geneva Continental Shelf Convention*

In pursuance of Article 5, Paragraph 8, the consent of the coastal State is condition *sine qua non* for any fundamental research carried out concerning the continental shelf and under-

14. *Summary records of the Fourth Committee*, p. 84, para. 6.

taken there. The question here arises as to what is to be understood by "research concerning the continental shelf and undertaken there". As regards the interpretation of this wording, it is possible to distinguish between two alternatives: either the words "and undertaken there" are to be considered as a further specification of "any research concerning the continental shelf", or the wording in question refers to two completely different types of research, *viz.*: research concerning the continental shelf, and research physically undertaken on the continental shelf not being an investigation of the continental shelf. According to the first interpretation, research concerning the continental shelf without physical contact with or into the continental shelf will not be governed by Article 5, Paragraph 8. Consequently, some kind of research concerning the continental shelf, for example, the measurement of magnetic fields of gravity in the superjacent waters, does not require the consent of the coastal State. In the second interpretation the consent of the coastal State is required for any research concerning the continental shelf wherever it may take place and for any research physically carried out on the continental shelf for other purposes.

In connection with the first interpretation, the point to be raised here is, why the consent of the coastal State should not be required for fundamental research undertaken on the continental shelf for purposes other than investigation of the continental shelf itself. Taking the view that the protection of the interests of the coastal State in the exploration and exploitation of the continental shelf is the fundamental basis for the requirement of its consent for scientific research, it is difficult to understand why this interest should be limited to scientific research carried out on the continental shelf concerning the shelf and exclude scientific research undertaken on the continental shelf for other purposes. Assuming that the concept of the coastal State's consent is to be applied, it is then preferable to replace in the first sentence of Article 5, Paragraph 8 the phrase "concerning the continental shelf and undertaken there", with the phrase: "concerning the continental shelf or physically undertaken there".

The second sentence of Article 5, Paragraph 8 also deserves some further consideration. Here, as it was already pointed out above in connection with the French proposal, the coastal

State has in essence discretionary power to permit or to refuse fundamental research on the continental shelf. It is true that it has been submitted that such consent shall not normally be withheld; but this clause is hardly relevant here, since any specification as to under what circumstances permission may be refused is entirely lacking. The approach embodied in the Iranian proposal, referred to above, would have filled this gap, as herein the conditions under which the coastal State *shall* have to give its consent were precisely formulated. Another objection against the requirement of the coastal States' consent is that the coastal State is then in a position to delay any kind of fundamental research by postponing its decision¹⁵.

In order to come to some kind of understanding of the clause on fundamental research contained in Article 5. Paragraph 8, it is necessary to highlight the recent developments of claims by coastal States to off-shore areas. After the Second World War an undeniable trend towards extending claims of different nature and scope to parts of the adjacent seas, sea-bed and subsoil has manifested itself. In this connection it is worth mentioning: (1) The calculation of the territorial sea from straight baselines in the case of a particular geographical configuration of the coast. This right was explicitly recognized under certain circumstances and conditions by the International Court of Justice in the Anglo-Norwegian Fisheries Case in 1951 and later on codified as a general rule of international law in Article 4 of the Geneva Convention on the Territorial Sea and Contiguous Zone. (2) The lack of agreement among States as to the width of the territorial sea and the development towards an additional exclusive fishing zone. At the Geneva Conferences of 1958 and 1960 no solution for these problems

15. This point has also been raised by M.B. Schaefer whose objections against Article 5, paragraph 8, are: (1) lack of certainty as to the geographical extent of jurisdiction of the coastal State with respect to the continental shelf; (2) lack of certainty as to what kinds of research are subject to control by the coastal State; (3) length and uncertainty of time required to obtain permission from the coastal State to carry on research in the portions of the oceans under its jurisdiction; and (4) inaccessibility of portions of the ocean in the event the coastal State denies permission". (The Changing Law of the Sea. Effects on Freedom of Scientific Investigation, in *The Future of the Sea's Resources*, Proceedings of the Second Annual Conference of the Law of the Sea Institute, June 26-29, 1967, The University of Rhode Island, Kingston 1968, p. 114-116).

was found. At the present moment a majority of States claim exclusive fishing rights up to 12 miles from the baseline of which the territorial sea is to be calculated. (3) The recognition of "special interests" of the coastal State in the maintenance of the production of the living resources in any area of the high seas adjacent to its territorial sea. In this respect reference is to be made to Articles 6 and 7 of the Geneva Convention on Fishing and the Conservation of the Living Resources of the High Seas. (4) The sovereign rights of the coastal States over the continental shelf for the purpose of exploring it and exploiting its natural resources. In the light of these developments the requirement of the coastal State's consent for fundamental research on the continental shelf is not entirely surprising.

Nevertheless, it is to be questioned whether the requirement of the coastal State's consent for fundamental research can be reasonably justified. It is certainly not hypothetical that a conflict may arise between the rights of the coastal State over its continental shelf and fundamental research carried out concerning that continental shelf. In this respect the interest of the coastal State in scientific research is not irrelevant. Other arguments put forward in favour of the coastal State's consent, as security considerations and industrial espionage¹⁶, are not only vague and unprecise, but are also not in conformity with the clearly restricted rights of the coastal State over the continental shelf. On the other hand, fundamental research in the high seas, including the sea-bed and subsoil, is of great importance for mankind. Accordingly, the crucial question is to find a synthesis for these two types of interests which may be in conflict.

However, in the approach laid down in Article 5, Paragraph 8, the interest of the coastal State has been overvalued because the formal consent of the coastal State for the purpose of fundamental research is always condition *sine qua non*. In essence, Article 5, Paragraph 8, is contrary to the rights of the coastal State over the continental shelf as provided for in Article 2 of the Geneva Convention on the Continental Shelf since it boils down to a direct and effective control of fundamental research concerning the continental shelf by the coastal State. Further-

16. See O. DE FERRON, *Le droit international de la mer*, vol. II, Librairie E. Droz and Librairie Minard, Genève-Paris 1960, p. 219.

more, the question arises as to whether the provisions of Paragraphs 1 and 8 of Article 5 are logically consistent. On the one hand, it is stated that the exploration and exploitation of the continental shelf must not result in any interference with fundamental research; on the other hand, it is submitted that the coastal State's consent is required for fundamental research of the continental shelf. These two provisions are only consonant if scientific research in Paragraph 1 is restricted to scientific research concerning the superjacent waters. However, the clause of Paragraph 1, here referred to, being the result of the Danish proposal discussed above, has been intended to include fundamental research of the sea-bed. Accordingly, the two paragraphs are legally inconsistent if the intention of the Danish proposal will be respected. This inconsistency is quite clear from the statement made by the French delegate at the twenty-ninth meeting of the Fourth Committee when he said that he could not accept the Danish or Panamanian proposals which contained no provision whatever regarding the coastal State's consent¹⁷. Therefore, it is understandable that it has been suggested to delete the provision of Article 5, Paragraph 8¹⁸.

In dealing with this matter it is in principle possible to distinguish among the following alternatives: (1) deletion of Article 5, Paragraph 8 without making any further provision on fundamental research undertaken on the continental shelf; (2) freedom of fundamental research on the continental shelf, provided that the institution planning to undertake this research notifies in advance the coastal State involved; (3) freedom of fundamental research, but on the condition that previously mutual consultation is required between the institution planning to undertake such research and the coastal State; (4) freedom of fundamental research, provided that certain explicitly mentioned conditions have been fulfilled on the part of the institution intending to undertake such research; (5) the consent of the coastal State is required, but may not be refused if certain specific conditions have been fulfilled on the part of the institution planning to undertake fundamental research; and (6)

17. See statement made by Mr. Patey, *Summary Records of the Fourth Committee*, p. 84, para. 2.

18. See M.S. McDougal and W.T. Burke, *The Public Order of the Oceans*, Yale University Press, New Haven - London 1962, p. 714-722.

the consent of the coastal State is unconditionally required and, accordingly, it is entirely within the discretionary power of the coastal State to grant or to refuse permission to undertake fundamental research on the continental shelf.

Application of the alternative mentioned *sub* (1) would in fact result in complete freedom of fundamental research, as it has in fact been laid down in Article 5, Paragraph 1. Nevertheless, this does not imply absolutely unrestricted freedom, since freedom of fundamental research, being one of the freedoms of the high seas, is to be exercised by all States with reasonable regard to the interests of other States in the exercise of the freedoms of the high seas¹⁹. If in exercising the freedoms of the high seas the interests of other States in the exercise of these freedoms have to be respected, it is beyond any doubt that no interference may take place with the continental shelf rights of the coastal State. The alternative suggested *sub* (2) implies that after notification of planned research the coastal State will have the opportunity to raise objections²⁰. A first step towards the solution of a possible controversy should be direct negotiations between the parties involved. In this approach strict time limits for the purposes of raising objections and the conduct of negotiations should be fixed previously in order to prevent the dispute being dragged out for a long period of time. Moreover, an impartial institution should be in charge of the settlement of the dispute if the parties do not come to terms on the basis of direct negotiations. An example for the settlement of these kind of disputes can be found in Article 9 of the Geneva Convention on Fishing and Conservation of the Living Resources of the High Seas. The third alternative is nearly identical to the second, although immediate consultation may speed up the whole procedure for the settlement of the question of whether fundamental research should be carried out or not. In the alternatives suggested *sub* (2) and *sub* (3) the coastal State should have the opportunity to participate in the planned fundamental research. In the fourth alternative the freedom of fundamental research is restricted because the undertaking of this research is *a priori* subject to certain conditions. By certain conditions

19. See Article 2 of the Geneva Convention on the High Seas, 1958.

20. This solution has also been suggested by M.S. McDougal and W.T. Burke, *op. cit.*, o. 722.

is to be understood here, in any event, that the institution planning to undertake fundamental research is willing: (a) to guarantee open publication of research results; (b) to offer the coastal State the opportunity to participate in the planned research to appoint observers; and (c) to propose an impartial institution for the settlement of any dispute that might arise. The coastal State may raise objections within a certain prefixed period of time after being notified of planned research. Within this same period — which should be rather restricted — the coastal State must prove that the aforementioned conditions have not been fulfilled. If no objections have been raised within the given period then fundamental research may be commenced, in accordance with the above conditions. The difference between the fifth and fourth alternative is that in the case of the fifth approach, the institution planning fundamental research has to prove that the coastal State has unjustly withheld its consent. Finally, the sixth alternative does not need further consideration because this approach laid down in Article 5, Paragraph 8 has been criticized above.

In order to promote fundamental research concerning the continental shelf and fundamental research physically to be carried out on the sea-bed for purposes other than scientific investigation of the continental shelf the second and third alternatives have to be preferred. As regards any other research physically to be carried out on the sea-bed but having no bearing on scientific investigation of the continental shelf, the consent of the coastal State should be required.

Unfortunately, it is not to be expected that in due course the Geneva Convention on the Continental Shelf will be changed as far as Article 5, Paragraph 8 is concerned. Accordingly, this provision, however regrettable it may be, will be applicable in large parts of the world. This situation is the more rejectable, since there is not yet agreement on the outer limit of the continental shelf in the legal sense. One of the most important conclusions to be drawn from the foregoing considerations is that in the development of a legal regime for the peaceful uses of the sea-bed beyond the limits of national jurisdiction the freedom of fundamental research is to be respected and not to be restricted by special provisions like those contained in the Continental Shelf Convention.

4. *Scientific research on the sea-bed beyond the limits of national jurisdiction*

Supposing that in the near future a special regime will be developed for the uses of this part of the sea-bed, two questions have to be taken into consideration: (1) What is the present legal regime for scientific research? and (2) What should be the legal regime for scientific research *de lege ferenda*?

In connection with this, attention is to be drawn to the concept of the freedom of the high seas. In pursuance of Article 2 of the Geneva Convention on the High Seas the freedom of the high seas comprises *inter alia*, for all States: freedom of navigation, freedom of fishing, freedom to lay submarine cables and pipelines and freedom to fly over the high seas. Furthermore, Article 2 provides that these freedoms and others which are recognized by the general principles of international law shall be exercised by all states with reasonable regard to the interests of other States in the exercise of the freedoms of the high seas.

In its commentary on Article 27 of its 1956 draft the International Law Commission stated that the list of freedoms of the high seas enumerated in this article is certainly not restrictive. It was merely the intention of the International Law Commission to specify four of the main freedoms, but it is aware that there are other freedoms, such as freedom to undertake scientific research on the high seas²¹.

At the Geneva Conference on the law of the sea of 1958, Portugal proposed to add to the four explicitly mentioned freedoms of the high seas the freedom to undertake research, experiments and exploration²². This proposal is, however, wider than freedom of fundamental scientific research, as clearly appears from the words "experiments and exploration". The word "experiments" especially encompasses political and mili-

21. U.N., Gen. Ass., Off. Rec., Eleventh session, *Report of the International Law Commission Covering the Work of Its Eighth Session*, ... p. 24. Article 27 of the 1956 draft reads: "The high seas being open to all nations, no State may validly purport to subject any part of them to its sovereignty. Freedom of the high seas comprises, *inter alia*: (1) Freedom of navigation; (2) Freedom of fishing; (3) Freedom to lay submarine cables and pipelines; (4) Freedom to fly over the high seas".

22. U.N., Gen. Ass., Off. Rec., doc. A/CONF.13/C.2/L.7.

tary aspects, because of past nuclear tests in the high seas, an issue which was subject to controversial discussions at the 1958 Conference. The Portuguese proposal would undoubtedly have been more successful if it would have been restricted to the explicit recognition of fundamental research being subject to open publication. As it was formulated, it was rejected by 29 votes to 13, with 8 abstentions.

Although freedom of scientific research has not been mentioned expressly in Article 2 of the Geneva Convention on the High Seas, it is to be considered as one of the freedoms of the seas. As it appears from the view taken by the International Law Commission, this freedom like the other freedoms of the high seas are limited only by the general principle that States are bound to refrain from any acts which might adversely affect the use of the high seas by nationals of other States.

From the expressly formulated freedoms of the high seas it seems to be clear that the concept of the freedom of the high seas relates to the air space above the high seas, the waters of the high seas and the sea-bed beneath the high seas. However, the question is to be raised as to whether the sea-bed and subsoil of the high seas beyond the continental shelf are capable of occupation. A positive answer to this question implies that to those parts of the sea-bed and/or subsoil which have been occupied the principle of the freedom of the seas is not applicable, while in a negative answer the application of this principle is not restricted.

As regards the sea-bed it is worth referring to the sovereign rights which have been exercised by some coastal States during a long period of time for the purpose of the exploitation of sedentary fisheries. By virtue of the recognition of these rights in international law the view has been advocated that the sea-bed is capable of occupation²³. In fact, these rights are exceptional rights based on an historic title and do not prove that the sea-bed in general is capable of occupation. As regards the subsoil, the question referred to above has been answered in general in the affirmative²⁴. In this connection attention

23. See Oppenheim-Lauterpacht, *International Law. A Treatise*, vol. I, 8th ed., Longmans, Green, and Co., Ltd., London etc. 1961, p. 628-629.

24. See *ibid.*, p. 629-631; also C.J. COLOMBOS, *International Law of the Sea*, 6th ed., Longmans, Green and Co., Ltd., London etc. 1967, p. 67-70.

is to be drawn to mining operations of mineral deposits which extend from the territory of the coastal State into the subsoil beneath the high seas and to the construction of tunnels between two parts of the mainland separated by the high seas. The exploitation of the subsoil by means of tunnelling has been recognized in Article 7 of the Geneva Convention on the Continental Shelf irrespective of the depth of water above the subsoil. Accordingly, it is in principle possible that the rights of coastal States into the subsoil may extend beyond the continental shelf by virtue of effective occupation. Exploitation of the subsoil by means of tunnelling has manifested itself in several parts of the world. Up to now, tunnels for transportation purposes have not yet been constructed in the subsoil beneath the high seas.

The occupation of the sea-bed and subsoil in the above-mentioned cases has taken place merely in areas relatively close to the coast. Since the continental shelf rights have been recognized in international law, coastal States are in general in a position to exercise these rights on the basis of this concept. If not, it is self-evident that fundamental research in the particular areas is not entirely free because important interests of the coastal State are at stake. Here, consultation between the institution planning fundamental research and the coastal State recommends itself²⁵.

It has not been decided in present-day international law whether a State is entitled to occupy a part of the sea-bed and/or subsoil, for example in the middle of the ocean where a clear geographical relationship between the State in question and the sea-bed and/or subsoil is entirely lacking. In the absence of any such rule and of any such occupation the assumption is to be made that the principle of the freedom of the high seas, including freedom of scientific research, is governing the use of the sea-bed and subsoil which are beyond the limits of national jurisdiction. Finally it deserves attention that scientific research on the sea-bed or into the subsoil of the ocean floor is not in itself a title for the acquisition of any sovereign rights.

In connection with a solution *de lege ferenda* for scientific research carried out on the sea-bed of the deep sea area it is

25. See pages 603-607 *supra*.

of great importance to remember that in the United Nations debates in 1967 as well as in the legal working group of the *ad hoc* committee to study the peaceful uses of the sea-bed and ocean floor beyond the limits of national jurisdiction, a large number of members expressed the view that the area under discussion was not susceptible to appropriation and that States could not exercise national sovereignty over such an area²⁶. If the future legal regime of the ocean floor will be developed along the lines of non-appropriation, fundamental research will not fall under the exclusive jurisdiction of any State.

In dealing with the legal regime of fundamental research concerning or physically carried out on the sea-bed of the deep sea area it is of great importance to focus the preliminary question: What legal regime will be applied to the uses of this area? Whatever legal regime ultimately will be applied to the exploration and exploitation of the natural resources of the sea-bed and subsoil of the ocean floor, one of the essential elements of such regime should be that the States directly or indirectly exploring and exploiting these resources should acquire exclusive rights²⁷. By exploration and exploitation exercised indirectly by a State will be understood here the exploration and exploitation by companies to which the State has granted licenses after having acquired itself a lease for part of the sea-bed and subsoil. The exclusiveness of rights is an absolute necessity because of the great risk to be taken on the part of those who will effectively undertake the exploration and exploitation operations. Moreover, it has to be taken into consideration that if exclusive rights will not be guaranteed in advance, it is hard to believe that any State or company will be willing to undertake the operations in question. Accordingly, there will be, in principle, no difference between the exclusive rights on the continental shelf and the deep sea area. The only substantial difference is that no State enjoys *ipso facto* exclusive rights over parts of the sea-bed and subsoil of the ocean floor,

26. See U.N., Gen. Ass., Off. Rec., *Report of the Ad Hoc Committee to Study the Peaceful Uses of the Sea-Bed and the Ocean Floor Beyond the Limits of National Jurisdiction*, (doc. A/7230), New York, September 1968, p. 44; also doc. A/AC.135/12, 7 June 1968, *Summary of Views of Member States*, p. 26-28.

27. From the practical point of view it is not to be expected that this exploration and exploitation will be undertaken by some type of international organisation.

such as the coastal State does in the case of the continental shelf.

In devising a regime for deep sea mining it will, however, be necessary to take into account the other interests protected and to be protected by international law, such as the freedom of navigation, fisheries, the laying of submarine cables and pipelines, the freedom of scientific research, the prevention of pollution, etc.²⁸. As regards the freedom of fundamental research we are again confronted with two different kinds of interests, as in the case of the continental shelf, *viz.*: exclusive exploration and exploitation rights on the one hand and the interest of fundamental research to be undertaken on the sea-bed on the other. Here, the importance of fundamental research is even more important because of the tremendous effort which is to be made in the scientific field to acquire a better understanding of the enormous and, in many respects, unknown deep sea area. It hardly needs to be emphasized that in making fundamental research dependent on the consent of the States which have acquired exclusive exploration and exploitation rights for particular areas of the sea-bed and subsoil of the deep-sea area would be a serious mistake. This would frustrate any research project to be carried out on the sea-bed. In this sense reference is to be made to the several alternatives suggested in Paragraph 3 above²⁹. In order to prevent all misunderstandings, a special provision governing the freedom of fundamental research undertaken on the sea-bed should be laid down in the future convention on the uses of the sea-bed beyond national jurisdiction. Here, the following provision is recommended:

The exploration of the sea-bed and exploitation of its natural resources must not result in any unjustifiable interference with navigation, fishing, the conservation of the living resources, scientific research of the waters of the high seas and fundamental research concerning the sea-bed and subsoil or physically undertaken on the sea-bed with the intention of open publication³⁰.

28. L.J. BOUCHEZ (rapporteur), *Report of the Deep-Sea Mining Committee on the Exploration and Exploitation of Minerals on the Ocean Bed and in Its Subsoil*, submitted to the Conference of the I.L.A., held in Buenos Aires (1968), p. 3.

29. See note 25.

30. See in this connection Article 5, Paragraph 1, of the Geneva Convention on the Continental Shelf, quoted on p. 596 *supra*.

The State under whose supervision exploration and exploitation on the sea-bed takes place should have the opportunity to raise objections to fundamental research intended to be undertaken on the sea-bed. For the solution of these conflicting interests the suggestions made previously in discussing fundamental research on the continental shelf have to be taken into account here, too ³¹. The consent of the State involved should always be required for (1) scientific research of the sea-bed and subsoil connected with the exploration and exploitation of natural resources, and (2) scientific research for specific purposes, having no bearing on scientific investigation of the deep sea area, physically undertaken on the sea-bed without the intention of open publication.

In the above considerations the view has been taken that only States will have the opportunity to acquire exclusive rights for the purposes of exploration and exploitation of the sea-bed of the deep sea area. Nevertheless, States will be in a position to grant licenses to enterprises. On the other hand, the view has been advocated that enterprises should be in a position to acquire, directly, exclusive rights. If States acquire exclusive rights the exploration and exploitation of the sea-bed will in principle be governed by the mining legislation and safety regulations of the States involved. Supposing, however, that exclusive rights will be acquired by enterprises directly, the question arises whether in this case international mining legislation has to be set up or whether the legislation of the State with which the enterprise has a genuine link will be applicable.

Whatever alternative will be chosen ultimately, at least general standards for the manner in which the sea-bed of the deep sea may be used have to be laid down in an international convention. Even if it would be decided to apply the national legislation of the States involved, international provisions containing these general standards should be made since the requirements of the respective national legislations have to be adapted to these general standards. In this connection attention is to be focussed on safety regulations governing exploration, exploitation and scientific research undertaken on the sea-bed. It

31. See pp. 603-604 *supra*; esp. alternatives *sub* (2), (3) and (4).

will not be that difficult to draft these general standards because the main principles have already been laid down in the safety regulations for off-shore operations of many coastal States ³². The general standards should refer to *inter alia*: exploration, drilling, abandonment of wells, the use of electric installations, the use of ocean data acquisition systems, the use of radioactive equipment, storage and use of explosives, communications on the sea-bed, the prevention of pollution or radioactive contamination, etc. In addition to these safety regulations it is necessary to provide for general standards relating to damage caused by the use of the sea-bed and subsoil to other uses of these areas and the high seas which have been recognized in international law. In this connection special attention should be drawn to liability regulations.

As it appears from the United Nations debates in 1967 and the report of the *ad hoc* committee to study the peaceful uses of the sea-bed beyond the limits of national jurisdiction, a very large number of States are in favour of the deep sea area being reserved exclusively for peaceful purposes ³³. It, however, the use of this area for military purposes will not be ultimately prohibited, scientific research may be hampered in several parts of the sea-bed. This conflict will not be solved easily since a State, operating for example some kind of naval base on the sea-bed, or using parts of the sea-bed or subsoil for testing military equipment, will not have much sympathy for scientific research to be undertaken in these areas or in the immediate vicinity thereof. This attitude is understandable because in this manner espionage could take place under the guise of fundamental research. Accordingly, the reservation of the deep-sea area for peaceful purposes only recommends itself, as it will be extremely difficult to solve conflicts which might arise between the uses for peaceful and military purposes. In support of this view it is worth noting two important precedents: the Antarctic Treaty of December 1, 1959, and the Treaty on

32. See *inter alia*: The Norwegian regulations relating to safe practice etc. in exploration for and exploitation of petroleum resources of the sea-bed and its subsoil, *Royal Decree of 25 August 1967*, reproduced in the U.N. doc. A/AC.135/1, Add. 1, 12 March 1968; also the *Netherlands Mining regulations for the continental shelf* of 13 March 1967.

33. See *Report of the Ad Hoc Committee ...* (U.N. doc. A/7230), p. 45.

principles governing the activities of States in the exploration and use of outer space including the moon and other celestial bodies of January 27, 1967.

5. *Co-operation and co-ordination of scientific research*

The use of the sea-bed and subsoil beyond national jurisdiction is one of the greatest challenges of mankind. In order to be able to acquire the greatest benefits for all nations it is condition *sine qua non* that a comprehensive programme of marine science activities will be developed and carried into effect in close co-operation among all nations. Such a programme should refer to scientific research of the ocean floor and the development of relevant technologies to be used in scientific research. The new frontier of knowledge should not be the privilege of a limited group of technologically and economically advanced countries. Accordingly it is not sufficient to express the view that the sea-bed beyond the limits of national jurisdiction should be regarded as the common heritage of mankind, but it is an absolute necessity to organize the co-operation in and co-ordination of research programmes among States. Moreover, taking into account the considerable investments to be made for marine research, co-operation in and co-ordination of research are required in order to prevent great inefficiencies inherent in an individualistic approach by the States separately.

Co-operation in and co-ordination of scientific research is relevant on the national as well as the international level. On the national level State agencies, universities and industry should combine their efforts. The State itself is in a position to stimulate such a development and should act as co-ordinator. In some States a national organization for the purpose of marine science activities has been set up recently. In the United States the Marine Resources and Engineering Development Act was approved on June 17, 1966³⁴. Section 2 (a) of this Act contains the following declaration of policy:

It is hereby declared to be the policy of the United States, to develop, encourage, and maintain a co-ordinated, comprehensive, and long-range

34. *Interim report on the United Nations and the issue of deep ocean resources together with hearings by the subcommittee on international organizations and move-*

national program in marine science for the benefit of mankind to assist in protection of health and property, enhancement of commerce, transportation, and national security, rehabilitation of our commercial fisheries, and increased utilization of these and other resources.

Furthermore, it is stated in Section 2 (b) that the marine science activities of the United States should be conducted so as to contribute to the following objectives: (1) the accelerated development of the resources of the marine environment; (2) the expansion of human knowledge of the marine environment; (3) the encouragement of private investment enterprise in exploration, technological development, marine commerce, and economic utilization of the marine environment; (4) the preservation of the role of the United States as a leader in marine science and resource development; (5) the advancement of education and training in marine science; (6) the development and improvement of the capabilities, performance, use, and efficiency of vehicles, equipment and instruments for use in exploration, research, surveys, the recovery of resources, and the transmission of energy in the marine environment; (7) the effective utilization of the scientific and engineering resources of the Nation, with close co-operation among all interested agencies, public and private, in order to avoid unnecessary duplication in effort, facilities, and equipment, or waste; and (8) the co-operation by the United States with other nations and groups of nations and international organizations in marine science activities when such co-operations is in the national interest. Furthermore a National Council on Marine Resources and Engineering Development has been established which is in charge of advising the President in matters of marine science activities, *inter alia* on the development of programmes of marine research and the co-operation in and co-ordination of these programmes.

According to the French Law of January 3, 1967³⁵, the *Centre National pour l'Exploitation des Océans* (C.N.E.X.O.) was established. The main tasks of C.N.E.X.O. are the development of knowledge of the oceans and the study and research

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ments of the committee on foreign affairs of the House of Representatives, Washington 1967, p. 224.

35. See *Journal Officiel de la République Française*, 1967, p. 131.

on the exploitation of the natural resources of the waters, the sea-bed and subsoil of the oceans. In exercising these functions C.N.E.X.O. will keep close contacts with the governmental departments and industry. Moreover, C.N.E.X.O. is in charge of suggesting proposals to the Government as regards development and research programmes. From the foregoing, it is clear that in the United States and France an important contribution has been made to the organization and co-ordination of marine science activities on the national level. These examples deserve imitation by the other economically and technologically advanced countries ³⁶.

For the organization and co-ordination of marine science activities on the international level some kind of international organization is required. The most qualified institution to fulfil these functions is UNESCO and, especially, the Intergovernmental Oceanographic Commission (IOC).

As it appears from Article 1, Paragraph 2 of the Statutes of IOC, the purpose of the Commission is to promote scientific investigation with a view to learning more about the nature and resources of the oceans through the concerted action of its members. Furthermore, the Commission is in charge of considering and recommending international programmes for oceanographic investigation together with the necessary steps for their execution which call for concerted action by its members. The Commission reviews the results of scientific investigation and defines the basic problems requiring international co-operation. The Secretariat of the IOC ensures the day-to-day co-ordination of the international programmes of oceanic investigations recommended by the Commission. From the foregoing it is not surprising that in the United Nations resolutions of December 6, 1966, December 28, 1967, and December 27, 1968, the qualifications of IOC in the field of marine science activities have been explicitly recognized ³⁷. The key-role to be played by IOC as regards the co-ordination of international scientific research of

36. In the United Kingdom a *Report on Marine Science and Technology* was presented to Parliament in April 1969 (Cmnd. 3992). This report was discussed in the House of Lords on July 2, 1969; see *Parliamentary Debates (Hansard)*, vol. 303, No. 86, H.M.S.O., London 1969.

37. See U.N., Gen. Ass., Off. Rec., doc. doc. A/RES/2172 (XXI); A/RES 2340 (XXII); A/RES/2414 (XXIII).

the oceans was clearly reflected in the United States draft resolution of August 26, 1968, on the international decade of ocean exploration and in the United Nations resolution of January 14, 1969³⁸. In the latter resolution it was *inter alia* suggested that the IOC should intensify its activities in the scientific field in particular with regard to co-ordinating the scientific aspects of a long-term and expanded programme of world-wide exploration of the oceans and their resources, including international agency programmes, an expanded international exchange of data from national programmes, and international efforts to strengthen the research capabilities of all interested nations with particular regard to the needs of the developing countries.

Finally, attention is to be drawn to Resolutions Nos. 2342, 2343 and 2344 adopted at the 15th session of the General Conference of UNESCO, held from October 15 through November 20, 1968. In the first resolution the Director-General of UNESCO was authorized *inter alia*: (1) to facilitate the short and long-term planning and co-ordinating by the IOC of international expeditions and other research activities in liaison with the Scientific Committee on Oceanic Research and the International Association for the Physical Sciences of the Ocean and to continue to ensure the publication of data, atlases and reports resulting from such activities; and (2) to assist the IOC with a view to solving the problem of safeguarding the freedom of scientific research outside territorial seas. In the second resolution the Director-General was authorized to take further measures in order to ensure adequate participation of the interested organizations of the United Nations in supporting the work of IOC. In the third resolution the Director-General was authorized, acting in co-operation with the United Nations and other international organizations, to continue to stimulate and assist study, research and training of personnel in marine science, as a contribution to the promotion of the general advancement of oceanography. In the meantime a special IOC Working Group on the long-term expanded programme of oceanographic research has been set up. According to the circular letter to members of April 16, 1969, a meeting of this working-group was scheduled to take place in Paris from June

38. See *ibid.*, doc. A/RES/2467 D (XXIII); also doc. A/AC.135/33.

16 to June 21, 1969, in order "to prepare a report setting forth proposals for the long-term and expanded programme of world-wide exploration of the oceans and their resources of which the International Decade of Oceanographic Exploration is an important element".

From the foregoing it is clear that IOC has been considered as the most qualified institution for the co-ordination of marine science activities on the international level. In order to promote this co-ordination and to be sure that the institutions intending to undertake fundamental research are sufficiently qualified, it would be desirable to register these institutions with UNESCO. Furthermore, a special institution should be established within the framework of UNESCO to be in charge of the co-ordination of the development of technology, directly connected with marine science activities.

6. *Conclusions*

(1) Freedom of fundamental research is essential for acquiring a better scientific understanding of the sea-bed and is of fundamental interest for mankind. (2) Scientific research to be carried out on the sea-bed of maritime internal waters, the territorial sea and continental shelf requires the consent of the coastal States involved. (3) The coastal State's consent as far as fundamental research of the continental shelf is concerned is in essence contrary to the purposes for which the coastal State enjoys rights over the continental shelf. (4) Instead of the coastal State's consent, freedom of fundamental research should prevail, provided that: (a) consultation between the coastal State and the institution intending to undertake fundamental research concerning the continental shelf will take place, and (b) the coastal State will be given opportunity to participate in this research. (5) Fundamental research of the sea-bed beyond the limits of national jurisdiction should be undertaken freely, provided, however, that consultation mentioned *sub* (4) will take place if, for example, in the area involved leases have been granted to a State for the exploration and exploitation of the sea-bed. (6) The conclusions mentioned *sub* (4) and (5) should also be applicable to fundamental research physically carried

out on the ocean floor, which has no relationship with the investigation of the sea-bed and subsoil. (7) As regards those portions of the sea-bed and subsoil of the ocean floor over which the State exercises exclusive exploration and exploitation rights, the consent of this State is to be requested for (a) scientific research connected with the exploration and exploitation of the natural resources of these areas, and (b) any research physically undertaken on the sea-bed without the intention of open publication. (8) As regards the manner in which scientific research, exploration and exploitation on the deep-sea area should be carried out, and as to liability flowing from these activities general standards have to be laid down in international safety and liability regulations. (9) Marine science activities should be co-ordinated on the national and the international level. On the national level the State itself and on the international level the Intergovernmental Oceanographic Commission should fulfil roles as co-ordinators.

SCIENTIFIC RESEARCH ON THE SEA-BED AND ITS REGIME

BY

Dr. EBERHARD MENZEL

*Professor of International Law; Director, Institute of International Law
at the University of Kiel, Kiel*

I. *No general "freedom of scientific research"?*

The Geneva Convention on the High Seas (1958) proclaims in Article 2 paragraph 1 four freedoms: freedom of navigation, freedom of fishing, freedom to lay submarine cables and pipelines and freedom to fly over the high seas. The second paragraph of that Article states:

These freedoms, and others which are recognized by the general principles of international law, shall be exercised by all States with reasonable regard to the interests of other States in their exercise of the freedom of the high seas.

Therefore, the freedom of scientific research can only be regarded as one of the "other" freedoms referred to in paragraph 2. This would require that it has been recognized as a general principle of international law.

The *travaux préparatoires* leading to the final text of the Convention on the High Seas¹ give the impression that there is no such generally recognized freedom of research. During the negotiations the United Kingdom suggested to add a "freedom of research, experiment and exploration"². But both the International Law Commission and the United Nations Conference on the Law of the Sea missed the opportunity to insert

1. U.N. Conference on the Law of the Sea, 1958, Official Records, Vol. II, p. 15, 92-93; vol. VI, p. 81-91, 119-120.

2. Yearbook of the International Law Commission, 1956, Vol. I, p. 29-32; Vol. II, p. 80, 253, 259.

the fifth freedom into the drafts. This seems to indicate that even the International Law Commission (ILC), a body of experts in the field of international law, was unwilling to recognize the freedom of research as a principle of present-day international law.

But one has to be cautious with a statement like this. There may be special reasons why the International Law Commission wished to remain silent on this point. This problem will be dealt with in the context of international regimes regarding the ocean floor.

But the right to scientific research was not totally ignored by the ILC or the Geneva Conference. It is mentioned explicitly in the Convention on the Continental Shelf, but in a negative rather than in a positive sense. Article 5 paragraphs 1 and 8 are as follows:

1. The exploration of the continental shelf and the exploitation of its natural resources must not result in any unjustifiable interference with navigation, fishing, or the conservation of the living resources of the sea, or result in any interference with fundamental oceanographic or other scientific research carried out with the intention of open publication.

And:

8. The consent of the coastal State shall be obtained in respect of any research concerning the continental shelf and undertaken there. Nevertheless, the coastal state shall not normally withhold its consent if the request is submitted by a qualified institution with a view to purely scientific research into the physical or biological characteristics of the continental shelf, subject to the proviso that the coastal State shall have the right, if it so desires, to participate or to be represented in the research, and that in any event the results shall be published.

These regulations are very vague in some points³: What is an "unjustifiable interference"? Who is to judge on the "intention of open publication"? What is meant by "nor-

3. For the explanation of legal terms used in Art. 5 of the Convention on the Continental Shelf see L.F.E. Goldie, *Submarine Zones of Special Jurisdiction*, in: Lewis M. Alexander (ed.), *The Future of Sea's Resources*, Proceedings of the Second Annual Conference of the Law of the Sea Institute, University of Rhode Island, June 26-28, 1967, Kingston, R.I., 1968, p. 100-107.

mally ” in paragraph 8? But one fact is quite clear: that these rules are only valid for the area of the continental shelf. This gives rise to the question whether or not the problem of freedom of scientific research is to be treated differently in the various maritime zones.

For practical reasons the legal status not only of men who are engaged in scientific work but also the legal status of the research vessels will be examined on the following pages.

2. Freedom of research in respect to the different maritime zones

1. Inland waters

Inland waters are those areas of water which although immediately adjacent to the land do not belong to the territorial sea in the strict technical sense of the word. These inland waters may be open to the passage by foreign vessels.

Research work in these waters requires the permission of the coastal State.

Research vessels flying the national flag of the country of registration have access, too. Even if they are governmental ships (State ships) operated for non-commercial purposes, their legal status is, as to the main aspects, the same as that of commercial ships (Art. 22 of the Convention on the Territorial Sea and Contiguous Zones). But if the research vessel is attached to the Navy and has the status of a warship the legal situation is different. The Geneva Convention on the Territorial Sea and the Contiguous Zone does not stipulate any previous authorization but empowers the coastal State to issue regulations in this sense. If a ship disregards these national regulations the coastal State may require the ship to leave the internal waters and the territorial sea.⁴ Research vessels that

4. Convention on the Territorial Sea and the Contiguous Zone (1958), Art. 23: “ If any warship does not comply with the regulation of the coastal State concerning passage through the territorial sea and disregards any request for compliance which is made to it, the coastal State may require the warship to leave the territorial sea ”.

are Governmental ships or have the same status as men-of-war enjoy immunities when passing through foreign inland and territorial waters.

2. *Territorial Sea*

The coastal State has sovereign authority over the territorial sea, but foreign vessels enjoy the right of innocent passage under international law.

Scientific research requires a special permission on the coastal State. It may be obtained through diplomatic channels. Only if such research work can be done in a way compatible with "innocent passage"⁵ — for instance limited to meteorological observations without further installations — no permission is needed⁶.

There is a general trend to enlarge the area of coastal waters. Formerly a distance of 3, 6 or even 12 miles was recognized. Nowadays some States, especially in Middle and South America and in Africa (Guinea) claim a breadth of the territorial sea of 120 or 200 miles. Though some States refuse to recognize the 200 mile rule, nevertheless the coastal States arrest ships not respecting these regulations (cf. the so-called Onassis cases and other incidents with Peru using warships against the offenders). No general consent as to the breadth of the territorial sea has been reached up to now, but there is a general rule that coastal waters and contiguous zone together shall not exceed 12 miles.

Scientific research by foreign ships within coastal waters requires the permission of the coastal state.

5. According to the Convention on the Territorial Sea and the Contiguous Zone (1958), Art. 14 par. 4 "passage is innocent so long as it is not prejudicial to the peace, good order or security of the coastal State. Such passage shall take place in conformity with these articles and with other rules of international law".

6. There is no legal definition of "scientific research" in the Geneva Conventions of 1958. It seems quite possible that future negotiations on the regime of the high seas will differentiate between the various kinds of research according to their purpose and means. Perhaps some sort of research which is not connected directly with economic or military purposes may be exempted from the requirement of the coastal State's permission. If this will happen one has to pay regard to three kinds of differentiation: one according to the maritime zones, the second to the legal status of the research vessel, and the third to the purpose and means of the scientific research concerned.

3. *Continental shelf*

As already mentioned above (under I) the Convention on the Continental Shelf regulates explicitly the scientific research concerning the continental shelf.

In order to define the term continental shelf, Article 1 of the Convention refers

a) to the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea, to a depth of 200 metres or, beyond that limit, to where the depth of the superjacent waters may admit the exploitation of the natural resources of the said areas;

b) to the sea-bed and subsoil of similar submarine areas adjacent to the coasts of islands”.

Two facts are of special interest for the purpose of this paper:

First: that the Convention refers only to the sea-bed and subsoil and not to the water space between sea-bed and surface and not to the surface itself. Therefore only the scientific research work dealing with the sea-bed and subsoil is covered by the above mentioned Article 5 of the Convention. Research work concerning the water space or the surface is, therefore, not regulated by Article 5 and does not need a permission by the coastal state. The decisive criterium therefore would be “the touching of the ground”. This view is backed by Article 3 of the Continental Shelf Convention which reads:

The rights of the coastal State over the continental shelf do not affect the legal status of the superjacent waters as high seas, or that of the air-space above those waters.

It is not quite clear whether this is really the State practice of today. There seem to be some attempts to ignore this limitation which in the interest of international scientific research should be stressed again and again.

Second: the other important conclusion to be drawn from the definition of the continental shelf in Article 1 of the Shelf Convention is the fact that the shelf area automatically increases in size to the same extent to which modern technology admits

the exploitation of the natural resources in depths of more than 200 metres. The definition avoids any indication concerning

a) a maximum depth; therefore the regime of the continental shelf in the near future may not be limited to the continental shelf in the geographical sense but may extend to the continental slope and even to the bottom of the deep sea;

b) a maximum distance from the shores or the outer boundary of the coastal waters; therefore it may be possible in a decade or so that the legal regime for the continental shelf will be applicable to zones outside the continental shelf in the geographical meaning of this term. As the last consequence, this may lead to a division of the seabed and subsoil even of the great oceans.

If modern technology will make it possible to exploit the sea-bed and the subsoil of the deep sea ("deep sea mining" in the strict sense), then the lacking of a maximum depth or a maximum distance from the shores will have such legal consequence that the regime of Article 5 of the Continental Shelf Convention will restrict the scientific research in regard in the bottom of the sea all over the world. No scientific work can then be done without the permission of the coastal State even if the coast is more than a thousand miles off.

This fact has led to the demand for a revision of the Continental Shelf Convention especially with regard to the definition in Article 1⁷.

7. There is strong opposition against the "exploitability test" or "exploitability clause" of Art. 1 of the Convention on the Continental Shelf. The demand for a fixed delimitation of the continental shelf was expressed during the negotiations for the final text of this convention and after 1958 for the elimination of this clause, e.g.: Burke, *Contemporary Legal Problems in Ocean Development*, in: *Towards a Better Use of the Oceans, A Study and Prognosis*, Stockholm, SIPRI (International Institute for Peace and Conflict Research), 1968, p. 15, 27-36; J.P. François — in U.N. doc. A/CN.4/Ser.A/1953, Add. 1, p. 38; G. Gidel — in U.N. doc. A/CN.4/32, p. 50-51; L.F.E. Goldie, *op. cit.*, p. 101; A. Gros in U.N. doc. A/CONF. 13/C.4/L.6, p. 2; Sir Hersch Lauterpacht, *Sovereignty over Submarine Areas*, 27 *British Yearbook of International Law* 1950, p. 376, 413-414; S. Oda, *Boundary of the Continental Shelf*, 12 *The Japanese Annual of International Law* 1968, p. 264-284; same author, *Proposals for Revising the Convention on the Continental Shelf*, 7 *The Columbia Journal of Transnational*

There is another problem emerging from these uncertainties of the text of Article 1 as now in force. It is said in this proviso that the continental shelf is extending to the depth of 200 metres "or where the depth of the superjacent waters admits of the exploitation of the natural resources of the said areas". As the limitation of the freedom of scientific research depends on the extension of the continental shelf, it is not clear whether the coastal State with the highest developed technology will be decisive, or whether this measurement is to be applied for each individual State. In the first case the continental shelf would have the same extent for all States using the fiction that all States have the same capability in applying modern technology. In the second case the extent of the continental shelf would differ according to the actual exploitation by each individual State. In the last mentioned case the extent of the continental shelves would differ from country to country and with it the extent of the limitations regarding the freedom of scientific research.

The question mentioned above should be answered in the sense that the extent of the continental shelf must be the same for all States. Besides practical reasons, the justification for this may be found in using an analogy drawn from Article 2 paragraph 3 of the Continental Shelf Convention. It says:

3: The rights of the coastal State over the continental shelf do not depend on occupation, effective or notional, or on any express proclamation.

If thus the coastal States possess a continental shelf although not making any use whatsoever of it, then the extent of this shelf area cannot depend on their activities in the individual case.

If this statement is true, the extent of the continental shelf already has over-stepped the 200 metres limit.

For authentic information on what is really going on in the field of exploration and exploitation permits one has to rely chiefly on American sources.

Law 1968, p. 1-31; Sir Humphrey Waldock — in U.N. doc. A/CN.4/Ser. A/1953, Add. 1, p. 213. For a recent report see G. Weissberg, *International Law Meets the Short-Term National Interests. The Maltese Proposal on the Sea-Bed and Ocean Floor — Its Fate in Two Cities*, 18 *The International and Comparative Law Quarterly* 1959, p. 41, 62-69.

William T. Burke in his excellent study "Contemporary Legal Problems in Ocean Development", presented to SIPRI in 1968, gives some interesting data.⁸

He first states that even in the USA the deepest oil producing well is located in only 340 feet of water off the coast of Louisiana. According to him none of the present non-fuel mineral exploitation efforts are located in deep water, that means outside the continental shelf. But on the other hand he reports that about fifteen countries have issued permits for industrial activity (not for research) beyond the 200 metres isobath. As to the permit practice of the USA he cites a report of Charles F. Luce, Under Secretary of the Interior, stating:

... the United States has taken action consistent with a claim of sovereign rights to the sea-bed and subfloor some distance from its coasts, by the granting of a phosphate lease some 30 miles from the California coast in the Forty Mile Bank area in 240 to 4.000 feet of water; by the granting of oil and gas leases some 30 miles off the Oregon coast in about 1.500 feet of water; and in the threatened litigation against creation of a new island by private parties on Cortez Bank, about 50 miles from San Clemente Island off the coast of California, or about 100 miles from the mainland. Each of the California areas is separated from the coast by troughs as much as 4.000 to 5.000 feet deep. The Department of the Interior has published OCS Leasing Maps indicating an intent to assume jurisdiction over the ocean bottom as far as 100 miles off the Southern California coast in water depths as great as 6.000 feet⁹.

Burke then reminds¹⁰ of the fact that exploratory drilling permits have been issued to depths of more than 3.000 feet (= 1.000 m) in the Gulf of Mexico and "apparently in the slope region" to depths of 4.000-5.000 feet off the Atlantic coast. Australia has granted an exploration permit for an area at some 200 miles distance from its coast. Honduras and Nicaragua have issued exploration permits for "an offshore area out to 225 miles".

These facts show that the definition of continental shelf in Article 1 of the Continental Shelf Convention is no more

8. See W.T. BURKE, *op. cit.*, p. 15, 25.

9. C.F. LUCE, The Development of Ocean Minerals and the Law of the Sea, Address before American Bar Association National Institute on Marine Resources, June 8, 1967; p. 4; quoted by Burke, *op. cit.*, p. 26.

10. *Loc. cit.*

in harmony with the technical progress. Therefore, enlarging the area of the continental shelf in the legal sense by unilateral acts of the coastal States has the consequence that the area in which the freedom of scientific research can be enjoyed without the permission of a coastal State will be narrowed more and more.

4. *Fishery zone*

The coastal state has a monopoly on fishing in the territorial waters. No foreigner is allowed to catch fish in these waters except with a special permission of the coastal State.

In the last twenty years there has been a trend to enlarge these zones. Especially States that, having not claimed a breadth of the territorial waters of more than 3, 4 or 6 miles, established a special fishery zone of twelve miles¹¹. Sometimes the outer boundary of the fishery zone coincides with the outer boundary of the contiguous zone thus furnishing an additional sovereign right at the disposal of the coastal State in the contiguous zone. Following the Truman Declaration on fishery of September 1945¹² there is the tendency to include the whole of the continental shelf area in these fishery zones.

The establishment of these newly created fishery zones has influenced the legal situation concerning scientific work in these areas. Some writers maintain¹³ that in these zones not only fishing but also observation of fish is unlawful.

11. Some nations claim even more than twelve miles. This is the case with Iceland. See Ambassador Anderson, International Rules and Organization for the Sea, Louis M. Alexander (ed.) *Proceedings of the Third Annual Conference of the Law of the Sea Institute*, University of Rhode Island, 1968, Kingston, R.I., 1969, p. 72-83: "... special consideration must be given to the problem where the coastal population is overwhelmingly dependent on the coastal resources for its livelihood. In that situation, instead of the otherwise laudable system of non discrimination beyond, say, twelve miles, a system of further exclusive jurisdiction or at least preferential rights would be required. The Convention does not provide for anything of that kind and this is the reason why it has not been ratified by Iceland".

12. Proclamation of President Truman of September 28, 1945, and Executive Order of the same day, 40 *American Journal of International Law* 1946, Official Documents, p. 45, 47.

13. An interesting collection of contributions regarding modern fishery question is given in Lewis M. Alexander (ed.), *The Future of the Sea's Resources*, *op. cit.*

A research vessel staying outside the territorial waters but inside the fishery zone could according to this view do all scientific research except that which has any connection with fish. Accepting this view would mean to give the coastal State not only the monopoly for fishing but also for scientific research regarding fish in the waters near the coast. This fact is interesting in another connection too: it shows that in handling the scientific research there are not only differences regarding the maritime zones but also in regard of special branches of oceanography if this term may be used here to include all objects of the marine sciences.

As a matter of fact, this legal question is still open. Some States solve the problem by issuing national decrees. But there are doubts whether they are in harmony with general principles of international law. If a revision of the Geneva Conventions concerning the law of the sea will take place in the near future, this question should find a definite answer, too.

5. *Contiguous Zone*

The Contiguous zone is part of the High Sea. According to Article 24 of the Convention on the Territorial Sea and the Contiguous Zone, the coastal State may:

“ exercise the control necessary to

a) prevent infringement of its customs, fiscal, immigration or sanitary regulations within its territory or territorial sea;

b) punish infringement of the above regulations committed within its territory or territorial sea ”.

The coastal State may exercise sovereign rights only in this limited manner. That means that the State is not allowed by international law to impose any other restriction on ships through this zone. The rights mentioned above do not include the power to make scientific work dependent on a special permission. Concerning these activities the contiguous zone is legally on the same footing as the high seas.

6. *High Seas*

The high seas, being that part of the oceans over which no State is entitled to exercise sovereign rights, are governed by the principle of the freedom of the seas. The freedom of scientific research as one of the "other freedoms" mentioned in Article 2 of the Convention on the High Seas can be fully enjoyed only in these areas of the oceans which do not belong to the internal waters, the territorial waters, the fishery zones or the continental shelf area of a coastal State.

The term "high seas" includes the surface of the water, the air space above the surface, the water space between surface and sea-bed as well as the sea-bed and its subsoil except those parts of the bottom of the sea which may belong to the continental shelf (in the legal, not in the geographical sense) of a coastal State. It has already been shown that nowadays there are no fixed limits for the continental shelf whether in regard to the distance from the coast or in terms of depth. Where a coastal State has entered into activities of exploring or exploiting the sea-bed or subsoil the fixing of the exact limit between continental shelf and the regime of the high seas may present some difficulties and give rise to uncertainties. In a period of rapid technological and legal changes this uncertainty is quite natural. Nevertheless, this point will need clarification at some time. In order to avoid misunderstandings it may be mentioned that even on the high seas there are some limitations in exercising the freedom of scientific research:

First: Though the high seas are free from all territorial sovereignty of any State, this does not exclude the State's sovereignty over ships flying the flag of the State concerned or over its nationals. Therefore, the coastal State may make regulations even for the conduct of scientific research on the high seas.

Second: There exist other restrictions, especially in regard to large scale scientific research operations. For instance, if such work requires fixed installations — for instance a buoy network or fixed oceanographic stations — special regard has to be taken not to interfere with the interests of shipping, access to harbours etc. What precise limitations are required can only be judged in a concrete case.

Thus, when UNESCO and IMCO discussed the idea of fixed oceanographic data stations, a joint report tried to fix the limitations of the freedom of the seas and the freedom of scientific research according to international law in a declaration consisting of the following five points:

1. Freedom of the high seas includes the freedom of research in the high seas.

2. No State may exercise exclusive sovereign rights in the high seas for the conduct of research by means of fixed oceanographic stations.

3. No state may restrict the reasonable conduct of such research by other governments or by individuals over whom it has no personal jurisdiction.

4. States are under a duty to ensure that such research undertaken by them or by their nationals is conducted with reasonable regard to the interests of other States in their exercise of the freedom of the high seas.

5. A State is permitted by international law to place additional restrictions on the conduct of research on the high seas for its own nationals and vessels, but not for persons over whom the State has no jurisdiction.¹⁴

Though some criticism was directed against these rules¹⁵, as a whole they summarize quite correctly the present legal situation in regard to the problems involved.

The legal position of the research vessels is clear and doubtless: there are no restrictions whatsoever. They enjoy the freedom of movement and action; no permission is needed. Even research vessels having the status of government ships being attached to the navy or having the status of warships have full liberty to participate in scientific work. There is no discrimination whatsoever from the point of view of international law.

14. UNESCO, Intergovernmental Oceanographic Commission, Preliminary Report of UNESCO and IMCO on the Legal Status of Unmanned and Manned Fixed Oceanographic Stations, p. 11.

15. BURKE, *op. cit.*, p. 160-162.

7. Summary

In order to summarize the legal situation of the freedom of scientific research in respect to the different maritime zones the main results may best be shown by the following table. To avoid any misunderstandings the "dimension" of water space is given here too, indicating whether the legal regime applies only to the surface of the water, to the column of water between surface and the bottom of the sea or to the sea-bed and subsoil:

MARITIME ZONE	"DIMENSION"	Permission of the coastal State is needed for	
		the passage of research vessels	the conduct of scientific research
Inland waters Territorial sea	surface water column sea-bed and subsoil	no, with the exception of research vessels belonging to the Navy (not governmental ships)	yes, according to national regulations
Continental shelf	sea-bed and subsoil	—	yes, according to Art. 5 of the Convention on the Continental Shelf
Fishery zone	surface and water column	no	no, with the possible exception of research regarding fish
Contiguous Zone	surface	no	no
High seas	surface, water column, sea-bed and subsoil	no	no

The survey given here of the legal situation regarding the realization of the freedom of scientific research in the different maritime zones would be incomplete if we should shut our eyes before the concepts for a new regime for the oceans. It must be stated very clearly that the present legal system of the high seas is at stake. There are proposals for a radical change in the near future. The nationalisation of the bottom of the sea or even of the oceans themselves on the one hand and a kind of internationalisation of the uses of the sea on the other hand are now under discussion. As a consequence of dealing with the problems of the continental shelf the whole regime of the high seas is questioned now.

Therefore, it seems advisable to show briefly the impact of these possible new regimes on the freedom of scientific research.

3. Impact of new regimes for the high seas on the freedom of scientific research

The concept of the continental shelf, the demand of the States for the largest possible share of the natural resources of the ocean floor and the rapid progress of marine technology have led to a variety of proposals to change the existing international maritime law. Any such change would automatically influence the present situation regarding the freedom of scientific research.

With some risk of simplification, these different proposals may be reduced to four groups ¹⁶:

16. See, BURKE, *op. cit.*, (p. 39-40) enumerates five possible solutions, from the point of view of "an allocation of competence over such resources": a) Division of the ocean bed among "coastal" states; b) provision for completely free access, leaving assurance of rights, the adjustment of conflicts, and accommodation with other uses to be resolved as controversy arises and in accordance with available international law principle; c) establishment of an international agency, either one already in existence or one to be created, to allocate rights among claimants and to regulate exploitation; d) provision for an international recording system, leaving regulation to national systems of law; e) provision for exploration and exploitation to be undertaken by a public international group on behalf of all States".

1. *Nationalisation of sea-bed and subsoil*

Some writers¹⁷ promote the idea of dividing the bottom of the oceans outside the territorial sea among the coastal States. They have been led to this concept of total apportionment by the lack of any fixed distance on the surface or depth in the Convention on the Continental Shelf. They foresee a technical development which will enable mankind to exploit not only the shelf areas but also the continental slope and the bottom of the deep sea ("deep sea mining"). Realizing this concept would mean that all coastal States have a monopoly of exploiting the mineral resources even if they are not technically capable to make use of these rights. Then all scientific research would need state permission, be it the researcher's own state or a foreign state.

2. *Nationalisation of the high seas*

In order to profit not only from the mineral resources of the sea-bed or subsoil there exists another concept, that of nationalisation of the high seas. The regime for the continental shelf would become the foundation of a regime of dividing the bottom and the water space including the surface. The division of the oceans would follow the principles of Article 6 of the Convention on the Continental Shelf, i.e. the system of median and equidistant lines described there.

The Law of the Sea Institute of the University of Rhode Island has published a map showing the effect of applying the methods of Article 6 when used for a division of the oceans. It is not the right place here to discuss these results. Even if the role of lonely islands would be more restricted, a division of the oceans along these lines would never get the consent of the States because it would amount to establishing a new kind of maritime colonialism.

17. Considering the size of political, economic, and legal literature dealing with those problems the author may be dispensed from quoting the opinions of the writers favouring one side or the other. Most treatises give a survey of the pros and cons in regard of each proposal; for parliamentary debates in USA and Great Britain see G. Weissberg, *op. cit.* It is not the purpose of this paper to comment on these alternatives but only to demonstrate what impact they will have on the freedom of scientific research.

3. *Internationalization by means of the UN-ownership*

According to a well-known phrase, the natural resources of the ocean belong "to the common heritage of mankind". Some authors, taking this word very literally, want the United Nations to enter into this heritage. This conveyance of ownership would entitle the UN to all activities regarding the exploration and exploitation of these resources. All decisions in this field would then have to be taken by a special organ of UN, finally perhaps by the General Assembly. The future development would depend on majority decisions though very few nations would be able to play an active role in this development.

Even if a special administrative body or a specialized agency would be established, these projects would run into stiff opposition from the side of the big powers. States with highly developed technical abilities and investment possibilities are quite unwilling to depend on the decisions of nations which have not reached these standards. Besides this, some people do not like to recognize a UN-sovereignty granting concessions and issuing regulations, thus acting as a supra-national authority.

Though the idealistic background of the proposals (namely, to give to the UN an income of their own to be spent chiefly for the benefit of the developing countries) is not at all ignored, the majority of the member states will not give them their consent.

4. *International registration*

A more more modest but more realistic approach would be the establishment of a kind of international registration office under the supervision of the UN or a new specialized agency. Such an organisation would have the function of an international patent office giving legal protection to those who apply for it. Here again some alternative solutions are possible. This Office could be restricted to registration tasks only. Or it could be vested with some competence to issue recommendations or even regulations securing a minimum standard in applying modern techniques, social welfare etc. It could act as a center for oceanographic data or for collecting and distri-

buting the scientific reports in pursuance of Art. 5 of the Continental Shelf Convention.

5. *Analysis of the four models from the viewpoint of scientific research*

These four models seem to indicate the main tendencies for shaping a new regime of the high seas. There may be other alternatives, too. For instance, some elements of one model can be combined with elements of another. But on the whole, these four models give a true picture of the main lines of the possible development.

Each of these four models has quite a different impact on the use of the sea for scientific research.

The first model would amount to a kind of nationalisation of the sea-bed and subsoil of all parts of the oceans. There are in fact proposals to divide not only the continental shelves but also the continental slope and even the bottom of the deep sea. This would mean to apply the median and equidistant line methods for limiting the parts of the ocean belonging to each coastal State. If this would happen, Article 5 paragraph 9 of the Continental Shelf Convention might be extended to these oceanic regions. Then all scientific research outside the territorial waters of the continental shelf of the State concerned would need the consent of the other States. Besides this the coastal State would then have the right, if it so desires, to participate or to be represented in the research. In choosing this model all scientific research would be restricted very much. Such restrictions may be acceptable for the continental shelf because only a relatively small part of the oceans consists of shelf areas. But they seem to be unacceptable for the sea-bed of the high seas.

The second alternative — nationalisation not only of the sea-bed and subsoil but also of the column of water from the ground to the surface and including the surface — would only mean to intensify the difficulties mentioned in the preceding paragraph. But as this model has the least chance to be realized there may be no real danger.

The third model — UN-ownership — is often misunderstood. Some writers argue that all natural resources of the

oceans should become property of UN. That would, for instance, include fish. But such ownership would be restricted to carbon products, especially to oil and gas, and perhaps include some minerals. The main object of this model is to let the UN obtain some revenue. Thus, there may not be any impact on scientific research even in the field of oil and gas. The UN may be satisfied by receiving royalties, or delegate this so-called ownership to one or more States. It is unlikely that the UN will act as a private entrepreneur. Lacking a staff of experts and lacking the necessary technical apparatus the UN will leave that to big firms or States. Even if such a pseudo-ownership of UN will be established this would not mean interference with scientific research.

The fourth model — international registration — would only mean that some protection is given to those who are engaged in making the natural resources available to others. Therefore this model implies no change of the present-day legal order concerning scientific work. The introduction of a better protection of those who are taking the initiative can only promote the use of the natural resources of the sea and thereby indirectly give support to the technical and scientific development in this field.

In summarizing these considerations on the impact of the four models on scientific research it may be stated that the first two models — nationalisation in different forms — show an inherent tendency towards restricting the freedom of scientific research especially in an international framework. The last even will stimulate individual or collective scientific research.

4. Problem of timing: wait for a new regime of the high seas or give priority to measures for securing the freedom of scientific research ?

This aspect of promoting or restricting the freedom of scientific research is certainly not the only criterion for establishing a new regime of the oceans but is a very important one. Modern science and technology have opened the door for uses of the high seas which were quite unknown in former days. To solve the big problems of the near future — world nutrition,

large scale irrigation projects, extraction of minerals from new sources — science is needed. Therefore only that regime of the oceans will meet the needs of the world society of tomorrow, which secures the freedom of scientific research and the international cooperation in this field.

But the establishment of a new regime of the high seas will take some time. There are many group interests involved: national power interest, economic and industrial interest, fishery interests, military interests, scientific interests. We know from the genesis of the four Geneva Conventions of 1958 dealing with the international maritime law that such a codification requires a decade for the formulation of the final draft and another decade to get enough ratifications to speak of general acceptance of the new rules. The creation of a new legal system for the oceans will certainly take the same time.

It would be detrimental to scientific research to wait that long for an appropriate arrangement between the nations. Therefore the question of securing the freedom of scientific research should be given priority. It seems quite conceivable if not necessary to have a convention on scientific research in all fields of oceanography before all other details of a new legal order of the oceans have been fixed. This period of transition in which we live should be used to clarify the position of scientific research. The development of military weapons and devices indicates that there are some dangers for the liberty of scientific research coming from this side. It is impossible to exclude the military use of the sea. This military use has the tendency to create large zones of security and to exclude activities of other nations in these zones with the only exception of innocent passage. Secrecy being the most efficient weapon in the development of new military techniques, it seems necessary to come to a compromise between these interests and the tendency to secure scientific research. There is no time to waste. If the nations leading in this field extend their military installations outside the coastal waters and even outside the continental shelf and thus exclude scientific research in these areas, it would be very difficult for a new regime of the high seas not to recognise these facts. A certain practice once established even by unilateral measures may soon become common usage.

Nations and scientists are aware of these dangers. In spite of the uncertainty regarding the choice of one or the other model for a new legal system of the oceans as a whole, some very substantial proposals have been made regarding the freedom of scientific research. It would be not too difficult to clarify the legal measures for securing this freedom, to get the consent of the nations to such a minimum standard, and to formulate a draft for a convention. Such a convention would add the freedom of scientific research as the fifth freedom to the four already recognized freedoms in the meaning of Article 2 of the Convention on the High Seas and thereby close the gap which had to be left open in the 1958 Conventions. Therefore all depends on the practicability of the proposals made in order to secure this freedom of scientific research.

5. Proposals for securing the freedom of scientific research

A wide variety of proposals has been offered for a new regime of the high seas or the uses of the sea in general. They range from the demand for an international specialized agency dealing with the problems of deep sea mining and international cooperation in scientific projects to special legal problems regarding, for instance, the use of submarines for scientific research or the establishment of an international buoy system collecting oceanographic data. In this context only a kind of short survey can be given. Therefore the following remarks do not strive for completeness at all.

For the purpose of this paper the existing proposals may be grouped into six categories: demand for an international specialized agency, co-operation in international scientific projects, concept of submarines zones of special jurisdiction, efforts for securing objectiveness regarding the decision of the coastal States for giving or refusing the permission for scientific work, the problem of the developing countries and some special technical questions.

1. Demand for an international specialized agency

Nearly all proposals demand the creation of a new international organization dealing with the problems of an international

regime for the sea-bed and subsoil of the oceans as well as with other maritime problems. The realization of the freedom of scientific research will be but one of the numerous tasks and functions of such an organization. A symposium of scientists from East and West that was arranged by SIPRI in 1968 made the following recommendation thus expressing the general opinion on this point:

4. The governments of the member states of the United Nations and the various United Nations agencies should give early and thorough consideration to the advisability and feasibility of establishing an inter-governmental ocean organization to deal with all aspects of ocean investigation and the uses of the sea ¹⁸.

There can be no doubt that there is already an *embarras de richesse* regarding organizations dealing with an international regime of the oceans: universal and regional, governmental and non-governmental, scientific and non-scientific, old and new organizations. But none of these existing organizations fully meets the demands of today, not even the specialized agencies of the UN.

The IMCO (Inter-Governmental Maritime Consultative Organization) owing to its internal structure does not seem capable to handle these problems even if wider jurisdiction would be given to this organization. UNESCO and FAO have certainly done good work in dealing with special aspects of oceanography and other questions. But being devoted to other aims they cannot treat maritime problems as central points of their activities. Therefore a new organization has to be founded, especially if close contact with UN seems to be necessary.

As a matter of fact only very few proposals deal with the question whether the new organization should have the status of a UN-organization or should be formed outside the framework of the UN. As there is some scepticism towards the further development of UN, for instance, in the USA and the Soviet Union, it is sometimes suggested to keep the new organization outside the UN. But that is evidently a minority view. For the great majority of writers it seems to be quite

18. Towards a Better Use of the Oceans, *op. cit.*, p. 10.

obvious that any new organization of this kind has to be formed by decisions of UN organs and shaped as an agency of the UN.

But even here there are two ways of realization. On the one hand, a kind of International Maritime Office or an International Ocean Authority could be founded, forming a part of the UN-administration. On the other hand, new organization could follow the lines of the specialised agencies in the technical sense i.e. the model set by UNESCO, FAO, WHO, etc.

It is quite natural that authors promoting an UN-ownership in regard to some of the natural resources of the sea are advocating the first possibility. But that would mean that non-member states of UN would be automatically excluded from participation (Switzerland, Federal Republic of Germany) just as they are excluded from being represented in the International Law Commission.

The second way seems to be more appropriate, i.e. the founding of a new specialized agency. This organisational form gives more room to own initiative and allows the decision-making body more independence from the UN administration and from political decisions of the General Assembly. The membership question could be solved more easily, using the so-called Vienna formula¹⁹.

This new maritime organization would be composed of three groups of States:

- a) the ocean-coastal States (like USA, United Kingdom)
- b) the coastal States not situated on the shores of the great oceans (like Sweden, Italy)
- c) the non-coastal States, i.e. States with no sea-coasts at all (like Austria, Switzerland).

19. The Vienna Convention on Diplomatic Relations of April 18, 1961, and the Vienna Convention on Consular Relations of April 24, 1963, regulate the question of future access to these conventions by stating (Art. 48 of the Consular Relations Convention, Art. 74 of the Diplomatic Relations Convention): "The present Convention shall be open for signature by all Member States of the United Nations or of any of the specialized agencies or Parties to the Statute of the International Court of Justice, and by any other State invited by the General Assembly of the United Nations to become a Party to the Convention ..." Switzerland is a Party to the Statute of the International Court of Justice, The Federal Republic of Germany is a member state of all specialized agencies of the UN.

Whether or not this grouping will have any impact on the infra-structure of such organization is not to be decided here. But it must be stressed again that the "common heritage of mankind" is of concern to all States. Especially from the point of view of scientific research all States should be admitted to membership and invited to work together. The scientific, technological and even financial capabilities of all nations are needed to solve the problems we are going to face in the field of ocean sciences in the next decades.

It is not the purpose of this paper to discuss at length the tasks and functions of this new organization. But it may be stated that this international body has to become the organizational centre for all scientific research with regard to the use of the oceans.

A special task may be mentioned in this context: as long as Art. 5 of the Continental Shelf Convention provides for the permission of the coastal State for scientific research to be undertaken in the submarine areas of the State concerned, it may be useful to confer on this organization the competence to recommend certain research projects. One should be aware that nowadays many states having no capacity for marine research of their own still will be inclined to prevent this work from being carried out by foreign States. If there is an international body consisting of experts and if this body recommends a certain scientific project, the coastal State concerned should not refuse to give the permission except for very important reasons. This would be one of the fundamental tasks of the new organization in order to secure freedom of scientific research.

Another field of activity will be organizing international cooperation for all projects which cannot be realized by one State alone or even by a small group of States. This would include even some planning functions.

This new maritime organization would have to play the role as a kind of world data centre for the use of all nations.

Another task will be that of initiating and coordinating projects which for one reason or another should preferably be realized by other organizations, for instance by another UN specialized agency or by a non-governmental scientific organization.

In view of this wide scope of duties such a new organization would have to perform, it may not be easy to decide on its size and internal structure. There are some concrete proposals more or less taking the UN-specialized agencies as a model. With very few exceptions there seems to exist a general consent that this new organization should be closely connected with the UN, thus ensuring the most efficient support by all nations.

2. International co-operation

As already mentioned, one of the main tasks of the new organization will consist in initiating, promoting and supervising international co-operation in the field of marine sciences. This never can or should exclude the possibility of national research. Especially the State disposing of enough scientific personnel and technical possibilities cannot and should not be prevented from carrying out scientific research of their own. But some projects can only be done with the help of other nations.

The President of the United States has proposed a decade of ocean research. The former "Geophysical Year" of international co-operation has been regarded as a success. This decade of oceanography will bring about international co-operation on a larger scale. This will give the opportunity not only to perform some concrete research work but also to examine the question how scientific research in marine sciences may most efficiently be done on the universal, regional, and national level.

International co-operation may be helpful in overcoming the difficulties connected with the requirements of the coastal State's permission. The State practice of the next years will be of decisive character and create test cases serving as precedents in the near future.

International co-operation should not be confined to get scientific results in special fields but should be extended to training of younger scientists and possible experts especially in developing countries. Research techniques should be made available to all nations, even financial support should be given to countries which without such aid could not engage in research work.

These remarks already indicate the wide range of international co-operation that is needed to meet all requirements of future development.

3. *Submarine zones of special jurisdiction for scientific research*

Occasionally the possibility of establishing submarine zones devoted to scientific research only has been discussed. A special legal regime would protect these areas. If there are special zones for military installations or for mining purposes there will be no difficulty in utilizing the same solution for scientific purposes. A future convention on the freedom of scientific research may include regulations concerning manned or un-manned surface or under-water stations serving scientific purposes.

An international network of buoys transmitting automatically data needed for weather forecast or for other purposes does not require the establishment of a special zone but may be subjected to similar regulations.

4. *Legal means to secure objectiveness regarding the permission of the coastal State for scientific purposes*

According to Art. 5 of the Convention on the Continental Shelf the coastal State has a monopoly of exploration and exploitation of the shelf outside the territorial waters. The State concerned may give or refuse the permission for other persons than its own nationals.

This regulation has met with distrust and criticism. Indeed if the State is allowed to act at its own discretion, nobody can prevent it from closing those parts of the continental shelf to any foreigner. This may be acceptable in case of economic reasons in the sense that only the nationals of the coastal State may be entitled to get the necessary concessions, but it seems unacceptable so far as scientific work is concerned. If the regime for the continental shelf should be extended to the water column above the sea-bed then the coastal State could prevent all scientific research. That may amount to closing whole parts of the oceans, for instance the West-African coast.

In order to avoid such an result it has been proposed to amend Art. 5 in the sense that state or private organisations under foreign control should notify their scientific program to the State concerned. The coastal State should have the right to withhold its consent only if there are important reasons. Thus — it is hoped — refusal of the permission would be regarded as an exception. It may be doubted whether this really will be the consequence. But even if so, these exceptional cases still would find no real solution. Who is to judge on the reasonableness of the State's arguments? And if they are found to be unreasonable how can the State be caused to give the permission?

These considerations lead to the conclusion that granting or withholding the permission might be brought before the International Court of justice. If the freedom of scientific research is recognized in a convention being in force between the Parties concerned, it may indeed be possible to ask the Court for a judgement. But as only States are allowed to institute proceedings, no organisation — with some exceptions — or individuals or group of individuals could bring a case before the court. Therefore, there is no effective protection of the right of scientific research.

The only solution will be to insert in a future convention a clause providing for a court of arbitration and to entitle States, private organizations and even individuals to submit refusals of permission to arbitration. There are plenty of precedents for establishing such arbitration courts. But it seems not quite clear whether the big powers or other States are inclined to confer on such a court of arbitration the competence to examine the legality of the State's refusal of permissions.

5. *Developing countries*

The special situation of the developing countries has to be considered in this context. They rarely will be able to contribute to scientific research programs. As the Report of the Secretary General of UN has clearly shown, they normally do not have at their disposal the necessary personnel and technical facilities in order to take part in international scientific research projects. But exactly this fact may make them inclined to

refuse permission to foreigners. It is a matter of experience that especially newly founded States are extremely proud of their sovereignty and therefore in danger of performing an act of "abus de droit".

There seem to exist two ways to overcome this difficulty: first, if States are to receive financial aid from other States or international organizations such aid may be made dependent on a declaration by which the receiving State declares its readiness to cooperate if asked for a permission for scientific research work on its continental shelf. This may be restricted to cases where the competent international organ has recommended the scientific project.

The other way may turn out to be more useful because it has more regard to the sensitiveness of the young States: even if the State concerned may not be able to make a considerable contribution to the scientific project, it would be useful to make the State a partner of this project. This even opens the possibility of training young experts in order to make the State capable of doing research work of its own.

6. Impact of technical questions on the existing legal order

Some final remarks may demonstrate that the modern techniques of scientific research influence the existing legal order.

Taking for instance the project of an international system of registration buoys transmitting certain data. There has to be an international agreement in order to protect these installations and to avoid interference of the coastal States if these buoys have to be moored in territorial waters. On the other hand this coastal State may be obliged to take care of these installations. If these buoys have to transmit data the wavelength of these transmissions has to be fixed by agreement. A control system has to be provided for. Even an individual measure like the installation of such a network of buoys may be the object of a special convention.

Another example may be quoted: modern deep sea mining will require the use of manned and un-manned submarines. According to Art. 14 para. 6 of the Convention on the High Seas "submarines are required to navigate on the surface and show their flag". Undoubtedly this refers to the passage of

foreign ships through coastal waters and not the use of submarines for scientific research. But nevertheless this regulation demonstrates a certain sensitivity of the States for uncontrolled stay of submarines in the territorial sea. Therefore the use of submarines may be subjected to a special permission for security reasons. If there are military installations on the sea-bed the permission may even be refused. On the other hand, an additional clause to Article 14 may be useful for clarifying the legal situation.

The technical development in modern times will require some other amendments of the four Geneva Conventions of 1958 dealing with maritime law. Especially military security interests and the freedom for scientific research will lead to some sort of compromise in order to avoid open conflicts.

6. *Conclusions*

1. A general "freedom of research" in the meaning of Article 2 para. 1 of the Geneva Convention on the High Seas (1958) is not yet recognized. It is mentioned explicitly in the Geneva Convention on the Continental Shelf (1958) but its exercise requires the permission of the coastal State.

2. Regarding the different maritime zones, freedom of scientific research can be exercised without limitations in the contiguous zone and the high seas but is doubtful in the fishery zone in respect of fish and needs the permission of the coastal State in the inland waters, the territorial sea and on the continental shelf. Privately owned research vessels and governmental ships have the same legal status in respect of freedom of scientific research while ships belonging to the navy may be treated differently with regard to "innocent passage".

3. If a new regime of the high seas will be introduced, all regulations having nationalisation tendencies will bring a change in the direction of limiting this freedom, while the internationalization by means of UN-ownership or the introduction

of an international registration system will have no impact on the present legal situation or may even promote the exercise of this freedom.

4. As the elaboration of a new regime of the high seas will take a long time it seems to be necessary to secure the freedom of scientific research by special agreements or other means. Priority should be given to regulations in respect of the freedom of scientific research.

5. Some proposals for securing the freedom of scientific research are already under discussion. First of all a new international organization in the framework of the UN should be established. It seems to be easier to found a new organization than to give new competences to already existing organizations. The international co-operation through realization of international scientific proposals should be supported. In some cases even the concept of special submarine zones may be useful for scientific purposes. As long as the coastal State has to give its permission to scientific research some efforts have to be made for the possibility of instituting legal proceedings before the International Court of Justice (but only in a conflict between states) or the introduction of arbitration procedures. Special regard should be given to the situation of developing nations.

6. Owing to modern techniques of scientific research the existing legal order of the seas — the 1958 Geneva Conventions — should be examined under the aspect whether or not some changes seem to be useful to avoid conflict situations.

SCIENTIFIC RESEARCH ON THE SEA-BED.
INTERNATIONAL COOPERATION IN SCIENTIFIC
RESEARCH AND EXPLORATION OF THE SEA-BED

BY

Dr. ROGER REVELLE

*Richard Saltonstall Professor of Population Policy, Harvard University;
Professor of Oceanography and Director Emeritus, Scripps Institution
of Oceanography, Cambridge, Mass.*

Introduction

In this paper we shall discuss some of the kinds of oceanic research needed for development and full human utilization of the living and non-living resources of the sea, the roles and mechanisms of international cooperation in carrying out this research and applying the results, and desirable changes in the international legal-political framework for scientific inquiry in the oceans.

Present ideas about the non-living resources of the sea are based on few facts and much speculation. Up to 1969, only about twenty deep sea drillings, a few hundred dredge samples of solid rocks, and less than two hundred seismic reflection profiles across the continental margins had been obtained. Many observational gaps must be filled, both for scientific understanding and practical use of the earth beneath the sea.

We have most information on the resources of the continental shelf, covering about ten percent of the area of the ocean, in part because its geological features are comparable with those of nearby continents. Some mining of tin, iron, and coal is conducted in the same types of rock as on the continents, and sedimentary gravels, sands and shells are dredged for construction materials. Heavy minerals - gold, tin, platinum, magnetite, ilmenite, rutile, zircon, monazite, and diamonds are recovered from placer deposits similar to those on land. Oil and gas reservoirs have been discovered by much the same kinds of

geological and geophysical surveys used ashore, and recovered by somewhat the same techniques.

We know much less about the continental slope and rise than about the shelf. Only its similarity in structure makes us believe that it may be as rich in resources. Here there are strong reasons for scientific investigations to precede industrial exploitation. It is the most promising frontier area, especially for oil and gas.

In the deep sea, our knowledge of marine resources is largely sporadic and accidental. Discoveries such as oil traces on a salt dome in the deepest part of the Gulf of Mexico, and sulfide deposits associated with hot brines in the Red Sea, have been limited to marginal seas. In the deep open ocean, which covers more than half the globe, only manganese nodules and some chromites in the rift zones of the mid-ocean ridges have appeared to be potential resources. However, if the Red Sea is part of a typical ridge and rift system, it is possible that zinc, copper, and lead may be found in many places in the great ridges, as well as metal ores such as chromite and nickel. Some parts of the deep open ocean may overlie sunken continental masses. If so, these could contain mineral or fuel resources.

An important practical result of geophysical and geological studies of the ocean is the help they can give in understanding the marine sedimentary rocks on land which form reservoirs for oil and gas, and in explaining the origin and formation of the continents. Because the deeper rocks of the crust and mantle are more easily accessible under the oceans, the keys to the formation and evolution of the continents may come from oceanic studies.

*Some needed research programs*¹

Several kinds of research and surveys are needed as a basis for exploration or exploitation of non-living resources:

1. *Reconnaissance geological and geophysical surveys of the continental margin* will give better understanding of the rocks

1. This description of some of the kinds of research needed for development of the living and non-living resources of the sea bed is based on a recently published report "Global Ocean Research", prepared by a joint working party

under the sea floor in the transition region from oceans to continents, the processes of sedimentary transport, the distribution of bottom organisms, and the depth and extent of the submerged terraces, relic beaches, and river valleys which were formed during the ice ages when the sea level was much lower than at present. Special efforts should be made to locate thick sedimentary basins where oil and gas accumulations may exist, to discover phosphorite deposits and placer and beach deposits of heavy minerals on the outer shelf, and to delineate rock structures containing mineral and fuel resources extending out from present land areas. The population of sessile invertebrates and demersal fishes are limited to certain kinds of bottom, and hence detailed morphological, geological, and sedimentological maps should be prepared for biologists and fishermen. By studying rates of sedimentation, it should be possible to find regions of rapid deposition, which may be the source beds of petroleum and natural gas, and also areas in which sedimentation is slow or lacking, where phosphorite or manganese crusts or nodules may have been formed, and placer deposits have remained unburied.

2. *Detailed, world-wide, echo-sounding surveys of the topography of the sea floor* should be made with first emphasis on the continental margins, as a basis for preparation of charts for bottom fisheries and offshore exploration for oil, gas, and ores. The positioning of the sounding lines should be accurate to plus or minus a hundred meters, and the surveys should include continuous seismic reflection profiles, and frequent sampling to determine bottom character. At present, our maps of the deep ocean are about equal in accuracy and detail to the maps of the land published 200 years ago.

3. *Deep drilling* through the sediments and into the underlying rocks should be conducted at 200 to 400 sites during the next ten years, with about one-third of the deep holes in mediterr-

of the Advisory Committee on Marine Resources Research of the Food and Agriculture Organization of the United Nations, the Scientific Committee on Oceanic Research of the International Council of Scientific Unions, and the Advisory Group on Ocean Research of the World Meteorological Organization. Dr. Cyril Lucas, Dr. P.J. Mead, and Professor Warren Wooster were co-charimen. The author was a member of this joint working party.

anean and marginal seas, one-third in the open sea, and one-third on the continental margins. This program should give an order-of-magnitude increase in our understanding of the history of the ocean floor, both through the direct study of the cores, and by improving the interpretation of seismic reflection profiles and magnetic surveys. For the deep open ocean and mediterranean and marginal seas, specialized drilling vessels will be required similar to the one now being used in the United States JOIDES Program. It may be possible to fit out oceanographic ships for drilling in the continental margins. New techniques need to be developed for drilling of shallow and deep holes in hard rock, including, if possible, a method for hole reentry, which would allow replacement of drilling bits, and, hence, deeper penetration into the earth's crust.

4. *Oceanwide surveys of remanent magnetism of sub-oceanic rocks* should be completed, using airborne and ship-towed magnetometers, to determine areas of magnetic lineations and the displacement of lineations along fracture zones. These surveys will show the locations and relative movement of plates of the earth's crust or mantle.

5. *Detailed investigations of the processes operating near the crests of mid-ocean ridges* should be undertaken to determine the modes of extrusion, spatial relationships, relative age, composition, and magnetic and other physical properties, of the basalts, serpentines, and ultra-basic rocks. They should also help in understanding similar rocks on land which are believed to be the source of many valuable ore bodies.

6. *Studies of the relationship between structures on land and in the sea in the great trench arc systems that surround the Pacific Ocean* should help to demonstrate or disprove the apparent downward movement of ocean sediments, rocky crust, and upper mantle under the trenches, and to give greater understanding of the processes of formation and growth of island and continental arc structures, their associated volcanic mountain chains, and marginal seas or lowlands.

7. *Reconnaissance surveys in mediterranean and marginal seas* should be made to search for possible structures that could

be reservoirs for oil and gas or areas of accumulation of valuable minerals.

8. *Surveys of the distribution and composition of manganese nodules in deep sea areas* should be made to determine the concentration and distribution pattern of these nodules, together with their contents of nickel, copper, cobalt, chromium, molybdenum and manganese. In addition to use of precision echo-sounding and bottom photography, methods of large-scale quantitative sampling must be developed.

Much research still needs to be done to improve the scientific basis for conserving and increasing the harvest of living resources from the sea. Programs that should be conducted, at least in part, along the continental margins include:

1. *Systematic surveys in productive regions*, using acoustic and exploratory fishing techniques, to determine the presence and concentration of animals of fishable sizes.

2. *Investigation of the structure and function of ecosystems* in areas subject to minor fishing exploitation, compared with others subject to moderate and high rates of exploitation.

3. *Identification of potential coastal aquaculture areas*, including selection of suitable species for culture. Such areas can be expected to occur in coastal regions where there is a continuing throughput, carried by tidal and other coastal currents, of planktonic and detrital animal foods.

4. *Studies of the mechanisms of upwelling*, by which nutrient-rich deep waters are carried upward into the sunlit subsurface zone where photosynthesis can take place. The most intense upwelling occurs along the western boundaries of continents where the winds carry the surface waters away from the coast, and also in the eastern equatorial current systems.

5. *Investigations of the reversals of the ocean circulation and their biological consequence under the action of the monsoon winds* in the Arabian Sea. This may be one of the most fertile and highly productive parts of the world ocean. At the same time, it is one of the least exploited.

6. *Studies of the problem of recruitment or replenishment* of the stocks of harvestable marine fishes and invertebrates, including estimates of density-dependent mortalities of incoming year classes.

To gain greater understanding of the pollution of the marine environment, and the actions that must be taken to prevent it, a world-wide system of pollutant monitoring needs to be established. Suitable techniques for measuring various pollutants must be developed, the most likely marine test animals selected, and ecological base lines established from which trends can be evaluated. In particular, monitoring stations should be installed at river mouths. Off some rivers, such as the Nile and the Indus, where river transport of both dissolved and solid material is being drastically changed by man's activities, marked alterations in the biological regime of the nearby ocean waters may occur, as well as destructive erosion and other shoreline changes. In other rivers, pesticides, excess nutrients, and a variety of pollutants are entering estuaries and open seas in potentially dangerous quantities.

To carry out the above-listed programs on a world-wide basis, ships and other equipment in large numbers and considerable variety will be required. These include: some twenty-five survey ships to make the echo-sounding surveys required for detailed bathymetric charts of the world ocean; perhaps forty major research ships, half of which should be equipped for fishery research; about twenty fishing vessels for systematic resource evaluation; thirty-seven weather ships for weather stations in the Atlantic and the Pacific; a small aircraft carrier and escorts for magnetic surveys; three deep-sea drilling vessels; about two hundred "ships of opportunity" (merchant ships, naval vessels, and fishing boats), equipped for both meteorological and oceanographic observations; a nuclear powered submarine for studies in the Antarctic; four small, self-propelled manned submersibles with depth capabilities up to several thousand meters; several hundred deep-sea anchored buoys, instrumented for meteorological and sub-surface measurements; and an equal number of instrumented drifting buoys. A world-wide precision navigational system, using combined satellite and long-wave radio navigation, should be established to enable

survey and research ships to fix their position within a few hundred meters, and a radio communication system for telemetering oceanographic data from ships and buoys should be developed. Earth-viewing satellites should be equipped for sensing temperatures and other surface and near-surface ocean properties. Fixed monitoring stations should be established near river mouths and elsewhere near shore. These seagoing facilities must be backed up by research laboratories, biological sorting centers, analysis centers for pollutant monitoring programs, standardization and test facilities, data centers, and facilities for production and distribution of charts and other publications. Greatly increased arrangements for training and education of specialists in a wide range of scientific disciplines and engineering skills will be required, particularly for the developing countries.

International cooperation in ocean research

From the above description of oceanic research programs and facilities needed for their accomplishment it is clearly evident that international scientific cooperation, both intergovernmental and non-governmental, is essential if the living generations of mankind are to reap the potential benefits of marine resources. The scale of many of the proposed research programs is greater than can be mobilized by any one of the countries concerned; the research involves a greater diversity of scientific competence or facilities than possessed by any one of the interested countries; the solutions of many problems require access to data and experience possessed by several countries (for example, assessment of the conditions of a fish stock exploited by several countries requires the pooling of information); the cost-effectiveness of the research for each country can be substantially increased by joining forces in international operations (this is the case in nearly all multi-ship international investigations); many programs would be affected by activities or laws of different countries (for example, important geological features of the sea floor extend offshore from the coasts of different countries across the continental shelf); there is a special need to reach agreement on the employment of comparable methods of research

(an ocean-wide study of primary organic production by standard methods can probably be accomplished only through international cooperation); there is a need to establish mutual confidence in observations or analyses bearing on particular problems of international action (for example, when fish stock assessments have revealed a need for regulation of exploitation as in the case of many bottom living fish and invertebrates, appraisal of the effects of alternative regulations requires joint analysis of biological statistics by scientists serving in an international capacity).

Perhaps the most important justification for international cooperation in ocean research is the need for mutual assistance between the developed and the less developed countries. Because the oceans are so vast and so little known, almost any nation that borders on the sea can make important contributions to oceanography, even with a modest effort. Oceanography deals with a familiar and visible, yet mysterious part of the real world, consequently it is an easily understood kind of science, well suited to creating public understanding of the purposes and methods of scientific research. At the same time, the less developed countries need to learn a great deal about their bordering seas, as a basis for conservation and full development of their fisheries, and for many other purposes. But many of these nations are too small or too poor to be able to afford a sufficiently broad and strong oceanographic institution.

Through the mechanisms of international collaboration the oceanographic institutions of the rich countries can provide facilities and intellectual back-up to the scientists in the poor countries and work with them on their national problems.

Experience shows that international scientific cooperation in oceanic research is best accomplished through the coordination and integration of research supported by national governments and carried out on ships or other platforms operated by them or by non-governmental institutions under their jurisdiction. Because governments have the primary responsibility, the institutions for planning, coordination, and integration need to be intergovernmental, preferably with advisory bodies of scientists acting in their personal capacity, and not as government representatives. In principle, intergovernmental organizations can be bi-lateral, regional or multi-lateral, or global.

An intergovernmental oceanic research organization has several tasks. In the planning stage of a cooperative research program, available information on the region or problem to be studied must be reviewed and synthesized, agreement reached on objectives and methods, and arrangements worked out for the nature and extent of participation by each interested country.

Cooperation, and, if possible, full participation by all coastal states bordering the region is essential, and, for this purpose, these states should be members of the intergovernmental organization and take an active part in the planning process. Permission of the coastal states is required for ships participating in an international program to make relevant observations and measurements in territorial and contiguous waters and elsewhere on the continental shelf. Ways must be found to remove barriers to free exchange of personnel and data, and to facilitate the passage of scientific materials through customs, the transfer of technicians among the different research ships, and the entry and resupply of research vessels in ports.

During the course of the field work, there must be good communication and exchange of both technical and operational information among all the participants. Results and observations should be evaluated frequently, so that the program can be revised as necessary, and new scientific and technological advances incorporated as they are developed. At the conclusion of the field program, arrangements need to be made for the exchange of data and samples, joint analysis of the results, and the publication and distribution of atlases, reports, and other products of the research.

The intergovernmental oceanographic commission

At the present time, the only global intergovernmental organization concerned chiefly with basic scientific research in the oceans is the Intergovernmental Oceanographic Commission sponsored by UNESCO. Other U.N. agencies, such as FAO, IAEA, and, to a lesser extent, IMCO and WMO, together with the United Nations itself, have a direct interest in applied ocean research relating respectively to fisheries, radioactive wastes, merchant shipping, meteorology, and mineral resources.

The Intergovernmental Oceanographic Commission has developed procedures for the conduct of international cooperative investigations, exchange of information about national oceanographic programs and their results, and consultation and agreement among member states that wish to cooperate in marine scientific research. From the standpoint of the present and future international situation concerning problems of sovereignty and jurisdiction over the oceans, it has the disability that its member states are primarily those countries which are sufficiently developed economically and scientifically to be able to afford marine research on a relatively large scale.

For future international cooperation in research, the membership of the Intergovernmental Oceanographic Commission should be widened to include as many coastal states as possible, or, if this is not feasible, its programs should be subject to broad final approval by a more representative intergovernmental body, such as the Economic and Social Council of the United Nations. In any case, the Commission should give far more emphasis than hitherto to the problems and interests of the less-developed countries, and should encourage mutual assistance between their scientists and engineers and the oceanographers of the scientifically advanced nations.

Present barriers to marine research

The existing international legal-political framework seriously impedes scientific inquiry in the oceans. Prior consent of a coastal state is required to conduct any scientific investigations in its internal or territorial waters, fishery research in the "contiguous zone" outside territorial waters where the coastal state has claimed exclusive right of access to the living resources, or research concerning the "sea bed and subsoil" of the continental shelf.

The Convention on the Continental Shelf, which became effective in 1964, is the chief international legal instrument that inhibits marine scientific research, compared to the previous situation in international law. It provides that the prior consent of the coastal state must be obtained for "any research concerning the continental shelf and undertaken there" (Article 5, Section 8).

The provision is apparently made somewhat less restrictive by the statement that the coastal state shall not "normally withhold its consent if the request is submitted by a qualified institution with a view to purely scientific research into the physical or biological characteristics of the continental shelf, subject to the proviso that the coastal state shall have the right, if it so desires, to participate or to be represented in the research, and that, in any event, the results shall be published".

This modifying statement contains several ambiguities. These have been implicitly taken advantage of in recent years by some coastal states to justify the imposition of stringent and complicated procedures which must be followed in attempting to obtain their consent. Some of these ambiguities have been specified in the Report of the International Panel of the United States Commission on Marine Science, Engineering, and Resources:

What is research, "concerning the continental shelf?" When is such research "undertaken there"? When are conditions not "normal" so that the coastal state may withhold its consent? What is a "qualified institution"? What is "purely scientific research"? ... What is the line between "exploring" the continental shelf... of which the coastal state exercises sovereign rights... and "fundamental oceanographic or other scientific research" with which, (according to the convention) neither the exploration of the continental shelf nor the exploitation of its natural resources may interfere?²

If American experience is a guide, the situation concerning freedom of marine scientific research on the continental shelf has rapidly worsened during the last few years. From 1963 to 1966, there were only six instances in which other nations refused requests from American flag vessels to conduct scientific research on their continental shelves or in their territorial seas. From January 1967 to September 1968, there were twelve such refusals.

Outright refusal of permission is perhaps less serious than the delays that may be interposed by unresponsive or reluctant

2. Panel Report of the Commission on Marine Science, Engineering and Resources, Vol. 3, Marine Resources and Legal-Political Arrangements for their Development, Part VIII, Report of the International Panel, U.S. Government Printing Office, Washington, D.C., p. VIII 74.

governments. The essence of the scientific enterprise is the rapid experimental investigation of new ideas as they arise in the mind of the investigator. If too much time elapses, the scientist and his financial supporters are very likely to abandon the new idea and go to work on something else. Moreover, the expensive research vessels of modern oceanography must be scheduled far in advance, and this cannot be done in the face of uncertainty and unpredictable delay in obtaining permission from a coastal state.

Under the convention, the consent of the coastal state is required for research outside territorial waters only when it "concerns" the "seabed and subsoil" of the continental shelf and is "undertaken there". Some authorities have interpreted this to mean research using sampling or other instruments that come in contact with the sea floor or with bottom-crawling or sessile marine organisms. But a surface ship making gravity measurements or an aircraft towing a magnetometer are certainly investigating the properties of the sea floor and the sediments and rocks beneath it, as is a ship making recording echo-soundings or operating a sonic sub-bottom profiler, and it is likely that most states will interpret the Convention as requiring their consent for such activities.

These instruments are used normally with the ship underway at cruising speed, and do not involve stopping or anchoring. Conceivably, a ship employing them in the territorial waters of a coastal state might be considered as exercising the ancient right of innocent passage, which is specifically protected by the Convention on the Territorial sea and the Contiguous Zone "so long as it is not prejudicial to the peace, good order, or security of the coastal state", and is in conformity to "laws and regulations relating to transport and navigation". However, this protection probably would not hold if the scientific ship cruised on a grid of survey lines, rather than simply traversing a territorial sea en route to or from the internal waters of the coastal state or to and from the high seas.

Similar ambiguities exist with regard to fisheries research, which many coastal states claim the right to prohibit in the "contiguous zone" adjacent to their territorial waters. Every aspect of oceanography, including the biology, physics, chemistry, geology, and meteorology of an ocean area is relevant in studying

the factors which determine or affect the abundance and availability of harvestable marine fish and invertebrates, and can facilitate their exploitation. Thus, at least in principle, any kind of oceanographic research can be prohibited in the contiguous zone. For many fisheries, such a prohibition is clearly against the interests of the community of nations, and may, in the long run, adversely affect the interests of the coastal state. This is so whenever a particular species that is being studied migrates from the high seas into the territorial waters or the contiguous zone during part or all its life cycle, especially if the conservation of the fishery depends on knowing the extent of the stock, or its rate of replenishment during that part of the life cycle spent in the waters of the coastal state.

Two possible approaches may be suggested toward lowering the present barriers to ocean research: a new international agreement on the freedom of marine research, or alternatively arrangements to liberalize present practices through action by an inter-governmental organization.

*An international agreement on freedom
of marine research*

A new international agreement on the freedom of marine scientific inquiry could be made, which would allow oceanographic research to be conducted in all parts of the oceans: territorial waters, "contiguous zones" in which states claim exclusive rights of access to the living resources of the sea, the continental shelves, and the high seas beyond the continental shelves. Ideally, such an agreement would specifically permit the conduct by any state of scientific research in the territorial waters, the "contiguous zone", and the continental shelf of a coastal state without its prior consent, under the following provisions:

1. The coastal state shall be given prior notification of the intent to carry on the research, the period or periods of time during which it will be conducted, and a description of the objectives and methods to be used.

2. Representatives of the coastal state may participate in all or part of the research as it desires.

3. The investigators agree to publish the results of the research in the open scientific literature, and to send copies of all data and adequate portions of biological and geological samples to the government of the coastal state.

4. Scientific research shall subsume, but not be limited to fishery research (including the taking of fish and other organisms for scientific purposes), as well as research on the continental shelf (including the collection of samples for scientific purposes from the "seabed and subsoil").

5. Research submersibles may be used for scientific research, provided that the coastal state has sufficient advance notification to assure safety of navigation.

6. Research buoys and other unmanned devices may be anchored, or installed on the bottom and maintained in place in the territorial waters, the "contiguous zone," and the remainder of the continental shelf, and provision shall be made for their protection. The coastal state may specify reasonable requirements for buoy location, lighting, marking, and radio communication, and may inspect buoys and other unmanned devices whenever it desires to do so.

7. By its right to participate in research, to observe research vessels from ships or aircraft, and to inspect buoys and other unmanned devices, the coastal state shall be able to ascertain readily whether a vessel or installation is engaged in unauthorized activities such as mineral resource exploitation, fishing, or espionage, under the pretext of doing scientific research.

With regard to the high seas, the following agreed principles would be established:

1. All states may freely conduct marine scientific research on the high seas by means of aircraft, surface ships, manned submersibles, or unmanned instruments, including anchored or free-floating buoys and bottom-mounted installations;

2. No state may restrict the reasonable conduct of such research by the government or citizens of other states;

3. Each state shall ensure that research undertaken by it or its nationals is conducted with reasonable regard to the inter-

ests of other states in the exercise of the freedom of the high seas. For this and other purposes, each state can place such restrictions as it considers necessary on the conduct of research on the high seas by its own aircraft, ships, and citizens, but not on those of other countries.

Intergovernmental administrative arrangements

An alternative to a new international agreement would be to give the Intergovernmental Oceanographic Commission, or some other United Nations agency, the responsibility for obtaining the consent of its member states for research to be conducted off their coasts. Presumably obtaining such consent would be an integral part of the planning process for all international cooperative research programs sponsored by the Commission. In addition, the member states might be persuaded to register with the Commission their continuing consent over periods of several years for specific broad categories of research that could be conducted off their coasts by all other member states.

SUMMARY OF DISCUSSION

WORKING GROUP I

A geologist indicated that in practice there are no problems with respect to scientific research beyond the limits of national jurisdiction. However, scientists do encounter certain difficulties in carrying out scientific projects involving the areas of the continental shelf and even slope.

An international lawyer referred to the assessment that the ocean floor is explored in only 5-10%, and asked whether this means that nothing is known about the rest of the ocean floor. He also raised the question, what are the expected results of the International Decade of Ocean Exploration, and whether — from the practical point of view — it is necessary to know much more about the ocean floor.

In reply to this question a geologist explained that the explored areas of the ocean floor are very scattered and, moreover, they are explored in various degrees, so that it is difficult to calculate the human knowledge of the ocean floor in percentage. However, his general assessment was that the present knowledge of the ocean floor has been roughly similar to the knowledge of continents some 200-300 years ago.

In this connection an international lawyer remarked that, if such a big area of the ocean floor is still unexplored, perhaps it would be advisable for the time being to continue research in those areas where no controversies arise in practice, and, in the meantime, to work out an arrangement for scientific research in other areas.

One rapporteur expressed the view that in the existing international law there is nothing which would give the coastal state the right to control scientific research in the area of the contiguous zone and of the continental shelf, provided that

research is being carried out with the intention of open publication, and that the coastal state is given an opportunity to join the research expedition through its representatives. He was also of the opinion that the jurisdiction of the coastal state does not apply to the fundamental research but is relevant only in connection with applied research, i.e. exploration of the resources of the sea-bed. In reply to a specific question, the rapporteur said that the research of the continental shelf does not necessarily involve a physical contact with the sea-bed.

A geologist, however, held the view that it is difficult to separate the fundamental research of the sea-bed from applied research. He gave as an example the sketching of seismic profiles, which is being done without touching the ground, and may be classified as fundamental research, but if the results are favourable, research turns out to be only a necessary beginning of research for purely practical purposes.

One rapporteur, however, thought that from the legal point of view the main criterion for judgement on admissibility or nonadmissibility of free scientific research in the continental shelf area is whether it is intended for open publication. The results of any research intended for practical purposes are not being published openly. Fundamental research should be free also on the sea-bed under national jurisdiction, subject to open publication.

Another international lawyer indicated, however, that a distinction should be made between the freedom of research in the high seas on one hand, and on the continental shelf on the other. In the latter case there are some limitations provided for by law. In that case we may only speak about freedom of fundamental research not directed towards commercial exploitation of the resources of the sea-bed.

Another participant drew attention to another criterion of distinction between different categories of research of the sea-bed, namely:

- the research carried on for peaceful purposes; and
- the research carried on for military purposes.

Although the speaker himself was not quite sure whether drawing a dividing line according to this criterion is always possible in practice, he believed that the implication of military

significance of a research project is often the reason for obstacles on the part of the coastal state with respect to some research projects.

Doubts as to feasibility of drawing a dividing line between research for peaceful and research for military purposes were shared by another international lawyer, who referred to such a common example as drawing maps. Furthermore, he indicated that even research on the noises produced by shoals of fish are of military value because they allow to distinguish such noises from those produced by sub-marines.

An international lawyer was of the opinion that the distinction between research for peaceful purposes and research for military purposes is practically covered by the criterion of open publication of the results of a research project, since projects carried on with military purposes in view are not intended for open publication.

One speaker expressed the view that cultural activity in the marine environment should be treated — from the legal point of view — as scientific research. He had in mind, first of all, archaeological research in the marine environment and pointed out to a special importance of this field of activities in the Mediterranean.

This view was supported by two other speakers. One of them was of the opinion that under the existing international law the notion of scientific research does include archaeological research as well.

A suggestion was also made that perhaps an intermediary of an international organisation might be useful in case of difficulties in obtaining the consent of the coastal state to carry out a research project in the area of its continental shelf. Perhaps international pressure and sponsorship would be helpful in such cases.

Another international lawyer suggested that perhaps a future United Nations declaration on the sea-bed should include a principle of the freedom of fundamental research in the high seas.

It was further proposed that the Working Group endorse the principles contained in the concluding part of the paper of Prof. Revellé (see p. 662). The speaker also drew attention to the principle No. 5, contained in the Report of the Commis-

sion to Study the Organisation of Peace.¹ He thought that this principle is general enough to gain the support of the Working Group.

The suggestion regarding the endorsement of the principle contained in the said Report was supported by two other speakers. One of them proposed additionally to stress the role of the Intergovernmental Oceanographic Commission and to include it in the list of bodies mentioned in the said principle. Another suggested the use of the term "fundamental research" and introducing a distinction based on the criterion of open publication.

Two other speakers, however, felt that it is not necessary to introduce the criterion of open publication once the Working Group is concerned with research beyond the limits of national jurisdiction.

One rapporteur suggested in this connection that the Working Group might additionally express the opinion that fundamental research should be free on the area of the continental shelf, subject to open publication of its results.

A geologist preferred to speak of an area between the outer limit of the territorial sea and the outer limit of national jurisdiction rather than of the "continental shelf".

This view with the said amendment was supported by the Working Group. The following opinion appeared in the report of the working Group.

"The deep-sea area should be open to scientific research without discrimination; international scientific cooperation and technical assistance should be fostered by the United Nations as well as by its specialised agencies, the Intergovernmental Oceanographic Commission and the International Atomic Energy Agency, so as to enable all States to participate in such research and to have access to the results thereof".

1. This area should be open to scientific investigation, without discrimination, and international scientific cooperation and technical assistance should be fostered by the United Nations, as well as its specialized agencies and the International Atomic Energy Agency, so as to enable all States to participate in such investigations and to have access to their results". ("The United Nations and the Bed of the Sea", Nineteenth Report of the Commission to Study the Organization of Peace, New York, March 1969, p. 21).

WORKING GROUP II

Present Regime of Scientific Research of the Sea-bed

A marine biologist recalled that up to the early fifties scientists were pursuing their work in the marine environment rather freely. In the period of negotiations of the conventions on the law of the sea the International Council of Scientific Unions made a very strong recommendation regarding the freedom of scientific research. The speaker noted that the International Law Commission in its comments to the draft Convention on the High Seas recognised the existence of other freedoms — besides the four mentioned in the draft — i.a. the freedom of scientific research. He recalled further that in 1958 some states submitted a proposal regarding non-interference with the fundamental scientific research on the continental shelf, which became art. 5, para. 1 of the Continental Shelf Convention. Unfortunately, some other states insisted on an amendment requiring a permission of the coastal state for carrying out scientific research on its continental shelf, and adoption of this amendment put scientists in a very bad situation. The difficulties the scientists have encountered are of four categories:

— uncertainty as to the precise extent of jurisdiction of the coastal state, because of the poor definition of the continental shelf in the Convention;

— uncertainty as to the kind of research which is subject to control by the coastal state; some countries maintain that it applies only to such categories of research which involve direct

physical contact with the bottom; according to some others it applies also to seismic studies, echo sounding, etc.;

— onerous timing requirements: some states require full description of the research project, including the names of participants, costs involved, etc. 180 days before the intended date of starting the expedition; but whether and when permission will be granted is not known;

— refusal by the coastal state means that research is barred from certain areas which may be of paramount importance from the scientific point of view.

The speaker referred further to a comparative study of the coasts on both sides of the Atlantic, recommended for the period of the International Decade of Ocean Exploration. He pointed out that the implementation of such a programme would involve passing over the continental shelves of many states. The whole venture may never come to being if states refuse to grant permissions.

Another marine biologist drew attention to the increasing use of scientific instruments which may stay on the bottom of the sea for a very long time. He submitted that some areas of the sea-bed like guyots, sea-mounts, etc. are particularly well suited for placing such instruments, and he was afraid that a competition may develop for such places.

In this connection it was remarked that the scientific data collecting stations are another example of difficulties encountered by scientists. These stations are anchored on the sea-bed but the data they collect pertain mainly to the high sea itself. Nevertheless, states are sometimes inclined to apply the continental shelf regime to these stations on the ground that they are anchored like buoys.

A navy expert referred to the example of the studies of the acoustic waves. It is quite a problem in this case to determine whether the research is carried on within or outside the limits of the continental shelf in the meaning of the existing law.

One participant referred to the difficulties encountered by scientists in connection with research projects off the coasts of the developing countries. According to the speaker, these states are afraid that the developed countries would make some commercial use of the data thus collected, which, however,

would be of no practical value to the coastal states themselves, because of the lack of technological capabilities on their part. He thought, accordingly, that more people from the developing countries should be given opportunity to participate in oceanographic research, which would allow them to understand better the meaning and significance of the scientific work.

An oil expert was of the opinion that this is a question of communication and of reminding people of the losses. If the developing countries refuse to allow research on their shelves, they will be the only losers. Research and subsequent discoveries will be simply made elsewhere.

An international lawyer expressed the view that the exclusive rights of the coastal state are in any case protected in the last instance by the exclusivity of exploitation. Thus, the coastal state may be only pleased if someone else is doing the research on its continental shelf. Several participants strongly pointed out that the exploration may never become a legal title for acquisition of any rights over the resources.

A marine geologist was of the opinion that the reluctance of coastal states in granting permissions for scientific research is motivated not so much by economic considerations as by suspicion that the results of a research could be used for military purposes. In this connection he referred also to the "Pueblo" case.

A navy expert noted that this seems also to be the case with the data collecting stations. He felt that the greatest difficulty here is distinguishing between those put for civilian purposes and those emplaced for military purposes, such as surveillance.

A marine biologist, however, remarked that there should be no problem if the following conditions are met:

— the collected data are made fully available to everybody in real time;

— emplacement of data collecting stations does not interfere with recognised freedoms (e.g. freedom of navigation) or with recognised exclusive rights of the coastal state.

He noted further that the Continental Shelf Convention provides for non-interference with the fundamental scientific

research on the continental shelf. But — at the same time — it requires permission by the coastal state to carry out such a research. Referring to measurement of sea currents, he argued that this is not a research on the continental shelf and should be exempted from requirement of permission. In practice, however, there is a tendency on the part of the coastal states to extend their jurisdiction over all kinds of research. According to the U.S. practice, permission is required only if the research project involves touching the bottom of the sea while some other states require permission in all cases.

An international lawyer noted in this connection that a distinction should be made between art. 5 para. 1 of the Continental Shelf Convention providing for non-interference with the fundamental scientific research on the continental shelf, and para. 8 of the same article requiring permission of the coastal state. The former is dealing with reconciliation of different uses of the continental shelf; the latter — with the competence of the coastal state. However, the exclusive rights of the coastal state on the continental shelf are limited only to exploration and exploitation of natural resources. Continental shelf is not a part of the territory of the coastal state and for scientific purposes it is open for all states. But, the freedom of scientific research is subject to certain conditions under the Continental Shelf Convention itself.

Another international lawyer recalled that under the Continental Shelf Convention the coastal states should grant permissions for scientific research on their continental shelf if conditions specified in the Convention are met. There is, however, no control over state practice, and the fact is that refusals for political reasons happen quite often. The speaker could not see any other form of control over state practice than an eventual recourse to the International Court of Justice if a refusal seems to be unwarranted under law. But he had doubts whether states would accept the jurisdiction of the Hague Court in these matters. The present situation is not agreeable but, perhaps, the best possible one. The speaker was afraid that whatever the new regime for the sea-bed, the situation with respect to freedom of research will deteriorate further.

Two international lawyers felt that there exists now a kind of a monopoly of scientific research.

Another participant, however, was of the opinion that the coastal states have no exclusive rights of scientific investigation, and referred to the example of Switzerland, which — though land-locked — does participate in oceanographic research.

Some speakers raised the question of international exchange of scientific information in the field of marine science. It was said that ever growing numbers of scientists and scientific institutions are sending in results of their research to the World Data Centres in Washington, Moscow, and Tokyo. There also exists a number of national oceanographic data centres, and an arrangement has been made for the exchange of their data through the I.O.C. Difficulties arise with all kinds of samples which should be made freely accessible but which are not capable of duplication.

Question of a Definition of Scientific Research

An international lawyer felt that it might be useful to define what scientific research is, and to what kind of research the provisions of the Continental Shelf Convention are applicable. He was afraid that in the state practice the notion of scientific research has bordered on the notion of national prestige, and that permissions for scientific research on the continental shelf are being refused sometimes merely because "*it is ours*", rather than out of concern about any real interest of the coastal state. He proposed a pragmatic approach to the question of definitions. In any case, the provisions of the Continental Shelf Convention should not apply when a research vessel — though passing over the continental shelf — is engaged in a research not pertaining to the bottom of the sea. Some difficulties may arise in connection with seismological research, when instruments are being sent down to the near vicinity of of the bottom. Disputes over such situations have been already known: scientists claimed that their research was not pertaining to the continental shelf since they were not touching the bottom, while the sea police of the coastal state maintained that it was precisely the continental shelf which was the object of the research, although instruments were not actually touching it.

A marine biologist was of the opinion that attempts at formulating definition of scientific research cannot be very useful, and that scientists need first of all operationally useful and workable criteria rather than theoretical concepts. He thought that if a research is carried on openly and results are being made openly available, it should be free. Otherwise, he could not think of any useful distinction between scientific research and economic exploration. Generally, research does not require very tight network of stations as does exploration. But in some cases even scientific research may require that.

Also a marine geologist felt that it is very difficult to define scientific research. The kind of data to be collected is about the same for scientific work as for economic exploration. The main difference is in spacing but he did not believe that these areas of activities may be clearly separated. He added that most of the finds on the sea-bed came as a result of purely scientific curiosity. Scientists are precursors of inventors. But if — for this reason — scientific exploration is paralysed, investors will never know about existing possibilities and wealth will be lost.

This point of view was supported by an oil expert.

An international lawyer was of the opinion that exploration is also a research carried on with scientific methods, and the difference is in the purpose. According to his opinion, exploration — under the Continental Shelf Convention — is aimed at the discovery of possibilities to exploit natural resources. Every research, the results of which are useful for discovering such possibilities, is exploration. And in this respect the coastal state exercises its sovereign rights — it may prohibit such an activity for different reasons, also just because it may not wish to have its resources discovered at all. This may be regrettable but it is so under the existing law.

A marine biologist remarked that this is precisely the problem, because even the observation of sea currents may in some way be used for further economic activities. And the result is that scientists cannot carry out scientific research on the vast areas of the ocean. If one insists on such an extensive interpretation of economic exploration, it will render any scientific work all over the continental shelf impossible, although such work may be vitally important for the benefit of mankind.

The following opinion appeared in the report of the Working Group: "There is a general agreement that freedom of scientific research is an essential prerequisite for the promotion of the exploration and exploitation of the natural resources of the sea-bed and ocean floor, although it is realised that sometimes it is difficult to differentiate between exploration and scientific research. A view was expressed that the exploration of natural resources in the meaning of the Geneva Convention on the Continental Shelf was always subject to the authorisation of the coastal state. Any scientific research which would be used for exploitation of natural resources should be qualified as exploration and could not be undertaken without the authorisation of the coastal state. On the contrary, according to this view, the coastal state was bound to tolerate scientific research undertaken by foreign nationals if it cannot be qualified as exploration of natural resources".

Future Regime of Scientific Research on the Sea-Bed

An international lawyer raised the question whether the problem of the freedom of scientific research should wait for a more comprehensive solution regarding the regime of the sea-bed, or should it be given priority in the form of special convention. He personally preferred the latter solution. Another question is the means by which the freedom of scientific research would be secured — i.e. the contents of a future convention.

A marine biologist said that he would also prefer a special convention, and recalled that this was also recommended by the U.S. Commission on Marine Science, Engineering and Resources. At the same time it was recognised that preparing a convention is a time-consuming process, and matters perhaps could be handled by other means pending the conclusion of a convention. He thought, e.g. of bilateral or even multilateral agreements between states, based on the principle of reciprocity. Such agreements could be concluded quicker than a general international convention, and might be easier renounced if they do not operate properly. He also suggested a more

far-reaching step, namely: unilateral declarations allowing free scientific research on own continental shelf, under some simple set of rules like those recommended recently by Intergovernmental Oceanographic Commission. The speaker believed that if such a declaration is made by a major maritime power, it may have a serious influence on the future development of law and practice regarding the freedom of scientific research.

An oil expert supported the suggestion regarding bilateral agreements.

Another participant referred to the meeting held at SIRPI in 1968, and recalled that the participants in that meeting were also in favour of some intermediate ways of solution. They recommended i.a. granting freedom of scientific research on the continental shelves to vessels engaged in declared national programmes, and granting permissions for scientific research in the territorial waters in a very liberal spirit.

A marine geologist presented two opposing extreme standpoints:

1) freedom of scientific research up to the outer limits of the territorial sea, without necessity of permission by the coastal state;

2) necessity to obtain permission from the coastal state for carrying out research on the continental shelf, whatever its extension may be and freedom of the coastal state to refuse such a permission on the basis that it is nobody's business to know anything about its continental shelf.

There may be many possible solutions in between but the speaker would advocate the first one.

This point of view was supported by two other participants who stated that the freedom of research on the sea-bed should become a starting point for establishing rights and priorities, and that the principle of freedom of research should prevail in all areas of the sea-bed — whether within or outside the limits of national jurisdiction.

A marine biologist proposed the following principles on which the status of scientific research should be based:

1) there should be no interference whatsoever with scientific research in the high seas or on the sea-bed beyond the limits of national jurisdiction;

2) In those portions of the ocean and of the sea-bed which lie within national jurisdiction but beyond the territorial sea, there should be freedom of all scientific research, subject only to the following conditions:

— prior notification (e.g. 60 days in advance) by the nation under whose flag the scientific research is being done;

— opportunity for the coastal state to participate in the research through one or more of its representatives aboard the vessel;

— data to be made fully available, and samples fully accessible to the scientific representatives of the coastal state;

3) Scientific data collecting stations may be placed on the sea-bed and in all parts of the sea, including those portions which are under national jurisdiction, subject only to the provision that in the areas under national jurisdiction:

— the data shall be made available to the world scientific community as promptly as possible — in real time, when desirable;

— the coastal state may regulate the placement of such stations so that they do not interfere unduly with other uses of these portions of the sea-bed.

The speaker insisted on the urgency of the matter in view of the difficulties encountered at present by the scientific community in carrying out oceanographic research, and recalled that in view of this situation the Intergovernmental Oceanographic Commission deemed it proper to create a special Working Group for this purpose. This Working Group has set forth a series of recommendations which are to be discussed further. His own proposals were along the lines of the recommendations of the Working Group. He believed that if these simple conditions are met, the coastal states would have no ground for suspicion with respect to scientific research. Under these conditions they have everything to gain and nothing to lose. The conditions, he proposed, should be sufficient — according to his opinion — also to dissipate any doubts as to possible military intelligence missions of research vessels. He

stressed that the freedom of scientific research must be reiterated as a matter of principle. It was recognised by the U.N. International Law Commission and there is no way back from law. The coastal states should permit scientific research undertaken by foreign nationals even if such a research may be useful for exploitation of the natural resources of the continental shelf.

Two international lawyers noted that, in view of existing practical difficulties, one cannot say now that the continental shelf is open for scientific research. It would be more correct to say that it should be, and in law is, open for scientific research.

An oil expert remarked that the sooner scientific research on the sea-bed is relieved from restrictions — the better.

A geographer expressed the opinion that besides the principle of freedom of scientific research, the necessity of coordination should also be emphasised, in order to avoid duplication and waste of efforts.

This point was taken up by another participant who drew attention to the multiplicity of agencies involved in marine affairs. He thought, therefore, that both international and interagency coordination would be needed. He was not sure, however, if creating a new agency would provide for a solution, and thought that, perhaps, some other practical measures to ensure coordination might be taken. He hoped that the International Decade of Ocean Exploration would allow to gather some useful experience in this respect.

A marine biologist believed that, perhaps, it would be desirable to set up a kind of a World Oceanographic Authority, which would include functions of the Intergovernmental Oceanographic Commission, the Department of Fisheries of the F.A.O., etc. This, however, must take time. In the meantime — he felt — the I.O.C. should be strengthened, and its cooperation with the F.A.O. fostered. In this connection he recalled a proposal made at the Working Group of the I.O.C. according to which the I.O.C. would serve as a sort of a clearing house facilitating oceanographic research off the coast of other states. National oceanographic institutions would submit their requests for permissions to undertake research to the I.O.C. which would transmit these requests to the coastal states. There was some debate as to the role of

the I.O.C. in these matters: should it certify the *bona fides* of the applying institution, or should it act just like a post office.

The following opinions appeared, i.a., in the report of the Working Group:

“ There should be greater efforts to remove the barriers and to reduce formal requirements for scientific research on the sea-bed and the ocean floor.

“ There should be better and more efficient coordination on different levels between the activities of states, institutions and international agencies in this matter.

“ It is necessary to foster international co-operation and to promote practical activities on national, regional, or world-wide scale, such as:

- long-term programmes of oceanographic studies,
- elaboration of international agreements on scientific investigation,
- establishment of basic documents (bathymetric, geophysical, geological, meteorological, etc.),
- exchange of scientific information and access to samples and other materials,
- setting up data collecting stations as well as data centres,
- putting greater emphasis on the role of the I.O.C.,
- study on the feasibility of establishing a new intergovernmental agency on oceanographic research ”.

WORKING GROUP III

Present Regime of Scientific Research of the Sea-Bed

One of the participants noted that the U.S. Commission on Marine Science, Engineering and Resources quoted in its report 12 instances in which only during the years 1967-68 the coastal states refused permission to carry out scientific research on their continental shelves. The speaker added that he knew about 25 such cases in the last four years, of which 5 were in 1969.

According to an international lawyer, it was very unfortunate that the Geneva Convention on the Continental Shelf led to restrictions regarding scientific research on the continental shelf. He was, however, aware of the difficulties involved, since research sometimes has bearing on the resources of the continental shelf. Sometimes even espionage was being carried out behind the screen of scientific research.

Another international lawyer was of the opinion that the difficulties encountered by scientists developed in state practice, and did not result directly from the letter of the Geneva Convention on the Continental Shelf. He recalled art. 5, para. 1 of that Convention which provides that there shall be no interference with fundamental scientific research carried out with the intention of open publication. From this he inferred that:

— anybody who wants to carry out fundamental oceanographic or other scientific research on the continental shelf with the intention of open publication does not need any permission at all;

— the right to carry out scientific research must not be restricted by exploration and exploitation of natural resources

of the shelf; this is how he interpreted the words "no interference" in art. 5, para 1 of the Continental Shelf Convention.

He admitted, however, that it is more difficult to carry out scientific research on the continental shelf without interfering with the recognised exclusive rights of the coastal state, which do not exist in the superjacent waters.

A natural scientist remarked that, apart from para. 1 of art. 5 of the Continental Shelf Convention, there is also para. 8 of the same article, which provides explicitly that prior consent of the coastal state is required for carrying out scientific research on the continental shelf. The text of that paragraph has several ambiguities, e.g.:

— it speaks about "research concerning the continental shelf" without defining what particular kinds of research are to be qualified as those "concerning" the continental shelf;

— permission of the coastal state is required with respect to the "research undertaken there" (i.e. — on the continental shelf), but the Convention does not define what type of research is to be considered as "undertaken there";

— para. 8 of art. 5 envisages that the permission shall "normally" be granted for "purely scientific research" when a research is undertaken by a "qualified" institution; however, it does not define what is "normal", when a research is "purely scientific";

— it does not indicate where a dividing line between the exploration of the continental shelf and fundamental scientific research should be drawn.

The speaker complained that on these grounds states believe that they have right to prohibit scientific research, and felt that unless the Continental Shelf Convention is modified, the situation is likely to deteriorate.

Another participant noted that one cannot ignore political and other susceptibilities involved in the activities of foreign nationals on the continental shelf.

It was also added by another speaker that total elimination of any interference by coastal states with the research carried out on their continental shelves is hardly possible. He

referred to cases of justified interference, i.a. — to a case when actually exploration for oil on the continental shelf was carried under cover of scientific research. He pointed out that this is not the question of governments wishing to hamper scientific research; however, the coastal states are entitled to an advance control over what is to be done on their continental shelves. Some ventures, as e.g. seismic shootings, even if carried out for purely scientific purposes, may be dangerous for the environment. The speaker believed that the coastal state has the right to prohibit an activity which may be harmful. This also includes measures to prevent pollution.

Future Regime of Scientific Research on the Sea-Bed

One of the participants submitted for discussion in the Working Group a series of principles. The passage relating to the question of freedom of scientific research reads as follows:

“ All states shall have the right to conduct scientific research anywhere in the ocean outside territorial waters ”.

According to the author, the only conditions for free conduct of scientific research on the continental shelf should be limited to: an opportunity for the coastal state to participate in the research, open publications of the results of the research, availability of collected data, and accessibility of collected samples to coastal state. There should be no other restrictions with regard to placing buoys and underwater devices, taking samples from the sea-bed, etc.

An international lawyer expressed the opinion that there seems to be general agreement that scientific research beyond the limits of the territorial sea should be free.

Two other international lawyers felt that while there is no objection against reiterating the principle of freedom of scientific research, any specific reference to the concept of territorial waters should be better omitted.

One participant felt that reference to the limits of contiguous zone rather than to the limits of the territorial waters would be more appropriate.

Some other participants were of the opinion that, when speaking about freedom of scientific research, references to any limits of a specific zone should be avoided since such limits might be subject to controversial interpretations.

One speaker, however, supported the criterion of the limits of territorial sea. He felt that if it is assumed that this limit is not univocally defined, it should be admitted consequently that the limits of the high seas are not univocally defined as well, and, therefore, the high seas should not be referred to either.

Difficulties involved in establishing any specific limits of applicability of the principle of freedom of scientific research were mentioned in the context of research on fish. Fish are unaware of any legal boundaries, still they must be followed during the implementation of a research programme.

Views were also expressed that when speaking of the future, there is no need to stress so much the right to carry out fresh scientific research, which otherwise exists also in the present law (although, according to one of the speakers this right is a matter of some controversy). The stress should be put rather on discouraging interference with scientific research in practice, and on elimination of unnecessary permissions and authorisations.

In this connection an international lawyer drew attention to possible deleterious effects of scientific research on marine environment.

Another international lawyer felt that it is difficult to grant an unrestricted freedom of research on those parts of the sea-bed which are being exploited. He thought that, perhaps, it would be better to entrust scientific research on the sea-bed to an international organisation. This might help to secure granting permissions by coastal states.

One international lawyer felt that the principle submitted for discussion mainly repeats the idea contained in art. 2 of the Geneva Convention on the High Seas but hardly fits the context of the discussion on the sea-bed. He felt that the discussion should be rather inspired by the provisions of the Convention on the Continental Shelf.

Two other international lawyers, however, were of the opinion that it would not serve any useful purpose to reiterate

principles of the Continental Shelf Convention in the present discussion. Its purpose is not to perpetuate restrictions to which scientific research on the continental shelf is subjected in practice as a result of the provisions of art. 5, para. 8 of that Convention.

Opinions were also voiced that the principle of freedom of the high seas, which implies that there should be no interference with scientific research, should be taken as a departing point; and that insofar as the very right to conduct scientific research is concerned the status of the underjacent shelf should not be separated from the high seas.

A natural scientist, however, felt that the situation in the high seas should not be confused or amalgamated with that prevailing on the continental shelf. Scientists encounter no difficulties in practice insofar as the application of the Convention on the High Seas is concerned. Difficulties arise in connection with the other convention — that on the continental shelf — and the speaker felt that discussion should be pointed to this direction.

These preoccupations were shared by another natural scientist.

On the other hand, the submission that there should be “no interference” with scientific research was challenged by one participant as too far-fetched. He would prefer to say that oceans, its bed and subsoil are open to scientific research.

An international lawyer noted that discussion actually involves four different elements, three of which are non-controversial, namely:

- 1) that the coastal state exercises exclusive jurisdiction in the territorial waters and on the underjacent sea-bed and its subsoil, including full control of scientific research;

- 2) that in the high seas the principle of their freedom comprises absolute freedom of scientific research;

- 3) that there is also absolute freedom of scientific research on the sea-bed outside the limits of the continental shelf.

The fourth element — freedom of scientific research on the continental shelf — appears to require some remedial

action since, according to some views, the existing law is misinterpreted, abused, or whatever term may seem appropriate.

The speaker added that the problem at stake here is not whether or not the coastal state is willing to admit scientific research on its shelf, but whether the coastal state considers that a given venture is scientific research.

The following opinion appeared in the Report of the Working Group:

“There shall be no interference by any state with the conduct of scientific research on the high seas, including the water over the continental shelf. There shall be no unreasonable interference with scientific research on the sea-bed and subsoil of the continental shelf, provided that the coastal state is given prior notification of the plan to conduct the research, has full opportunity to participate in the research, is given copies of all data obtained and portions of all samples collected, and the research does not deleteriously affect marine resources and other uses of the sea”.

FINAL REPORT

INTRODUCTION

The Symposium on the International Regime of the Sea-Bed was organized by the Istituto Affari Internazionali and held in Rome from June 30 to July 5, 1969.

Its Steering Committee included:

Prof. J. ANDRASSY, University of Zagreb, Yugoslavia

Prof. G. ARANGIO-RUIZ, University of Bologna, Italy

Prof. R.N. GARDNER, Columbia University, United States

Dr. V.J. GAUCI, Permanent Mission of Malta to the United Nations

Prof. D.H.N. JOHNSON, London School of Economics, Great Britain

Dr. J. MARTENSON, Assistant Director, SIPRI, Sweden

Prof. E. MENZEL, University of Kiel, Federal Republic of Germany

Prof. S. ODA, Tohoku University, Sendai, Japan

Prof. L.B. SOHN, Harvard University, United States

A. SPINELLI, Director, Istituto Affari Internazionali, Italy

Prof. G.I. TUNKIN, Moscow University, Soviet Union

In the Symposium participated 52 scholars and experts from the following 22 countries: Australia, Bulgaria, Canada, Ceylon, Czechoslovakia, Denmark, Federal Republic of Germany,

France, Indonesia, Israel, Italy, Japan, Malta, Netherlands, Norway, Portugal, Soviet Union, Sweden, Switzerland, United Kingdom, United States, Yugoslavia.

Dr. J. SZTUCKI of the Istituto Affari Internazionali served as the Scientific Secretary of the Symposium.

24 papers on 15 items of the programme were presented.

The Symposium proceeded partly in Plenary Meetings and partly in three Working Groups.

The Final Report produced at the end of the Symposium consists of two parts. Part I — Summary of the Discussion — containing different views presented, was drawn up on the basis of the Reports of the three Working Groups. Part II — Statement of Conclusions — was submitted by the Steering Committee. Both parts were considered in plenary meetings and accepted without voting as adequate presentation of the results of the Symposium.

ALTIERO SPINELLI

Director, Istituto Affari Internazionali

I

SUMMARY OF THE DISCUSSION

1. *General Problems. The configuration of the ocean floor and its subsoil; geopolitical implications*

A.

Questions related to this part of the discussion were considered on the basis of the paper of Prof. Guilcher and of the contribution of Prof. Menard. Statements concentrated mainly on the possibility of exploitation and use of those areas of the sea-bed which though covered by relatively shallow waters do not form a part of the continental margin (banks, seamounts, guyots, etc.) On this matter it was said that:

1) the area of paramount importance at present is that of the sea-bed of the continental shelf and slope;

2) banks are exploitable and some of them have already been exploited; seamounts could be exploited in the future; banks and seamounts are not, however, likely to contain deposits of petroleum;

3) although seamounts, guyots, etc. may be of little importance from the point of view of economic exploitation, they could be of considerable importance for scientific, military, and also recreational purposes;

4) all banks, seamounts etc. cannot be treated on the same footing; their value as possible areas of exploitation and use depends on their depth, configuration of the tops (in the case of the seamounts) etc.

B.

It was also clarified during the discussion that the structure of the continental margin and the scientific terminology for its specific parts (shelf, slope, terrace, rise, margin) were sufficiently known at the time of the drafting of the Convention on the Continental Shelf of 1958.

C.

A group of participants submitted a set of definitions of different sea-floor provinces, based on geomorphology (ocean basins, enclosed and marginal sea, continental shelf, continental slope, continental rise, deep-sea trench, abyssal plain, continental terrace, continental margin) and also offered terminology and definitions as substitutes for geomorphological terms, intended to suit legal objectives (sea-bed of the territorial sea, national sea-bed, international sea-bed). This latter terminology and corresponding definitions gave rise to a series of objections. The opinion was expressed by a number of participants that the legal terminology relating to the sea-bed problems needs further elaboration.

2. The economic resources of the sea-bed. Pollution and other dangers to marine environment

Questions related to this part of the discussion were considered on the basis of the papers of: Dr. K.O. Emery, Prof. H. Niino, Dr. T.F. Gaskell, Dr. G. Muscarella, Dr. F.T. Christy, Dr. S.J. Holt, Prof. M.B. Schaefer, Dr. C. Polvani.

During the discussion the following opinions were expressed:

A.

In general that

1) More effective means are needed to ensure conservation, development, and rational use of all ocean resources, including the resources of the sea-bed.

2) Oil and gas are at present the main products of the continental shelf; in the future the exploitation would extend

to the continental slope; however, it is not to be expected that oil and natural gas deposits will soon be exploited on the seabed beyond the continental slope;

3) Manganese nodules are the other assets of the deep sea-bed likely to become the next object of exploitation; however, the opinion was also expressed that most likely this would not happen in the next decade and that at the moment more research and sampling was needed;

4) Economic feasibility to exploit mineral resources depends *inter alia* on: the quantity and quality of the mineral in a particular area; the costs of transportation; and the direct or indirect governmental support to the enterprises undertaking the exploration and exploitation;

5) Production of certain minerals from the sea-bed could affect world market prices and some control recommends itself in order to avoid damage to the current producer nations, especially developing nations; it deserves consideration whether or not certain payments for compensation should be paid to an international fund. On the other hand, an opinion was voiced that the extraction of minerals from the sea-bed will be more costly than the extraction from the land and would not automatically result in the decrease of prices on world market;

6) In the first stage of exploration and possible exploitation there will be little competition because of the magnitude of investments required; however, in the long run and certainly after successful exploitation in particular areas competition might increase;

7) The main living resources of the sea-bed are the sedentary and demersal fish and also the crustacea on the continental shelf and slope; however, according to present day knowledge, the living resources beyond the continental slope are unlikely to become of any economic importance;

8) The provisions on living resources in the Geneva Convention on the Continental Shelf (1958) should be studied with a view to determining whether they should be replaced by the rules governing the high seas, or those contained in the Convention on Fishing and Conservation of Living Resources of the High Seas;

9) Biological categories of fauna do not correspond to geological divisions of the ocean floor; some types of fauna start and end the cycle of life in different parts of the sea.

B.

In view of possible conflicts of uses, especially of the impact of the exploration and exploitation of mineral resources on the living resources of the high seas, it was suggested that:

1) it is necessary to fix general standards for the exploration and exploitation of minerals according to which the damage which may be caused to living resources will be reduced to a minimum;

2) some criteria for the evaluation of priority of uses should be formulated and adequate international measures for the application of such priority criteria are necessary; an international machinery in charge of the application of such criteria is necessary;

3) in solving the question of conflicting uses of the seabed on the one hand of the superjacent waters on the other hand, it may be relevant to recall the law of international rivers where the reconciliation of conflicts has been under consideration for a long period of time;

4) the erection of installations for exploitation of the seabed beyond the limits of national jurisdiction automatically interferes with free navigation; it is therefore important to reconcile the exploration and exploitation of the seabed with other uses of the high seas, by analogy to art. 5 of the Geneva Convention on the Continental Shelf; it was noted that drilling installations occupy only a small part of the seabed, and that they sometimes can be beneficial to fishermen.

C.

Considerable attention was devoted to the problems of pollution and other dangers to marine environment. In this connection views and suggestions were voiced that:

1) more effective means are needed than presently exist for the prevention or control of any kind of pollution in the

ocean; this will require internationally coordinated action concerning pollutants coming from the land or the air (for example, pesticides, radioactive substances, poisonous chemicals and sewage); pollution from ships, submarines or other equipment used at sea; and pollution resulting from exploitation of marine resources (for example, exploration, production, storage, and transportation of oil and gas); in this connection a view was also expressed that not enough is known about the effects of oil pollution and of detergents, and that, therefore, the preventive measures have to be found without over-dramatization of the existing situation.

2) there exists a vacuum as regards provisions concerning pollution and other dangers caused by new techniques of exploration and exploitation of the natural resources of the sea-bed and ocean floor; the problem has become more important because of increased activities on the sea-bed;

3) proper zoning and control of mining practices and an orderly manner of location of installations could minimize hazards;

4) pending the establishment of an effective international regime, some practical measures might be adopted including the registration of disposal of dangerous pollutants;

5) especially strict measures of organised international control were suggested with respect to disposal of radioactive waste; the problem of radioactive waste was especially difficult for countries with a small land area; and a view was expressed that in the deep-sea area waste could be disposed of by drilling holes in the sediment of the sea-bed in areas which are tectonically stable;

6) the types of containers for medium-level radioactive waste used in the past could explode as a result of outside as well as inside pressure; that they are never 100 % safe; tectonic movements of the sea-bed also cause problems;

7) with respect to disposal other dangers than those resulting from the action of natural forces should also be borne in mind, e.g. those of irresponsible salvagers; an in-

ternational regime should also deal with salvage of waste from the sea-bed;

8) waste, whether radioactive or not, such as ammunition, is a hazard to fishing and oceanic research.

3. *The present regime and possible future regimes for the sea-bed resources*

Questions related to this part of the discussion were considered on the basis of the papers of: Prof. E.D. Brown, Prof. F. Durante, Prof. G. Arangio-Ruiz, Dr. E. Bettini, Prof. S.Oda, Amb. A. Pardo, Prof. L.B. Sohn, and Dr. A.K. Zhudro jointly with Dr. A. L. Kolodkin.

A.

On the present regime of the sea-bed beyond the limits of national jurisdiction it was stated in the discussion that:

1) there are principles and norms applicable to the sea-bed but considerable deficiencies exist, a new system of rules has to be developed;

2) according to present international law there exists an area of the sea-bed beyond national jurisdiction;

3) in a few instances exclusive claims to the resources of small areas of the sea-bed had occurred in the past; unless adequate steps are taken at the normative level there may be — according to certain views — a danger that international law might — under the pressure of factual situations — evolve in the sense of admitting appropriation;

4) the definition of the continental shelf in the 1958 Convention is ambiguous and subject to different interpretations and might be construed as leading potentially to the division of the whole sea-bed among the coastal states; however, it was also stated that the Geneva Convention on the Continental Shelf does not allow such a possibility.

B.

The discussion focused mainly on the possible future regimes. Many different opinions and suggestions regarding this matter were presented. Among them were the following:

1) the establishment of an international regime depends upon sound scientific, technical, economic and political evaluations; according to one view, until the facts are ascertained it is difficult to decide among several possible alternative regimes; according to another view, although this choice depends on a better knowledge of the offshore areas and on a clear identification of national interests, too much delay in the envisioning and adopting of an international regime might permit the growth and consolidation of vested interests which might jeopardize the establishment of such a regime;

2) a convention on the regime of the sea-bed is necessary and should be concluded as soon as possible;

3) establishment of an international regime of the sea-bed is closely interconnected with the definition of boundary between the continental shelf and the sea-bed beyond national jurisdiction; the revision of art. 1 of the Continental Shelf Convention is needed in order to avoid ambiguity and confusion as to the outer limits of the continental shelf in the light of advancing technology; an opinion was also expressed that final decision on this point requires some supplementary studies.

4) the following choices were proposed in the course of the Symposium for the determination of the outer limit of the continental shelf:

- (a) the 200-metre isobath;
- (b) a distance-off-the-coast criterion;
- (c) an agreed depth criterion;

(d) a combination of the depth criterion with the distance-off-the-coast criterion — whichever extends further seaward, as advocated by some participants in the discussion, or, as advocated by some other participants — subject to the principle that the area in which the coastal State exercises exclusive rights should be as small as is feasible;

(e) the marked increase in declivity leading to the continental slope;

(f) the outer limit of the continental slope;

(g) the outer limit of the continental rise;

5) claims to the sea-bed should be frozen; this could be done by recognising the minimum of the 200-meter isobath and beyond this isobath up to the limit where economic production actually takes place, for example, as of January 1, 1970: according to another view, the claims should not be frozen;

6) the United Nations General Assembly should proclaim at the earliest opportunity a minimum area of the sea-bed which is unquestionably beyond national jurisdiction, leaving the precise definition of the continental shelf subject to national jurisdiction to a future international conference;

7) the future regime of the sea-bed should be directed to the encouragement of exploitation and exploration, and the elimination of possibilities of conflict;

8) all countries, and especially the developing countries should share in the benefits deriving from the exploitation of the sea-bed resources;

9) the sharing of benefits can also take the form of technical assistance, in order to spread known-how, training and knowledge of the sea-bed including the continental shelf.

C.

A number of principles of the future regime of the sea-bed were advanced in the discussion, with various degrees of support or opposition. Among them were the following:

1. "The resources of the high seas, including those of the underlying sea-bed and subsoil, shall be used and preserved in the common interest of all men";

or, according to another proposal:

"The use and exploitation of the sea-bed and subsoil of the high seas beyond the generally recognized limits of national jurisdiction should be developed in the interest of mankind

and of all States — whether coastal or landlocked — taking into account the special needs of the developing States ”.

The reference to the sea-bed as “ a common heritage of mankind ” supported by a number of participants was opposed by some other participants. Furthermore, the view was expressed that the sea-bed and subsoil beyond the limits of national jurisdiction are in common use of peoples and have the same status as the high seas.

2. “ Outside those areas in which under international law coastal States enjoy exclusive rights for exploration and exploitation of the resources of the sea-bed and the subsoil, individual States and their nationals shall not unilaterally appropriate the sea-bed in any manner ”;

or, according to another proposal:

“ No State should be permitted to claim or exercise sovereignty, jurisdiction or any exclusive rights over the sea-bed beyond the limits of national jurisdiction, and no part of this area should be subject to national appropriation by any means whatsoever ”.

3. “ The benefits gained from exploitation of the resources of the sea-bed and its subsoil beyond the zone in which the coastal States exercise exclusive rights shall be used for the welfare and in the interest of all countries and the international community as a whole, keeping in mind that the developer is entitled to a reasonable profit. All countries shall participate in an equitable manner in the benefits derived from the exploitation of these resources ”.

4. “ International agreement is needed to ensure the protection and legal status of personnel, equipment, and investment employed in all marine activities, including research, exploitation and exploration of the resources of the sea-bed ”.

On this problem an opinion was also expressed that a business company is unlikely to invest in an offshore operation unless there is legal security not only as regards the title but also in other matters such as insurance, workmen’s compensation, criminal and civil law.

5. “ Appropriate provision should be made for determining responsibility in case of any default or damage caused by

activities relating to the sea-bed beyond the limits of national jurisdiction and for preventing any unjustifiable interference with the freedom of the high seas”.

According to another proposal on the question of responsibility:

“ The State bears the responsibility for all national activities concerning the exploration and exploitation of the natural resources of the sea-bed and its subsoil. The installation and other artificial constructions for the exploration and exploitation of the natural resources of the sea-bed and its subsoil should be subject to the jurisdiction of the flag State ”.

6. “ The use of the sea-bed and its subsoil beyond the limits of national jurisdiction shall in no way interfere with the freedoms of navigation, fisheries, maintenance of submarine cables and pipe lines, scientific research or other freedoms recognised in the Geneva Convention on the High Sea ”.

7. “ The use of the sea-bed and its subsoil should be in accordance with the principles of contemporary international law, including the United Nations Charter and the principle of freedom of the sea ”.

8. “ The advancement of the beneficial exploitation of the resources of the sea-bed, together with technological developments for this purpose shall be encouraged ”.

9. “ There should be intensified international cooperation and coordination of activities involving the sea-bed and the superjacent waters beyond the limits of national jurisdiction ”.

D.

Participants were in favour of intensified international cooperation and rationalization of existing activities involving the sea-bed and its subsoil. In addition, a large number of participants were in favour of the establishment of an international machinery connected with the future regime of the sea-bed beyond the limits of national jurisdiction, and a great variety of views was presented as to its possible purposes, structure, powers, etc. Among them were the following:

1. With respect to the main purposes of an international organisation for the exploration and exploitation of the sea-bed

the following were mentioned during the discussion: maximum economic effectiveness of exploitation, adequate international participation, and prevention of harmful competition;

2. It was also stressed in the discussion that the organisation should ensure appropriate incentives for the exploration and the exploitation of the sea-bed, such as security of tenure, participation of States as well as enterprises, reduction of bureaucratic procedures, etc.

3. As to scope of functions and powers of a possible future organisation for the sea-bed, the following alternatives were mentioned: simple registration, registration of qualified applicants, licensing or leasing, or the direct management of the resources by an international organisation; it was also pointed out that even simple registration machinery, in order to be meaningful, must include an adequate international legal protection of the rights of registrants.

4. A suggestion was made that the correct approach in this matter is the evolutionary approach, starting from a registration system without fees, and gradually proceeding towards ownership of the sea-bed resources by the United Nations.

5. More specifically, the following possible functions of an international organisation for the sea-bed were mentioned during the discussion as examples: the prevention of disputes; guarantee of investment to the entrepreneur, through the granting of exclusive rights; allocation of rights; collection of royalties and other levies; distribution of revenues; administration and registration of rights and activities; setting up standards and procedures for mining operations.

6. A range of possible choices was offered in the discussion as to the organisational framework of the future sea-bed agency: a specialised agency of the United Nations, an organisation of the IAEA type, of the Intelsat type, or a new type of organisation endowed with such features as would enable it to carry out the quasi-governmental functions (regulatory, administrative, judicial) necessary for an international control. Within the framework of the latter alternative a weighted voting system in the agency's primary body was advocated. A reservation was also made during the discussion that the regulatory function with

respect to the sea-bed should not be vested in the United Nations. A view was also expressed that the present distribution of voting power in the United Nations bodies and the lack of the binding decision power by the General Assembly in most relevant matters would make the allocation of the net revenue of the sea-bed agencies by the United Nations very problematic.

7. An opinion was also voiced that there should be a combination of a world-wide arrangement with regional arrangements.

8. According to another opinion, the proposed agency should deal not only with the exploration and exploitation of the sea-bed beyond the limits of national jurisdiction but also with all other peaceful uses of the seas (navigation, fishing, etc.).

9. With respect to exploration and exploitation the following alternatives were put forward: (a) world or regional organisation should carry out operational activities; (b) states should acquire leases and thereupon would license enterprises; or (c) enterprises should acquire the rights of exploration and exploitation directly.

10. A view was expressed that the regulation of the exploration and exploitation of the natural resources beyond the limits of national jurisdiction should be based on the methods of the bilateral and multilateral conventions which might be concluded by States in conformity with their accumulated practical experience and the rules of contemporary international law.

4. *The military uses of the sea-bed and their regime*

Questions related to this part of the discussion were considered on the basis of the papers of: Prof. J. Andrassy, Prof. D.G. Brennan, Dr. J.P. Craven, Dr. J. Evensen.

A.

Opinion were expressed that:

1) there is a growing concern for the military developments that have already taken place; with the advancement

of technology, the prospects of using the sea-bed for military purposes have generally increased; any increase in this field will mean the reduction of the areas available for the peaceful exploration, exploitation and scientific research;

2) the scope of weapons, whether tactical or strategic, which may be installed on the sea-bed is constantly becoming wider; when drafting an instrument for an international régime on military uses these factors should not be neglected;

3) the present regime, though appearing in one view as imposing some limitations, does not contain clear rules explicitly banning the military uses of the sea-bed; some participants, while preferring not to express a final view with regard to the admissibility of military uses of the continental shelf under the Geneva Convention on the Continental Shelf, noted that in any case this Convention does not provide for any exclusive right of the coastal State with regard to the military uses of the sea-bed; the question was also posed whether the demilitarisation of the sea-bed is enough to diminish the military uses of the oceans.

B.

For the future military régime the following points were proposed for consideration:

- (1) what area should be reserved for peaceful purposes only;
- (2) the distinction between defensive and offensive installations;
- (3) nuclear weapons;
- (4) military bases and fortifications;
- (5) other weapons systems;
- (6) other installations which are not weapons systems, bases or fortifications;
- (7) military manoeuvres;
- (8) testing of weapons;
- (9) the use of military personnel;

(10) control and inspection; and

(11) what international agency should deal with these problems.

1. On point 1 the predominant view was that the area should include the continental shelf and the area beyond it. In this connection reference was made to the draft treaty submitted by the USSR to the 18 Nation Disarmament Committee on the demilitarisation of the sea-bed and ocean floor outside the 12-mile coastal zone, and to the draft treaty submitted to that Committee by the United States, which would ban weapons of mass destruction in the area of the sea-bed beyond the 3-mile coastal zone.

2. On points 2 to 6 an opinion was expressed that no military bases, fortifications or similar installations should be established in the area of the sea-bed reserved for peaceful purposes only; no nuclear weapons or other weapons of mass destruction should be emplaced on it, implanted on it, or affixed to it, and no such weapons especially designed for use on the sea-bed should be deployed thereon. Some participants expressed the view that a total prohibition of military uses should be the goal of international action. Others suggested that total prohibition was not feasible and only partial measures might be acceptable; a progressive approach was suggested in this connection. An opinion was also voiced that the use of weapons in waters superjacent to the ocean floor cannot invariably be separated from the uses of the sea-bed and ocean floor, and that elimination of the use of weapons system in superjacent waters can only be accomplished in the context of wider measures of arms control and disarmament.

3. On points 7 to 9 (military manoeuvres, testing of weapons, and use of military personnel for peaceful purposes) the provisions of the Outer Space Treaty, the Treaty on Antarctica, and the Nuclear Test Ban Treaty were recalled in the discussion.

4. With respect to points 10 and 11, the question of verification and detection, inspection and enforcement of international agreements dealing with measures of arms control or

demilitarisation of the sea-bed, were discussed. The view was expressed that such questions could be effectively dealt with in various ways either within an international framework or directly by the States adhering to a future international convention. It was stated that new arrangements based on general agreement are needed to establish the future regime of military uses of the sea-bed, in order to secure the peaceful and orderly exploration and use of the sea-bed. The opinion was also expressed that all States should be invited to adhere to, and as many of them as possible included as parties to an international regime of the demilitarisation of the sea-bed.

5. *Scientific research on the sea-bed and its legal regime*

Questions related to this part of the discussion were considered on the basis of the papers of: Prof. L. Bouchez, Prof. E. Menzel and Prof. R. Revelle.

A.

There was a general agreement that freedom of scientific research is an essential prerequisite for the promotion of the exploration and exploitation of the natural resources of the sea-bed.

B.

Views were expressed that:

1) the sea-bed and subsoil thereof beyond the limits of national jurisdiction are open to scientific research without discrimination; international scientific co-operation and technical assistance should continue to be fostered by the United Nations as well as the specialised agencies, the Intergovernmental Oceanographic Commission, the IAEA, and other international organisations so as to enable all States to participate in such research and to have access to the results thereof;

2) the exploration of natural resources in the meaning of the Geneva Convention on the Continental Shelf is subject to

the authorization of the coastal State; however, it was noted that the refusal by coastal States to permit scientific research on the ground that it is also useful for exploration of national resources is detrimental to scientific progress;

3) there should be no interference by any State with the conduct of scientific research in the high seas, including the water over the continental shelf;

there should be no unreasonable interference with scientific research on the sea-bed and subsoil of the continental shelf, provided that the coastal State is given prior notification of the plan to conduct the research, has full opportunity to participate in the research, is given copies of all data obtained and access to all samples collected, and the research is not detrimental to marine resources or other uses of the sea;

4) fundamental research subject to open publication should be free on the sea-bed under national jurisdiction but beyond the territorial sea.

C.

More specifically, it was also proposed and recommended that:

1) there should be no interference with scientific research in the high seas or the sea-bed beyond national jurisdiction;

2) in those portions of the ocean and of the sea-bed within national jurisdiction, beyond the territorial sea, there should be freedom for all scientific research, subject only to the following conditions:

(a) prior notification to the coastal State by the State under whose flag the scientific research is to be carried out;

(b) opportunity for the coastal State to participate in the research through one or more of its representatives aboard the vessel;

(c) full availability of data and accessibility of samples to the scientific representative of the coastal State;

3) scientific data collecting stations may be placed on the sea-bed and in all parts of the sea, including those areas under

national jurisdiction, subject only to the provision that, in areas under national jurisdiction:

(a) data shall be made available as promptly as possible, in real time when desirable, to the world scientific community;

(b) coastal States may regulate the placement of these stations in such a manner as not to interfere unduly with other uses of these areas of the sea-bed.

4) greater efforts should be made to remove the barriers to and to reduce formal requirements for, scientific research on the ocean floor;

5) there should be more efficient co-ordination at various levels between activities of States, institutions and international agencies in this matter, so as to promote practical activities on national, regional or world-wide scale such as:

(a) long-term programs of oceanographic studies;

(b) elaboration of international agreements on scientific investigation;

(c) establishment of basic documents (bathymetric, geophysical, geological, meteorological, etc);

(d) exchange of scientific information and access to samples and other materials;

(e) setting up of data collecting devices and installations as well as data centers;

(f) intensification of the IOC activities within its present terms of reference;

(g) the study of the feasibility of establishing a new inter-governmental agency on oceanographic research.

In this connection reference was also made to the recommendations of the Symposium held by SIPRI in 1968.

II

STATEMENT OF CONCLUSIONS

At the close of their discussions the participants in the Symposium on the International Regime of the Sea-Bed reviewed as a group the following statement. The statement represents a general consensus; but it should not be assumed that every participant adheres to every conclusion.

1. According to present international law there is an area of the sea-bed and its subsoil, underlying the high seas, beyond the limits of national jurisdiction.

2. The exploration, use and exploitation of this area should be developed in the common interest of all men and all States — whether coastal or landlocked — taking into account the special needs of the developing countries.

3. The precise boundary of this area should be defined with all possible speed, and in such a manner as to reserve and utilize the largest amount of resources for the common benefit of mankind.

4. No part of this area should be subject to national appropriation by any State through claim of sovereignty, through use or occupation by the State itself or its nationals, or through any other means.

5. Appropriate provisions should be made for determining responsibility in case of any default or damage caused by activities relating to this area, and for preventing any unjustifiable interference with the freedom of the high seas or with the principles established for the protection of the marine environment and the control and prevention of pollution.

6. No military bases, fortifications or similar installations should be established in this area; no nuclear weapons or other weapons of mass destruction should be emplaced on it, or affixed to it, and no such weapons of mass destruction especially designed for use on the sea-bed should be deployed, thereon.

7. Scientific research in this area in law is and should remain open to all without discrimination and without interference by any State, freedom of scientific research being an essential pre-requisite for the promotion of the exploration and exploitation of the natural resources of this area. International scientific co-operation and technical assistance should be fostered, so as to enable all States to participate in such research and to have access to the results thereof. Greater efforts should be made to remove barriers to and reduce formal requirements for, scientific research on the sea-bed beyond the territorial sea.

8. A reasonable system should be devised for ensuring that appropriate shares of the net gains above an appropriate profit and return of costs of the enterprise engaged in the exploitation of the resources of this area are devoted to financing the economic and social progress of the developing countries and other internationally accepted objectives.

9. As existing international law is not adequate to achieve all the above objectives and as its provisions relating to this area may require adaptation to new technological developments, an international treaty, in accordance with the principles and purposes of the United Nations Charter, should be concluded at an early date taking into account the conclusions listed in this document.

Pending the coming into force of such a treaty, activities in this area should be carried out in accordance with the Charter of the United Nations, the provisions of existing international law, in particular those relating to the high seas and their sea-bed, and the above stated conclusions, especially paragraph 4.

10. The implementation of such a treaty embodying the principles listed above, would require appropriate supplementary arrangements leading towards the establishment of an effective international machinery.

B I B L I O G R A P Y
OF THE PROBLEM OF THE INTERNATIONAL REGIME
OF THE SEA-BED AND RELATED MATTERS
FOR YEARS 1965-1969

BY

Dr. JERZY SZTUCKI

Scientific Secretary of the Symposium, Istituto Affari Internazionali Rome

INTRODUCTORY NOTE

The present bibliography is limited to the period 1965-1969, i.e. to the period in which the questions of the exploration and use of the ocean floor have gained recognition and significance as problems of international relations.

Having in mind the complexity of the questions involved, which border also on many other problems of the law of the sea, a number of writings dealing with these related matters, which appeared during the period indicated above, were also included in the bibliography. On the other hand, it does not include either general textbooks on international law or general textbooks on the law of the sea.

Time limitations did not allow for any attempt at presenting an exhaustive material. It is focused mainly on political, legal, military and also economic aspects of the problem. The writings on technological and scientific aspects of the problem are treated rather as a background or auxiliary material and, consequently, were selected much less extensively. It is believed, however, that this bibliography — as conceived in accordance with the above-mentioned criteria — will provide a useful reference source for those interested in the problem.

The following explanations may facilitate the use of the bibliography:

1) For the sake of conciseness the U.N. documents of purely formal character as well as those later reproduced in full in other U.N. documents of a more general character have been omitted here.

2) Having in mind the extensive surveys of relevant national legislations and of international agreements, made in the UN documents A/AC.135/10/Rev. 1, A/AC.135/11, Corr. 1 and Add. 1, and A/AC.138/9 - these acts and agreements are not listed separately.

3). The bibliography includes certain number of collective works, proceedings of conferences, etc. Individual contributions to these publications, however, are also listed separately in order to present the names of the authors as well as the titles of their contributions, which are often referred to in other publications.

The Istituto Affari Internazionali is indebted to The Library of Congress, Washington, D.C.; to the Institute of International Law at the University of Kiel, and to the Library Research Service of The Encyclopaedia Britannica for their kind and valuable contributions to this bibliography.

Rome, June 1969

PART A.

DOCUMENTS AND OFFICIAL PUBLICATIONS

I. THE UNITED NATIONS

I. General Assembly, Official Records

(a) 21ST SESSION

Agenda item 94 - Development of National Resources

Plenary Documents

- A/6303 - Report of the Economic and Social Council 1 August 1965 to 5 August 1966, Chapter VII, Sept. 1966.
A/6460 - Note by the Secretary-General, 10 Oct. 1966, 5 p.
A/6525 - Statement of financial implications of the draft resolution recommended by the Second Committee; 16th report of the Advisory Committee on Administrative and Budgetary Questions to the General Assembly at its 21 session, 22 Nov 1966, 3 p.
A/6533 - Report of the Second Committee, 29 Nov 1966, 11 p.
A/6534 - Financial implications of draft resolution I recommended by the Second Committee (A/6533, para. 20); Report of the Fifth Committee, 29 Nov. 1966, 2 p.
A/RES/2172(XXI) - Resources of the Sea. Resolution adopted by the General Assembly, 6 Dec. 1966, 2 p.
Verbatim record of the meeting:
A/PV.1485 - 1485th meeting - 6 Dec 1966

SECOND COMMITTEE

Summary records of the meetings:

- A/C.2/SR. 1060 - 1060th meeting - 7 Nov 1966
- - - 1062 - 1062nd ,, - 8 Nov 1966
- - - 1063 - 1063rd ,, - 8 Nov 1966
- - - 1064 - 1064th ,, - 9 Nov 1966
- - - 1065 - 1065th ,, - 10 Nov 1966

(b) 22ND SESSION

Agenda item 92 - Examination of the question of the reservation exclusively for peaceful purposes of the sea-bed and the ocean floor, and the subsoil thereof, underlying the high seas beyond the limits of present national jurisdiction, and the use of their resources in the interest of mankind

Plenary documents

A/6695 - Request for the inclusion of a supplementary item of agenda of the Twenty-Second Session; Note verbale dated 17 August 1967 from the Permanent Mission of Malta to the United Nations to the Secretary-General, 18 Aug 1967, 2 p.

A/6964 - Report of the First Committee, 12 Dec 1967, 5 p.

A/6982 - Financial implications of the draft resolution contained in document A/6964; Report of the Fifth Committee, 13 Dec 1967
1 p.

A/RES/2340(XXII) - Resolution adopted by the General Assembly, 18 Dec 1967, 3 p.

Verbatim records of the meetings:

A/PV. 1582 - 1582nd meeting - 6 Oct 1967

--- 1583 - 1583rd " - 6 Oct 1967

--- 1639 - 1639th " - 18 Dec 1967

First Committee

A/C.1/952 - Note by the Secretary-General, 31 Oct. 1967, 4 p.

Verbatim records of the meetings:

A/C.1/PV. 1515 - 1515th meeting - 1 Nov 1967

--- 1516 - 1516th ,, - 1 Nov 1967

--- 1524 - 1524th ,, - 8 Nov 1967

--- 1525 - 1525th ,, - 8 Nov 1967

--- 1526 - 1526th ,, - 10 Nov 1967

--- 1527 - 1527th ,, - 13 Nov 1967

--- 1528 - 1528th ,, - 14 Nov 1967

--- 1529 - 1529th ,, - 15 Nov 1967

--- 1530 - 1530th ,, - 16 Nov 1967

--- 1542 - 1542nd ,, - 7 Dec 1967

--- 1543 - 1543rd ,, - 7 Dec 1967

--- 1544 - 1544th ,, - 8 Dec 1967

(c) 23RD SESSION

(i) *Agenda item 26 - Examination of the question of the reservation exclusively for peaceful purposes of the sea-bed and the ocean floor, and the*

subsoil thereof, underlying the high seas beyond the limits of present national jurisdiction, and the use of their resources in the interest of mankind: Report of the Ad Hoc Committee to Study the Peaceful Uses of the Sea-Bed and the Ocean Floor Beyond the Limits of National Jurisdiction

Plenary documents

- A/7134 - Letter dated 5 July 1968 from the Permanent Representative of the Union of Soviet Socialist Republics to the United Nations addressed to the Secretary-General; Memorandum of the Government of the Union of Soviet Socialist Republics concerning urgent measures to stop the arms-race and achieve disarmament, 8 Jul 1968, 7 p. (9. Peaceful uses of the sea-bed and ocean floor - paras. 22-23).
- A/7189 - Report of the Conference of the Eighteen-Nation Committee on Disarmament, 4 Sep 1968, 78 p. (paras. 17 and 29).
- A/7230 - Report of the Ad Hoc Committee to Study the Peaceful Uses of the Sea-bed and the Ocean Floor Beyond the Limits of National Jurisdiction, Sep. 1968, 69 p.
- A/7477 - Report of the First Committee, 20 Dec. 1968, 34 p.
- A/7478 - Administrative and financial implications of draft resolution A contained in the report of the First Committee (A/7477, para. 29); Report of the Fifth Committee, 20 Dec 1968, 2 p.
- A/RES/2467/A-D(XXIII) - Resolution adopted by the General Assembly, 21 Dec 1968, 10 p.

Verbatim records of the meetings:

A/PV. 1677	- 1677th meeting,	2 Oct 1968
---	1678 - 1678th	„ 2 Oct 1968
---	1679 - 1679th	„ 3 Oct 1968
---	1680 - 1680th	„ 3 Oct 1968
---	1682 - 1682nd	„ 4 Oct 1968
---	1683 - 1683rd	„ 7 Oct 1968
---	1686 - 1686th	„ 8 Oct 1968
---	1687 - 1687th	„ 9 Oct 1968
---	1688 - 1688th	„ 9 Oct 1968
---	1692 - 1692nd	„ 11 Oct 1968
---	1693 - 1693rd	„ 14 Oct 1968
---	1697 - 1697th	„ 16 Oct 1968
---	1698 - 1698th	„ 16 Oct 1968
---	1701 - 1701st	„ 21 Oct 1968
---	1705 - 1705th	„ 23 Oct 1968
---	1707 - 1707th	„ 25 Oct 1968
---	1752 - 1752nd	„ 21 Dec 1968

First Committee

- A/C.1/973 - Note by the Secretary-General, 25 Oct. 1968, 4 p.
- A/C.1/L.425 and Add. 1-7 - Argentina, Australia, Austria, Belgium, Brazil, Canada, Ceylon, Chile, Ecuador, El Salvador, France, Iceland, India, Italy, Japan, Kenya, Liberia, Libya, Malta, Norway, Pakistan, Perù, Senegal, Somalia, Thailand, UAR, United Kingdom, Tanzania, Yugoslavia, Mexico, Rwanda, Sudan, Zambia, Ghana, Indonesia, Ivory Coast, Bolivia, Madagascar, Maldive Is., Philippines, Trinidad and Tobago, Turkey, Barbados, Dahomey, Jamaica, Mauritius, Southern Yemen, Togo, Columbia, New Zealand, Spain, Costa Rica, Netherlands: draft resolution, 23 Oct 5 Nov 1968, 3 p.
- A/C.1/L. 426 and Add. 1 - Kuwait, Venezuela, Saudi Arabia; amendments to draft resolution A/C.1/L.425, 30/31 Oct 1968, 1 p.
- A/C.1/L.449 - Australia, Austria, Canada, France, Iceland, Italy, Netherlands Norway, United Kingdom, United States: draft resolution, 1 Nov 1968, 2 p.
- A/C.1/L.429/Rev.1 - Australia, Austria, Canada, Ceylon, France, Iceland, India, Italy, Libya, Netherlands, Norway, United Kingdom, United States: revised draft resolution, 4 Nov 1968, 2 p.
- A/C.1/L.431 and Add. 1-3 - Argentina, Australia, Austria, Bulgaria, Canada, Ceylon, Chile, Czechoslovakia, Denmark, El Salvador, Finland, France, Iceland, India, Ireland, Italy, Japan, Libya, Norway, Pakistan, Perù, Poland, Romania, Senegal, Sudan, Sweden, Soviet Union, UAR, United Kingdom, United States, Trinidad and Tobago, Turkey, Belgium, Brazil, Ivory Coast, Mexico: draft resolution, 4/7 Nov 1968, 2 p.
- A/C.1/431/Rev.1 - Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Ceylon, Chile, Czechoslovakia, Denmark, Ecuador, El Salvador, Finland, France, Iceland, India, Ireland, Italy, Ivory Coast, Japan, Lebanon, Lesotho, Libya, Madagascar, Mauritius, Mexico, Norway, Pakistan, Peru, Poland, Romania, Senegal, Sudan, Sweden, Trinidad and Tobago, Turkey, Soviet Union, UAR, United Kingdom, United States; revised draft resolution, 8 Nov 1968, 3 p.
- A/C.1/L.432 - Cyprus: draft resolution, 5 Nov 1968, 2 p.
- A/C.1/L.434 - Liberia: draft resolution, 6 Nov 1968, 1 p.
- A/C.1/L.436 - Administrative and financial implications of the revised draft resolution contained in document A/C.1/L.425/Rev. 1; Statement by the Secretary-General, 6 Nov 1968, 3 p.
- A/C.1/L.440 and Rev. 1 - Tanzania: amendments to revised draft resolution A/C.1/L.429/Rev./2/Add. 1-4, 8 Nov/2 Dec 1968, 2 p.

A/C.1/L.465 and Rev. 1 - Trinidad and Tobago, Tanzania: amendments to revised draft resolution A/C.1/L.429/Rev.2/Add. 1-4, 17-18 Dec 1968, 2 p.

A/C.1/L.465/Rev. 2 - Guyana, Trinidad and Tobago, Tanzania, Yugoslavia: revised amendments to revised draft resolution A/C.1/L.429/Rev.2/Add.1-4, 19 Dec. 1968, 3 p.

Verbatim records of the meetings:

A/C.1/PV. 1588	- 1588th meeting	- 28 Oct 1968
- - - 1589	- 1589th	„ - 29 Oct 1968
- - - 1590	- 1590th	„ - 29 Oct 1968
- - - 1591	- 1591st	„ - 30 Oct 1968
- - - 1592	- 1592nd	„ - 31 Oct 1968
- - - 1593	- 1593rd	„ - 31 Oct 1968
- - - 1594	- 1594th	„ - 1 Nov 1968
- - - 1595	- 1595th	„ - 1 Nov 1968
- - - 1596	- 1596th	„ - 4 Nov 1968
- - - 1597	- 1597th	„ - 4 Nov 1968
- - - 1598	- 1598th	„ - 5 Nov 1968
- - - 1599	- 1599th	„ - 5 Nov 1968
- - - 1600	- 1600th	„ - 6 Nov 1968
- - - 1601	- 1601st	„ - 6 Nov 1968
- - - 1602	- 1602nd	„ - 7 Nov 1968
- - - 1603	- 1603rd	„ - 8 Nov 1968
- - - 1604	- 1604th	„ - 8 Nov 1968
- - - 1605	- 1605th	„ - 11 Nov 1968
- - - 1606	- 1606th	„ - 12 Nov 1968 (*)
- - - 1609	- 1609th	„ - 18 Nov 1968 (*)
- - - 1612	- 1612th	„ - 19 Nov 1968 (*)
- - - 1646	- 1646th	„ - 18 Dec 1968
- - - 1647	- 1647th	„ - 19 Dec 1968
- - - 1648	- 1648th	„ - 19 Dec 1968
- - - 1649	- 1649th	„ - 20 Dec 1968

(ii) *Agenda item 41 - Resources of the Sea*

Plenary documents

A/7203 - Report of the Economic and Social Council, 5 August 1967 - 2 August 1968 (Ch. VI, Sec. B), September 1968, xvii, 140 p.

A/7245 - Note by the Secretary-General, 27 Sep. 1968, 2 p.

(*) Meetings devoted to the consideration of the items of the agenda dealing with disarmament problems.

- A/7394 - Report of the Second Committee, 16 Dec 1968, 13 p.
 A/7417 - Administrative and financial implications of the draft resolution submitted by the Second Committee in document A/7394; Report of the Fifth Committee.
 A/RES/2413(XXIII) - Exploitation and Conservation of Living Marine Resources. Resolution adopted by the General Assembly, 17 Dec 1968, 2 p.
 A/RES/2414(XXIII) - International Co-operation in Problems Related to the Oceans. Resolution adopted by the General Assembly, 17 Dec 1968, 3 p.
 Verbatim record of the meeting:
 A/PV.1745 - 1745th meeting, 17 Dec 1968

SECOND COMMITTEE

- A/C.2/244 - Note by the Secretary-General, 29 Oct 1968, 4 p.
 Summary records of the meeting:

- A/C.2/SR. 1192 - 1192nd meeting - 15 Oct 1968
 - - - 1193 - 1193rd " - 16 Oct 1968
 - - - 1224 - 1224th " - 15 Nov 1968
 - - - 1226 - 1226th " - 21 Nov 1968
 - - - 1227 - 1227th " - 22 Nov 1968
 - - - 1228 - 1228th " - 22 Nov 1968
 - - - 1229 - 1229th " - 25 Nov 1968
 - - - 1231 - 1231st " - 26 Nov 1968
 - - - 1244 - 1244th " - 11 Dec 1968
 - - - 1245 - 1245th " - 11 Dec 1968
 - - - 1246 - 1246th " - 12 Dec 1968

(d) *Ad Hoc Committee to Study the Peaceful Uses of the Sea-Bed and the Ocean Floor Beyond the Limits of National Jurisdiction* (1968)

- A/AC.135/1 and Corr. 1 - Note by the Secretary-General (transmitting replies by Member Governments in accordance with para. 3 (a) of the Resolution 2340 (XXII), 11 Mar./3 Apr. 1968, 48 p.

- Add. 1, 12 Mar 1968, 39 p.
 — Add. 2, 14 Mar 1968, 9 p.
 — Add. 3, 25 Mar 1968, 2 p.
 — Add. 4, 2 Apr 1968, 4 p.
 — Add. 5, 24 Apr 1968, 2 p.
 — Add. 6, 16 May 1968, 5 p.
 — Add. 7, 23 May 1968, 2 p.
 — Add. 8, 5 Jun 1968, 4 p.
 — Add. 9, 25 Jul 1968, 6 p.
 — Add. 10, 20 Aug 1968, 5 p.

- A/AC.135/2 - Letter dated 7 February 1968 from the Director-General of UNESCO addressed to the Secretary-General, 19 Mar 1968, 7 p.
- A/AC.135/3 - Letter dated 20 March 1968 addressed to the Chairman of the Ad Hoc Committee ... by the Permanent Representative of Belgium; Work Program of the Ad Hoc Committee on the Sea-Bed, 20 Mar 1968, 7 p.
- A/AC.135/4 - Scientific Aspects Relevant to the Study of the Peaceful Uses of the Sea-Bed and Ocean Floor Beyond the Limits of National Jurisdiction; An Outline prepared by the Inter-governmental Oceanographic Commission (IOC) Secretariat, 26 Mar 1968, 4 p.
- A/AC.135/5 - Statement by the Chairman of the Ad Hoc Committee at its 9th meeting on 27 March 1968, 27 Mar 1968, 5 p.
- A/AC.135/6 - Statement by the Chairman of the Ad Hoc Committee at its 4th meeting on 21 March 1968, 28 Mar 1968, 3 p.
- A/AC.135/8 and Corr. 1 - Letter dated 13 May 1968 from the Secretary-General of the World Meteorological Organization addressed to the Secretary-General; Meteorological Activities in Support of Peaceful Use of the Resources of the Sea-Bed and Ocean Floor Beyond the Limits of National Jurisdiction.
- A/AC.135/10 and Rev. 1 - Survey of Existing International Agreements Concerning the Sea-Bed and the Ocean Floor, and the Subsoil Thereof, Underlying the High Seas Beyond the Limits of Present National Jurisdiction; Document prepared by the Secretariat, 4 Jun/12 Aug 1968, 45 p., Annex
- A/AC.135/11 and Corr. 1 - Survey of National Legislation Concerning the Sea-Bed and the Ocean Floor, and the Subsoil Thereof, Underlying the High Seas Beyond the Limits of Present National Jurisdiction, 4 Jun/22 Aug 1968, 114 p. - Add. 1, 13 Aug 1968, 29 p.
- A/AC.135/12 - Summary of Views of Member States; Working Paper prepared by the Secretariat, 7 Jun 1968, 54 p., Appendix
- A/AC.135/13 - Note by the Secretariat, 11 Jun 1968, 2 p.
- A/AC.135/14 - Economic Implication of the Exploitation of Mineral Resource On and Underlying the Sea-Bed and Ocean Floor with Particular Reference to World Trade and Prices; Note by the Secretariat, 11 Jun 1968, 3 p., Annexes
- A/AC.135/15 - Effects of the Exploitation of Mineral Resources on the Superjacent Waters and on Other Uses of the Marine Environment; Note by the Secretariat, 11 Jun 1968, 3 p.
- A/AC.135/17 - Scientific Aspects of the Peaceful Uses of the Ocean Floor; Prepared by the IOC Secretariat for the United Nations General Assembly Ad Hoc Committee to Study the Peaceful Uses of the Sea-Bed ..., 18 June 1968, 57 p., Annexes.

- A/AC.135-18 - Programme of Work; Statement by the Chairman of the Ad Hoc Committee at its 10th meeting on 17 June 1968, 17 Jun 1968, 4 p.
- A/AC. 135/19 - Legal Aspects of the Question of the Reservation Exclusively for Peaceful Purposes of the Sea-Bed and the Ocean Floor, and the Subsoil Thereof, Underlying the High Seas Beyond the Limits of Present National Jurisdiction, and the Use of Their Resources in the Interest of Mankind; Study prepared by the Secretariat, 21 Jun 1968, 30 p.
 — Add. 1, 18 Jun 1968, 33 p.
 — Add. 2, 25 Jun 1968, 29 p.
- A/AC.135/22 - Letter dated 30 May 1968 from the Director-General of the United Nations Educational, Scientific and Cultural Organization to the Secretary-General, 24 Jun 1968, 2 p.
- A/AC.135/23 - Regulatory Aspects of Exploration and Exploitation Including Rules Respecting Ocean Data Stations, Drilling Rigs, Production Platforms and Other Devices; Note by the Inter-Governmental Maritime Consultative Organization, 25 Jun 1968, 4 p.
- A/AC.135/28, The Military Uses of the Sea-Bed and the Ocean Floor Beyond the Limits of Present National Jurisdiction; Working Paper prepared by the Secretariat, 10 Jul 1968, 6 p.
- A/AC.135/30, Statement by the Chairman of the Ad Hoc Committee at its 13th meeting on 19 August 1968, 19 Aug 1968, 9 p.
- A/AC.135/32 and Corr. 1 - Statement by the Chairman of the Ad Hoc Committee at its 17th meeting on 23 August 1968, 23/27 Aug 1968, 11 p.
- A/AC.135/34 and Corr. 1 - Statement by the Chairman of the Ad Hoc Committee at its 19th meeting on 26 August 1968 summarizing the discussion on the scientific aspects of the item, 26/27 Aug 1968, 11 p.
- A/AC.135/36 - Statement by the Chairman of the Ad Hoc Committee at its 21st meeting on 27 August 1968, 27 Aug 1968, 5 p.

Summary records of the meetings:

- A/AC.135/SR. 1 - 1st meeting, 18 Mar 1968
 — — — SR. 2 - 2nd „ 19 Mar 1968
 — — — SR. 3 - 3rd „ 20 Mar 1968
 — — — SR. 4 - 4th „ 21 Mar 1968
 — — — SR. 5 - 5th „ 22 Mar 1968
 — — — SR. 6 - 6th „ 25 Mar 1968
 — — — SR. 7 - 7th „ 26 Mar 1968
 — — — SR. 8 - 8th „ 27 Mar 1968
 — — — SR. 9 - 9th „ 27 Mar 1978

and Rev. 1

- - -	SR. 10 - 10th meeting,	17 Jun 1968
- - -	SR. 11 - 11th	„ 20 Jun 1968
- - -	SR. 12 - 12th	„ 9 Jul 1968
- - -	SR. 13 - 13th	„ 19 Aug 1968
- - -	SR. 14 - 14th	„ 20 Aug 1968
- - -	SR. 15 - 15th	„ 21 Aug 1968
- - -	SR. 16 - 16th	„ 22 Aug 1968
- - -	SR. 17 - 17th	„ 23 Aug 1968
- - -	SR. 18 - 18th	„ 26 Aug 1968
- - -	SR. 19 - 19th	„ 26 Aug 1968
- - -	SR. 20 - 20th	„ 27 Aug 1968
- - -	SR. 21 - 21st	„ 27 Aug 1968
- - -	SR. 22 - 22nd	„ 28 Aug 1968
- - -	SR. 23 - 23rd	„ 29 Aug 1968
- - -	SR. 24 - 24th	„ 29 Aug 1968
- - -	SR. 25 - 25th	„ 30 Aug 1968
- - -	SR. 26 - 26th	„ 30 Aug 1968

Legal Working Group

Summary records of the meetings:

A/AC.135/WG.I/SR.	1 - 1st meeting,	18 Jun 1968
- - -	SR. 2 - 2nd	„ 20 Jun 1968
- - -	SR. 3 - 3rd	„ 21 Jun 1968

(4th and 5th meetings - closed; records not issued)

- - -	SR. 6 - 6th	„ 26 Jun 1968
- - -	SR. 7 - 7th	„ 27 Jun 1968
- - -	SR. 8 - 8th	„ 29 Jun 1968
- - -	SR. 9 - 9th	„ 1 Jul 1968
- - -	SR. 10 - 10th	„ 2 Jul 1968
- - -	SR. 11 - 11th	„ 5 Jul 1968
- - -	SR. 12 - 12th	„ 5 Jul 1968
- - -	SR. 13 - 13th	„ 8 Jul 1968
- - -	SR. 14 - 14th	„ 8 Jul 1968

Economic and Technical Working Group

Summary records of the meeting:

A/AC.135/WG.II/SR.	1 - 1st meeting,	18 Jun 1968
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(2nd to 6th meetings closed - records not issued)

- - -	SR. 7 - 7th meeting,	27 Jun 1968
- - -	SR. 8 - 8th	„ 28 Jun 1968
- - -	SR. 9 - 9th	„ 1 Jul 1968
- - -	SR. 10 - 10th	„ 2 Jul 1968
- - -	SR. 11 - 11th	„ 3 Jul 1968
- - -	SR. 12 - 12th	„ 19 Aug 1968
- - -	SR. 13 - 13th	„ 20 Aug 1968
- - -	SR. 14 - 14th	„ 22 Aug 1968
- - -	SR. 15 - 15th	„ 23 Aug 1968

(e) *Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor Beyond the Limits of National Jurisdiction* (1969) *

Plenary documents

- A/AC.138/1 - Letter dated 4 February 1969 from the Permanent Representative of Belgium addressed to the Secretary-General. Suggestions concerning the Organization of the Work of the Committee ... 5 Feb 1969, 6 p.
- A/AC.138/2 - Draft Programme of Work of the Committee ... Submitted by Argentina, Brazil, Chile, El Salvador, Mexico, Peru and Trinidad and Tobago, 5 Feb 1969, 2 p.
- A/AC/138/3 - Draft Programme of Work of the Committee ... Submitted by Bulgaria, Czechoslovakia, Poland, Romania, USSR, 6 Feb 1969, 2 p.
- A/AC.138/4 - Outline of Programme of Work of the Committee Submitted by the United States of America, 5 Feb 1969, 2 p.
- A/AC.138/5 - Programme of Work for 1969 of the Committee ... Submitted by India, Kenya, Kuwait, Liberia, Libya, Madagascar, Malaysia, Sierra Leone, Sudan, Thailand, United Arab Republic and Yugoslavia, 7 Feb 1969, 2 p.
- A/AC.138/6 - Economic considerations conducive to promoting the development of the resources of the Sea-Bed and ocean floor beyond the limits of national jurisdiction in the interest of mankind. Preliminary note by the Secretariat, 4 Mar 1969, 6 p.
- A/AC.138/7 - Proposals and views relating to the adoption of principles. Working paper prepared by the Secretariat, 6 Mar. 1969, 37 p., Annex.
- Corr. 1, 11 Mar 1969, 1 p.
- Corr. 2, 14 Mar 1969, 1 p.

(*) Further documents of the Committee were not yet available at the moment of the preparation of the present bibliography.

— Corr. 3, 31 Mar 1969, 1 p.

— Corr. 4, 28 Apr 1969, 1 p.

A/AC.138/8 - Organization of Work. Proposals by the Chairman presented in accordance with agreement reached at the meeting of the Committee held on 7 February 1969, 6 Mar 1969, 4 p.

A/AC.138/9 - Supplement to the Survey of national legislation concerning the sea-bed and the ocean floor, and the subsoil thereof, underlying the high seas beyond the limits of present national jurisdiction (A/AC.135/11, A/AC.135/11/Corr. 1, A/AC.135/11/Add.1) Document prepared by the Secretariat, 11 Mar 1969, 7 p.

A/AC.138/10 - Letter dated 27 February 1969 from the Chairman of the IOC addressed to the Secretary General, 17 Mar 1969, 4 p.

A/AC.138/11 - Malta: draft resolution, 18 Mar 1969, 2 p.

Summary records of the meetings:

A/AC.138/SR. 1	- 1st meeting,	6 Feb 1969
- - - SR. 2	- 2nd „	6 Feb 1969
- - - SR. 2	- 3rd „	7 Feb 1969
- - - SR. 4	- 4th „	10 Mar 1969
- - - SR. 5	- 5th „	28 Mar 1969
- - - SR. 6	- 6th „	28 Mar 1969

Legal Sub-Committee

A/AC.138/SC.1/1 - Programme of Work. Note by the Chairman, 10 Mar 1969, 5 p.

A/AC.138/SC.1/3 - Programme of Work adopted by the Sub-Committee at its 3rd meeting on 14 March 1969, 14 Mar 1969, 1 p.

Summary records of the meetings:

A/AC.138/SC.1/SR. 1	- 1st meeting,	12 Mar 1969
- - - - - SR. 2	- 2nd „	13 Mar 1969
- - - - - SR. 3	- 3rd „	14 Mar 1969
- - - - - SR. 4	- 4th „	17 Mar 1969
- - - - - SR. 5	- 5th „	18 Mar 1969
- - - - - SR. 6	- 6th „	19 Mar 1969
- - - - - SR. 7	- 7th „	20 Mar 1969
- - - - - SR. 8	- 8th „	21 Mar 1969
- - - - - SR. 9	- 9th „	24 Mar 1969
- - - - - SR. 10	- 10th „	25 Mar 1969
- - - - - SR. 11	- 11th „	26 Mar 1969

Economic and Technical Sub-Committee

A/AC.138/SC.2/2 - Programme of Work. Note by the Chairman, 10 Mar 1969, 2 p.

A/AC.138/SC.2/3 - Statement by the Chairman at the First Meeting of the Economic and Technical Sub-Committee on 11 March 1969, 12 Mar 1969, 6 p.

A/AC.138/SC.2/5 - Programme of Work. Note by the Chairman, 20 Mar 1969, 1 p.

A/AC.138/SC.2/6 - Interim Report of the Economic and Technical Sub-Committee, 1 Apr 1969, 29 p.

Summary records of the meetings:

A/AC.138/SC.2/SR.	1 - 1st meeting,	11 Mar 1969
-- -- -- -- SR.	2 - 2nd	„ 12 Mar 1969
-- -- -- -- SR.	3 - 3rd	„ 13 Mar 1969
-- -- -- -- SR.	4 - 4th	„ 14 Mar 1969
-- -- -- -- SR.	5 - 5th	„ 17 Mar 1969
-- -- -- -- SR.	6 - 6th	„ 18 Mar 1969
-- -- -- -- SR.	7 - 7th	„ 19 Mar 1969
-- -- -- -- SR.	8 - 8th	„ 20 Mar 1969
-- -- -- -- SR.	9 - 9th	„ 21 Mar 1969
-- -- -- -- SR.	10 - 10th	„ 24 Mar 1969
-- -- -- -- SR.	11 - 11th	„ 25 Mar 1969
-- -- -- -- SR.	12 - 12th	„ 26 Mar 1969
-- -- -- -- SR.	13 - 13th	„ 27 Mar 1969

2. Economic and social council, official records

(a) 40TH SESSION

Agenda item 7 - Development of National Resources; ... (b) Non agricultural resources ...

Plenary documents

E/4164 - Report of the Economic Committee, 4 Mar 1966, 8 p.
— Corr. 1, 7 Mar. 1966, 1 p.

E/4164/Add.1 - Statement of financial implications by the Secretary-General relating to the draft resolution in document E/AC.6/L.330, 4 Mar 1966, 3 p.

E/L.1107 - Statement by Mr. Philippe de Seynes, Under Secretary for Economic and Social Affairs, at the 1408th plenary meeting on 28 February 1966, 28 Feb 1966, 7 p.

E/RES/1112(XL) - Resolution adopted by the Economic and Social Council, 7 Mar 1966, 2 p.

Summary records of the meetings:

- E/SR. 1408 - 1408th meeting, 28 Feb 1966
- - 1409 - 1409th ,, 28 Feb 1966
- - 1417 - 1417th ,, 7 Mar 1966

Economic Committee

E/AC.6/L.330 - Ecuador, Pakistan, United States: draft resolution, 2 Mar 1966, 2 p.

Summary records of the meetings:

- E/AC.6/SR. 377 - 377th meeting, 3 Mar 1966
- - - - 378 - 378th ,, 4 Mar 1966

(b) 44TH SESSION

*Agenda item 3 - The Development of Non-Agricultural Resources:
(c) Resources of the Sea ...*

E/4449 - Resources of the sea (beyond the continental shelf) Report of the Secretary-General. Introduction and summary, 21 Feb 1968, 20 p.

— Add. 1 —. Part One: Mineral resources of the sea beyond the continental shelf, 19 Feb 1968, 94 p.

— Add. 2 —. Part Two: Food resources of the sea beyond the continental shelf, 7 Feb. 1968, 145 p.

E/4486 - Development and co-ordination of the activities of the organizations within the United Nations System. 34th report of Administrative Committee on Co-ordination (Ch. II, para. 6), 19 Apr. 1968, 49 p.

— Add. 1 —. Annexes (Annex V. Marine science and its applications, 20 p.), 19 Apr 1968.

E/4487 - Marine science and technology. Report of the Secretary-General, 24 Apr 1968, 221 p.

— Corr. 1, 21 Jun 1968, 26 p. (replaces part B of Annex XI)

— Corr. 2, 8 Aug 1968, 1 p.

— Corr. 3, 26 Aug 1968, 1 p.

— Corr. 4, 6 Sep 1968, 1 p.

— Corr. 5, 6 Sep 1968, 1 p.

— Corr. 6, 26 Nov 1968, 1 p.

— Add. 1, 12 Sep 1968, 8 p.

E/4492 - Resources of the sea (beyond the continental shelf). Observations made by the Advisory Committee on the Applications of Science and Technology at its 9th session on the report of the Secretary-General (E/4449 and Add. 1-2), 18 Apr 1968, 2 p.

— Add. 1 —. Financial implications of issuing "Resources of the Sea" (E/4449 and Add. 1-2) as a United Nations publication. Note by the Secretary-General, 9 May 1968, 2 p.

Summary record of the meeting
E/SR. 1516 - 1516th meeting, 6 May 1968

(c) 45TH SESSION

Agenda item 13 - The Sea: (a) Resources of the sea, (b) Marine science and technology

Plenary documents

E/4584 - Report of the Co-ordination Committee, 2 Aug 1968, 7 p.
E/RES/1380(XLV) - Resources of the Sea. Resolution adopted by the Economic and Social Council, 2 Aug 1968, 2 p.

E/RES/1381(XLV) - Long-Range Programme for the Exploitation of the Sea. Resolution adopted by the Economic and Social Council, 2 Aug 1968, 3 p.

E/RES/1382(XLV) - Marine Science and Technology. Resolution adopted by the Economic and Social Council, 2 Aug 1968, 1 p.

Summary records of the meetings:

E/SR. 1531 - 1531st meeting, 8 Jul 1968

- - 1561 - 1561st " 2 Aug 1968

(d) 46TH SESSION

E/4611 - Advisory Committee on the Application of Science and Technology to Development: 6th Report, March 1969, iv, 45 p.

— Add. 1, Future Arrangements for the Advisory Committee, 16 Apr 1969, 4 p.

— Add. 2, Note by the Secretary-General, 15 Apr 1969, 9 p.

(e) *Co-ordination Committee*

E/AC.24/L.336 - Soviet Union and United Kingdom: draft resolution, 23 Jul 1968, 1 p.

E/AC.24/L.338 - Upper Volta: draft resolution, 24 Jul 1968, 2 p.

E/AC.24/L.339 - Soviet Union, United Kingdom, United States: draft resolution, 25 Jul 1968, 2 p.

— Rev. 1, 29 Jul 1968, 2 p.

E/AC.24/L.247 - Venezuela: amendments to the draft resolution
E/AC.24/L.339

Summary records of the meetings:

E/AC.24/SR. 346 - 346th meeting, 22 Jul 1968

- - - 347 - 247th ,, 22 Jul 1968

- - - 348 - 348th ,, 23 Jul 1968

- - - 351 - 351st ,, 24 Jul 1968

- - - 352 - 352nd ,, 25 Jul 1968

- - - 353

	and Corr. 1 - 353rd meeting,	26 Jul 1968
- - -	354 - 354th "	29 Jul 1968
- - -	357 - 357th "	31 Jul 1968
- - -	362 - 362nd "	2 Aug 1968

(f) *Advisory Committee on the Application of Science and Technology to Development.*

E/AC.52/L.33 - Record of the 9th Session, 1-11 April 1968, 29 Apr 1968, 49 p.

E/AC.52/L.54 - Record of the 10th Session, 25 November - 9 December 1968, 5 Feb 1969, 58 p.

Summary records of the meetings:

E/AC.52/SR. 103 - 103rd meeting, 2 Apr 1968

- - - 124 - 124th " 4 Dec 1968

(g) *Economic Commission for Asia and the Far East*

E/CN.II/L.162 - Report of the 1st Session of the Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas, held at Quezon City, Philippines, 26 May - 2 June 1966, 15 Jul 1966, 107 p.

E/CN.II/L.186 - Report of the 3rd session of the Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas, held at Seoul, Republic of Korea, 24 June - 4 July 1967, 31 Aug 1967, 157 p.

E/CN/II/L.190 - Report of the 4th Session of the Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas, held at Taipei, China, 6-16 November 1967, 31 Jan 1968, 158 p.

3. International court of justice

Reports of Judgements, Advisory Opinions and Orders, 1969. North Sea Continental Shelf Cases (Federal Republic of Germany/Denmark; Federal Republic of Germany/Netherlands). Judgement of 20 February 1969, p. 3-258.

FEDOROV, K.N., International Oceanography - The Way Scientific Cooperation Develops, "U.N. Monthly Chronicle", vol. III, No. 3, p. 9-37.

II. CONFERENCE OF THE EIGHTEEN-NATION COMMITTEE ON DISARMAMENT (*)

ENDC/240 - Union of Soviet Socialist Republics: Draft Treaty on Prohibition of the Use for Military Purposes of the Sea-Bed and the Ocean Floor and the Subsoil Thereof, 18 Mar 1969, 2 p.

ENDC/247 - Nigeria: Working Paper on proposed amendment to Article I of the USSR draft Treaty on Prohibition of the Use for Military Purposes of the Sea-Bed and the Ocean Floor and the Subsoil Thereof, 15 May 1969, 1 p.

ENDC/249 - United States of America: Draft Treaty Prohibiting the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-Bed and Ocean Floor, 22 May 1969, 2 p.

Verbatim records of the meetings:

ENDC/PV. 381	- 381st meeting,	16 Jul 1968
- - - 383	- 383rd "	23 Jul 1968
- - - 385	- 385th "	30 Jul 1968
- - - 386	- 386th "	1 Aug 1968
- - - 389	- 389th "	13 Aug 1968
- - - 390	- 390th "	15 Aug 1968
- - - 392	- 392nd "	22 Aug 1968
- - - 394	- 394th "	28 Aug 1968
- - - 395	- 395th "	18 Mar 1969
- - - 396	- 396th "	20 Mar 1969
- - - 397	- 397th "	25 Mar 1969
- - - 398	- 398th "	27 Mar 1968
- - - 399	- 399th "	1 Apr 1969
- - - 400	- 400th "	8 Apr 1969
- - - 402	- 402nd "	10 Apr 1969
- - - 403	- 403rd "	15 Apr 1969
- - - 404	- 404th "	17 Apr 1969
- - - 405	- 405th "	22 Apr 1969
- - - 406	- 406th "	24 Apr 1969
- - - 408	- 408th "	6 May 1969

III. U.N.E.S.C.O. - INTERNATIONAL OCEANOGRAPHIC COMMISSION

IOC/B-37 - Recommendations of the 1st meeting of the IOC Working Committee for an Integrated Global Ocean Station System (IGOSS)

(*) Further documents of the Committee were not yet available at the moment of the preparation of the present bibliography.

IOC/INF.108 - Information Paper on the Legal Problems Associated with Manned and Unmanned Ocean Data Stations, March 1967.
SC/CS/150 - Summary Report of the Fifth Session - UNESCO Paris, 19-27 October 1967 (Item 6 - Legal Aspects of Scientific Research and Its Application on the High Seas), March 1968.
Five Years of Work, IOC Technical Series, UNESCO, Paris, 1966.
Project for a Centre for the Scientific Application of Long-Period Undersea Living. Technical Note prepared for the 4th Session of the IOC by J. Alinat (Oceanographic Museum of Monaco).

IV. F.A.O.

CECAF: 1/69/Inf. 3 - FAO Fishery Committee for the Eastern Central Atlantic (CECAF). First Session, Accra, Ghana, 24-28 March 1969. General Conclusions of the Symposium on the Living Resources of the African Atlantic Continental Shelf between the Straits of Gibraltar and Cape Verde, 6 p.

International Council for the Exploration of the Sea. Symposium on the Living Resources of the African Atlantic Continental Shelf between the Straits of Gibraltar and Cape Verde (March 1968, Santa Cruz, Teneriffa). Section Chairman's Reports, 26 p.

V. I.A.E.A.

Proceedings of the Symposium on the Disposal of Radioactive Wastes into Seas, Oceans, and Surface Waters, held by the I.A.E.A. at Vienna, 16-20 May 1956, Vienna, I.A.E.A., 1966, 898 p.

VI. VARIOUS INTERNATIONAL AGREEMENTS (*)

Convention for the International Council for the Exploration of the Sea, Copenhagen, September 12 - December 31, 1964 (entered into force on July 22, 1968), *H.M.S.O., Treaty Series No. 67* (1968) Cmnd. 3722, 16 p.

Declaration of the German Democratic Republic, Poland, and Union of Soviet Socialist Republics on the Continental Shelf of the Baltic Sea, October 23, 1968, "*International Legal Materials*", vol. VII, No 6, November 1968, p. 1393-1394.

Final Act of the Fisheries Policing Conference, London, March 31, 1966 to March 17, 1967, and Convention on Conduct of Fishing Operations in the North Atlantic, London June 11 to November 30, 1967, *H.M.S.O., Miscellaneous No. 11* (1968), Cmnd. 3645, 42 p.

(*) Other than those surveyed in U.N. Doc. A/AC.135/10/Rev.1.

VII. OFFICIAL GOVERNMENT PUBLICATIONS

I. UNITED KINGDOM

- Cmnd. 3992, Report on Marine Science and Technology, April 1969, 60 p.
- 3996, The Exploration of North Sea Gas. Observations of the Minister of Power, April 1969, 8 p.
- Ministry of Power, Continental Shelf Act 1964, Report for Year 1964 - 1965 (H.C. 24).
- , Report for Year 1965-1966 (H.C. 286), January 1967, 20 p.
- , Report for Year 1966-1967 (H.C. 4), December 1967, 12 p.
- , Report for Year 1967-1968 (H.C. 46), December 1968, 12 p.
- Proceedings of the Conference on the Technology of the Sea and the Sea-Bed held at the Atomic Energy Research Establishment, Harwell April 5-7 1967; sponsored by the Ministry of Technology, London H.M.S.O., 1967, 3 vols.

2. UNITED STATES

- ATOMIC ENERGY COMMISSION, *The Atom and the Ocean*, Washington, D.C., G.P.O., January 1968.
- Commission on Marine Science, Engineering and Resources, Executive Office of the President, *Panel Reports*, Washington, D.C., G.P.O., various pagings:
- vol. I - Science and Environment
 - vol. II - Industry and Technology: Keys to Oceanic Development
 - vol. III - Marine Resources and Legal-Political Arrangements for Their Developments
- , *Our Nation and the Sea: A Plan for National Action*. The Report of ..., Washington, D.C., G.P.O., January 1969.
- Congress 89th, 1st Session, House, Committee on Merchant Marine and Fisheries, Marine Resources and Engineering *Development Act of 1965*, Report to Accompany S. 944, Washington, G.P.O., 1965, 23 p.
- , 2nd session, House, Committee on Merchant Marine and Fisheries, *Abridged Chronology of Events Related to Federal Legislation on Oceanography 1965-1966*, Washington, G.P.O., 1967, v, 39 p.
- Congress 90th, House, Committee on Merchant Marine and Fisheries, *Oceanography Legislation*, Hearings before the Subcommittee on Oceanography, October 11, 1967- July 29, 1968, Washington, G.P.O., 1968, vi, 229 p.

- , 1st session, House, Committee on Foreign Affairs, *Interim Report on the United Nations and the Issue of Deep Ocean Resources*, together with hearings by the Sub-committee on International Organizations and Movements, H. Rept. 999, Washington, G.P.O. 1967, 311 p.
 - , Committee on Merchant Marine and Fisheries, *Marine Resources and Engineering Development Act of 1966*, Report to accompany H.R. 13273. S. Rept. 939, Washington, G.P.O., December 1967, 16 p.
 - , *National Marine Science Program*, Hearings before the Sub-committee on Oceanography on Implementation of National Marine Science Program, August 17-December 12, 1967, Washington, G.P.O., 1968, vii, 509 p.
 - , Senate, Committee on Foreign Relations, *Governing Use of Ocean Space*, Hearing on S.J.Res.111, S.Res.172 and S.Res.186 November 29, 1967, Washington, G.P.O., 1967, iii, 71 p. (for statement of J.J. Sisco, Recent International Developments Concerning the Ocean and the Ocean Floor see also: "*The Department of State Bulletin*", vol. LVIII, No. 1488, Jan 1, 1968, p. 17-19).
 - , 2nd session, *Ocean Exploration*, Report to accompany S.Con. Res. 72, S.Rept.1476, July 26, 1968, Washington, G.P.O., 1968, 5 p.
 - , *The Oceans; A Challenging New Frontier*, H.Rept. 1957, October 9, 1968, Washington, G.P.O., 1968, 128 p.
- DEPARTMENT OF COMMERCE, *Development Potential of U.S. Continental Shelves*, A Report by the Battelle Memorial Institute, Washington G.P.O., 1966, 1 vol. (various pagings).
- DEPARTMENT OF DEFENCE, Naval Oceanographic Office, *Oceanography 1966*, Annual Report of ..., Washington, G.P.O., 1967, iv, 62 p.
- , *Oceanography 1967*, Annual Report of ..., Washington, G.P.O., 1968, vi, 75 p.
 - , *Science and the Sea*, Washington, G.P.O., 1967, iii, 80 p.
 - , Office of the Oceanographer of Navy, *The Ocean Engineering Program of the U.S. Navy; Accomplishments and Prospects*, September 1967, Washington, G.P.O., 1968, vi, 122 p.
 - , *The Oceanographic Operations Program of the U.S. Navy; Accomplishments and Prospects*, Washington, G.P.O., December 1967, vi, 109 p.
 - , *The Ocean Science Program of the U.S. Navy; Accomplishments and Prospects*, Washington, G.P.O., June 1967, x, 104 p.

- DEPARTMENT OF INTERIOR, *Petroleum Production, Drilling and Leasing on the Outer Continental Shelf; A Summary*, Washington, G.P.O., 1966, 20 p.
- ECONOMIC ASSOCIATES INC., *The Economic Potential of the Mineral and Botanical Resources of the U.S. Continental Shelf and Slope*, Washington, G.P.O., Clearinghouse for Federal Scientific and Technical Information, 1968.
- FOSTER, WILLIAM C., Crossroads in Arms Control, Address made before the Federal Bar Association at Washington, D.C., on September 13, 1968, "*The Department of State Bulletin*", vol. LIX, No. 1528, Oct. 7, 1968, p. 366-267.
- HERRINGTON, WILLIAM C., International Issues of Pacific Fisheries, *ibid.*, vol. LV, No. 1423, Oct. 3, 1966, p. 500-504.
- HUMPREY, HUBERT HORATIO, International Cooperation for Development of the Oceans, Address made before the State of Maine Conference on Oceanography on July 29, 1967, *ibid.*, vol. LVII, No. 1469, Aug. 21, 1967, p. 227-229.
- INTERNATIONAL JOINT COMMISSION Asked to Study Pollution Risks from Lake Erie Oil Spills; Press Release dated March 21, 1969, *ibid.*, vol. LX, No. 1554, Apr. 7, 1969, p. 296-297.
- IJC Holds Meetings on Pollution of Great Lakes Connecting Channels; Press Release dated February 21, 1969, *ibid.*, No. 1551, Mar 17, 1969, p. 234-235.
- JOHNSON, LYNDON BAINES, Public Papers of the Presidents, 1966, Book II, p. 722.
- , Return to Glassboro, Address made at the commencement exercises at Glassboro State College on June 4, 1968, "*The Department of State Bulletin*", vol. LVIII, No. 1513, Jun 24, 1968, p. 816.
- National Council on Marine Resources and Engineering Development, Executive Office of the President, *Marine Science Activities of Nations of Africa*, Washington, G.P.O., April 1968, iv, 76 p.
- , *International Decade of Ocean Exploration*, Washington, G.P.O., May 1968, iv, 7 p.
- , *Marine Science Affairs - A Year of Plans and Progress*; The Second Report of ..., Washington, G.P.O., March 1968, 228 p. (see also excerpts in: "*The Department of State Bulletin*", vol. LVIII, No. 1504, Apr. 22, 1968, p. 537-542).
- , *Marine Science Affairs - A Year of Transition*, The First Report of ..., Washington, G.P.O., March 1967, 162 p.
- POLLACK, HERMAN, National Interest, Foreign Affairs, and the Marine Sciences; paper presented on December 27, 1967, during annual meeting of the American Association for the

- Advancement of Science at New York, " *The Department of State Bulletin* ", vol. LVIII, No. 1494, Feb 12, 1968, p. 211-215.
- POPPER, DAVID H., The Deep Ocean Environment - U.S. and International Policy; Address made at Newport, R.I., on July 12, 1968, before the Symposium on Mineral Resources of the World Ocean, *ibid.*, vol. LIX, Aug 12, 1968, p. 171-177.
- PRESIDENT'S SCIENCE ADVISORY COMMITTEE, *Effective Use of the Sea*, Report of the Panel on Oceanography, Washington, G.P.O., June 1966.
- RUSK, DEAN, Consolidating the Rule of Law in International Affairs, Address made at the University of Georgia, on Law Day, May 4, 1968 " *The Department of the State Bulletin* ", vol. LVIII, No. 1509, May 27, 1968, p. 672.
- U.S. Protests Soviet Failure to Give Notice of Scientific Tests; Note delivered by the American Embassy in Moscow on November 8, 1967, *ibid.*, vol. VLIII, No. 1488, Jan 1, 1968, p. 16.

PART B.

LITERATURE

I. COLLECTIVE WORKS, PROCEEDINGS AND REPORTS OF CONFERENCES AND NON-GOVERNMENTAL ORGANISATIONS

1. ALEXANDER, LEWIS M. (ed.), The Law of the Sea: The Future of the Sea's Resources. Proceedings of the Second Annual Conference of the Law of the Sea Institute, University of Rhode Island, June 26-28, 1967, Kingston, R.I., 1968, v, 155 p.
2. —, The Law of the Sea: International Rules and Organization for the Sea. Proceedings of the Third Annual Conference of the Law of the Sea Institute, University of Rhode Island, June 24-27, 1968, Kingston, R.I., 1969, v, 464 p.
3. —, The Law of the Sea: Offshore Boundaries and Zones. Proceedings of the First Annual Conference of the Law of the Sea Institute, University of Rhode Island, June 27-July 1, 1966, Columbus, Ohio State University Press, 1967, xv, 321 p.
4. California and the Use of the Ocean - A Planning Study of Marine Resources. Prepared for the California State Office of Planning, La Jolla, University of California, 1965, 1 vol. (various pagings).
5. Conference on Law, Organisation and Security in the Use of the Ocean, March 17-18, 1967, Columbus, Ohio, The Ohio State University, 1967, mimeo., vol. I - 208 p.; vol. II - 131 p.

6. Exploiting the Ocean, Transactions of the 2nd Annual Marine Technology Society Conference, June 27-29, 1966, Washington, D.C., 1966, 570 p.
7. EICHELBERGER, CLARK M. (ed.), New Dimensions for the United Nations: The Problems of the Next Decade. Seventeenth Report of the Commission to Study the Organization of Peace, Dobbs, Ferry, N.Y., Oceana Publications Inc., 1966, xiv, 225 p.
8. GULLION, EDMUND A. (ed.), Uses of the Seas. The American Assembly, Columbia University, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1968, xviii, 205 p.
9. THE INTERNATIONAL LAW ASSOCIATION, Report of the Fifty-Second Conference, Helsinki 1966, London 1967.
10. THE INTERNATIONAL LAW ASSOCIATION, Report of the Fifty-Third Conference, Buenos Aires 1968, London 1969.
11. INTERNATIONAL STUDY CONFERENCE on the Political and Juridical Aspects of the Problem of the Sea-Bed. Summary record of preliminary meetings held in Rome on 28 and 29 June 1968, Istituto Affari Internazionali, Resoconto Sommario No. 2232, mimeo., 8 p.
12. KONECCI, EUGENE B. (ed.), Marine Sciences and Industrial Potential. Proceedings of Symposium, Houston, Texas, June 14, 1967, University of Texas, 1967, 263 p.
13. NEW WEALTH FROM THE SEAS. National Association of Manufacturers of the United States of America, Science and Technology Division, New York. 1966, 80 p.
14. NATIONAL SYMPOSIUM ON OCEAN SCIENCES AND ENGINEERING OF THE ATLANTIC SHELF. Transaction, Philadelphia 1968, 366 p.
15. OLSON, THEODORE A., and BURGESS, FREDERICK J., (eds.), Conference on the Status of Knowledge, Critical Research Needs, and Potential Research Facilities Relating to Ecology and Pollution Problems in the Marine Environment, Galveston 1966, New York, Interscience Publishers, 1967, xvi, 364 p.
16. PANEL: Whose Is the Bed of the Sea ? - "*Proceedings of the American Society of International Law at its 62nd Annual Meeting*" Washington 1968, p. 214-251.
17. Papers presented at Second Conference on Law, Organization and Security in the Use of Oceans, October 5-7, 1967, Columbus, Ohio, The Ohio State University 1967, mimeo., 174 p.
18. Proceedings of the American Bar Association National Institute on Marine Resources, Long Beach, California. June 7-10, 1967.
19. Proceedings of the Marine Frontiers Conference, University of Rhode Island, July 27-28, 1967, Kingston, R.I., 1968.

20. Proposed Treaty Governing the Exploration and Use of the Ocean Bed. Recommendations of the United Nations Committee of the World Peace through Law Center, New York, 27 p.
21. Report of the Committee on Natural Resources, Conservation and Development, National Citizens' Commission on International Co-operation, 1965, p. 4-7.
22. Torrey Canyon Pollution and Marine Life. A Report by the Plymouth Laboratory of the Marine Biological Association of the United Kingdom, Cambridge University Press, 1968, xiv, 196 p.
23. Towards the Better Use of the Oceans. A Study and Prognosis, International Institute of Peace and Conflict Research, Stockholm, 1968, 322 p.
24. The United Nations and the Bed of the Sea. Nineteenth Report of the Commission to Study the Organization of Peace, New York 1969, 30 p.
25. WHITTARD, WALTER F. and BRADSHAW, R. (eds.), Submarine Geology and Geophysics. Proceedings of the 17th Symposium of the Colston Research Society, held at the University of Bristol, April 5-9, 1965, London, Butterworth, 1965, 465 p.

II. MONOGRAPHS AND ARTICLES - LEGAL, POLITICAL, AND MILITARY ASPECTS.

26. ALVARADO GARAICOA, TEODORO, El Dominio del mar, Departamento de publicaciones de la Universidad de Guayaquil, 1968, 200 p.
27. ALEXANDER, LEWIS M., Resources of the Sea, National Jurisdiction and the Use of the Sea, "*Natural Resources Journal*", 1968, No. 8, p. 373-400.
28. ANDERSEN, WOLFGANG, Das Seerecht der Sowjetunion, Hamburg, Hansischer Guildverlag, 1968, vi, 245 p.
29. ANDRASSY, JURAJ, Application of the Geneva Convention, 1958, in Delimitating the Continental Shelf of the North Sea Area, "*Revue egyptienne de droit international*", vol. 23, 1967, p. 1-19.
30. —, Les progrès techniques et l'extension du plateau continental, "*Zeitschrift für ausländisches öffentliches Recht und Völkerrecht*", vol. 26, 1966, No. 3/4, p. 698-704.
31. —, Potreba dalje kodifikacije medunarodnog prava mora (in Serbo-Croatian), "*Jugoslavenska Revija za medunarodno pravo*" vol. 12, 1965, p. 163-171.
32. BARRY, FRANK J., Administration of Laws for the Exploitation of Offshore Minerals in the United States and Abroad, see: *item 18*.

33. —, The Administration of the Outer Continental Shelf Lands Act, " *The Natural Resources Lawyer* ", vol. I, 1968, No. 3.
34. BASIUK, VICTOR, Marine Resources Development, Foreign Policy and the Spectrum of Choice, " *Orbis* ", vol. 12, 1968, No. 1, p. 39-72.
35. BASKIN, J.J., Mezhdunarodnopravovye voprosy bor'by s zagriaznieniem vod, " *Izvestiya Vysshikh Ucebnykh Zavedeniy. Pravoovedenie* ", vol. 10, 1966, No. 2, p. 122-128.
36. BELMAN, MURRAY J., The Role of the State Department in Formulating Federal Policy Regarding Marine Resources, " *Natural Resources Lawyer* ", vol. I, 1968, No., 2 p. 14-22.
37. BERNFELD, SEYMOUR S., Developing the Resources of the Sea - Security of Investment, " *The International Lawyer* ", vol. 2, 1967-68, p. 67-76.
38. BIERZANEK, REMIGIUSZ, Comments on Professor William T. Burke's Report, see: *item 23*, p. 207-223.
39. BILDER, RICHARD B., Emerging Legal Problems of the Deep Sea and Polar Regions, " *Naval War College Review* ", vol. 20, 1967, No. 5, p. 34-49.
40. BOHMERT, VIKTOR, Natur und Umfang der der Bundesrepublik Deutschland am Kontinentalshelf zustehenden Rechte, " *Internationales Recht und Diplomatie* ", 1967, p. 101-129.
41. BOS, MAARTEN, La liberté de la haute mer: quelques problèmes d'actualité, " *Nederlands Tijdschrift voor Internationaal Recht* ", vol. 12, 1965, p. 337-364.
42. BROCK, JOHN R., Mineral Resources and the Future Development of the International Law of the Sea, " *Judge Advocates General Journal* ", vol. 22, 1967, p. 39-44.
43. BROWN, EDWARD DUNCAN, Deep-Sea Mining - The Legal Regime of "Inner Space", " *Yearbook of World Affairs* ", vol. 22, 1968, p. 165-190.
44. —, The Legal Regime of Inner Space, Military Aspects, " *Current Legal Problems* ", vol. 22, 1969, p. 181-204.
45. —, The Outer Limit of the Continental Shelf, " *The Juridical Review* ", August 1968, p. 111-148.
46. BROWNING. DAVID S., Inter-American Fisheries Resources - A Need for Co-operation, " *Texas International Law Forum* ", vol. 2, 1966, p. 1-39.
47. —, Exploitation of Submarine Mineral Resources Beyond the Continental Shelf, *ibid*, vol. 4, 1968, No. 1, p. 1-27.
48. BROWNLIE IAN, Comments on Professor William T. Burke's Report, see: *item 23*, p. 225-258.

49. BURKE, WILLIAM T., Aspects of International Decision-Making Processes in Intergovernmental Fisheries Commissions, "*University of Washington Law Review*", 1967, No. 43, p. 115-178.
50. —, Contemporary Legal Problems in Ocean Development, *see: item 23*, p. 15-206.
51. —, International Legal Problems of Scientific Research in the Ocean, 1968.
52. —, Law and New Technologies *see: item 3*, p. 204-227.
53. —, Legal Aspects of Ocean Exploitation - Status and Outlook, *see: item 6*.
54. —, A Negative View of a Proposal for United Nations Ownership of Ocean Mineral Resources, "*Natural Resource Lawyer*", vol. I, 1968, No. 2, p. 42-62.
55. —, Ocean Sciences, Technology and the Future International Law of the Sea, Columbus, Ohio State University Press, 1966, 91 p.
56. BUSCH, ECKART, Festlandssockel im Schnittpunkt von Meeresfreiheit und Staatensouveränität, "*Internationales Recht und Diplomatie*", 1967, p. 79-100.
57. BUTLER, WILLIAM E., The Soviet Union and the Continental Shelf, "*American Journal of International Law*", vol. 63, 1969, No. 1, p. 103-107.
58. CALDER, N., Undersea Colonialism, "*New Scientist*", 1969, p. 322-323.
59. CARROZ, J.E. and ROCHE, A.G., The Proposed International Commission for the Conservation of Atlantic Tunas, "*American Journal of International Law*", vol. 61 1967, No. 3, p. 673-702.
60. —, The International Policing of High Sea Fisheries, "*Canadian Yearbook on International Law, 1968*", p. 61-90.
61. CHAPMAN, WILBERT MCLEOD, Judicial Zones in the Ocean: Their Extent and Attributes. Paper prepared for the 4th Meeting of the Governor's Advisory Commission on Ocean Resources, San Diego, Cal., 9-10 June 1966.
62. —, Who Owns the Sea?, "*Oceanology International*", May-June 1967.
63. CHEEVER, DANIEL S., The Role on International Organization in Ocean Development, *see item 16*, p. 37-77; also in: "*International Organization*", vol. XXII, 1968, No. 3, p. 629-648.
64. CHEPROV, IVAN IVANOVICH, Mezhdunarodnopravovoy rezhim morskogo dna, "*Sovetskoye Gosudarstvo i Pravo*", 1968, No. 10, p. 80-86.
65. CHRISTY, FRANCIS T., Jr., Alternative Regimes for the Minerals of the Sea Floor, *see item 17*; also in: "*Natural Resources Lawyer*", vol. I, 1968, No. 2, p. 63-77 (under the title: "Alter-

- native Regimes for the Marine Resources Underlying the High Seas ”).
66. —, Economic Criteria for Rules Governing Exploitation of Deep Sea Minerals, “ *The International Lawyer* ”, vol. 2, 1967-68, p. 224-242.
 67. —, Marine Resources of the Freedom of the Seas, “ *Natural Resources Journal* ”, vol. 8, No. 3, July 1968, p. 424-433.
 68. CLIFF, A.D., North Sea Gas: A Case Study in International Cooperation, “ *The World Today* ”, vol. 23, 1967, No. 4, p. 146-152.
 69. COHEN, JAY M., The Deep Questions, “ *U.S. Naval Institute Proceedings* ”, vol. 95, 1969, No. 1, p. 26-37.
 70. La conquête des grands fonds océaniques, “ *Revue internationale de défense* ”, 1969, No. II, p. 127-131.
 71. COSTOPOULOS, VASSILI TH., Examen de la loi italienne du 21 juillet 1967, relative à la recherche et l’exploitation des hydrocarbures sur la mer territoriale et le plateau continental dans la lumière du droit d’établissement, “ *Revue du Marche Commun* ” 1969, April, No. 122, p. 193-197.
 72. CRAVEN, JOHN P., The Challenge of the Ocean Technology for the Law of the Sea, “ *Judges Advocates General Journal* ”, vol. 22, 1967, p. 31-38.
 73. —, Ocean Technology and Submarine Warfare, *Adelphi Papers* No. 46, 1968.
 74. —, Seapower and Seabed, “ *U.S. States Naval Institute Proceedings* ” vol. 92, 1966, No. 4, p. 36-51.
 75. —, Technology and the Law of the Sea, *see: item 5*, mimeo., 37 p.
 76. DANESTVAR, H. and PERRET, CH. A., Identification des limites dans les eaux territoriales iraniennes du Golf Persique, “ *La revue pétrolière* ”, 1965, Mai, No. 1072.
 77. CREAMER, R.A., Title to the Deep Sea-bed - Prospects for the Future, “ *Harvard International Law Journal* ”, vol. 9, Spring 1968, p. 205-231.
 78. DEAN, ARTHUR D., Geneva Convention on the Continental Shelf, “ *Tulane Law Review* ”, vol. 41, 1966-67, p. 419-432.
 79. —, Delings problem for Østersjön, “ *Politiken* ”, 26 December 1968.
 80. —, Destinazione a fini pacifici del letto e del sottosuolo dei mari e degli oceani in alto mare, “ *Comunità Internazionale* ”, vol. XXIII, Gennaio 1968, p. 85-89.
 81. DOUENCE, JEAN-CLAUDE, Droit de la mer et développement économique sur la côte occidentale d’Afrique, “ *Revue générale de droit international public* ”, vol. 71, 1967, p. 110-142.

82. DURANTE FRANCESCO, Piattaforma continentale italiana ed attività private, " *Rivista di diritto internazionale* ", vol. LI, 1968, N. 1, p. 118-121.
83. EEK, HILDING, The Hydrological Cycle and the Law of Nations, " *Scandinavian Studies in Law* ", 1965, p. 51-91.
84. EICHELBERGER, CLARK M., The Peaceful Use of the Sea, " *Saturday Review* ", October 5, 1968.
85. —, The Promise of the Sea's Bounty, *ibid.*, June 18, 1966.
86. —, Sharing the Sea's Resources, *ibid.*, August 13, 1966.
87. —, The U.N. and the Sea. *ibid.*, October 14, 1967.
88. —, The United Nations and the Bed of the Sea, " *San Diego Law Review* ", vol. 3, 1969, No. 3.
89. ELY, Northcutt, American Policy Options in the Development of Undersea Mineral Resources, " *The International Lawyer* ", vol. 2, 1967-78, p. 215-223.
90. —, A Case for the Administration of Mineral Resources Underlying the High Seas by National Interests, *see: item 18*; also in: " *Natural Resources Lawyer* ", vol. I, 1968, No. 2, p. 78-94.
91. —, The Laws Governing Exploitation of the Minerals Beneath the Sea, *see item 6*.
92. ENGEL, UGGI, Sagen for Haag-domstallen om afgræezingen of Kontinentalsokkelen i Nordom, " *Nordisk Tidsskrift for International Ret* ", vol. 37, 1967, No. 4, p. 272-279.
93. —, The Case of the Delimitation of the North Sea Continental Shelf Before the International Court of Justice, *ibid.*, vol. 38, 1968, No. 1-2, p. 18-25.
94. EVENSEN, JENS, Borge og havbrunnen, nasjonale og internasjonale aspekter (in Norwegian), " *Internasjonal politik* ", 1968, No. 3 p. 285-311.
95. —, Rettsproblemer i forbindelse med oljeleting og utvinning av olje pa den norske kontinentalsokkel (in Norwegian), " *Lov og Rett* ", 1966, p. 337-351.
96. FLEISCHER, CARL AUGUST, Fiskerisonen og kontinentalsokkelen to overenskomster mellom Norge og Storbritannia og deres bakgrun (in Norwegian), " *Nordisk Tidsskrift for International Ret* ", vol. 35, 1965, p. 141-158.
97. FRANCOIS, J.P.A., Réflexions sur l'occupation, *Recueil d'études de droit international, en hommage à Paul Guggenheim*, Genève 1968, p. 793-804.
98. FROSCH, ROBERT A., Military Uses of the Ocean, *see: item 17*, p. 154-174.
99. FROWEIN, JOCHEN, Verfassungsrechtliche Probleme um den deutschen Festlandsokkel, " *Zeitschrift für ausländisches öffentliches Recht und Völkerrecht* ", vol. 25, 1965, No. 1, p. 1-29.

100. GIRARD CLAUDE, Military Uses of the Continental Shelf and the Sea-bed Beyond, *see: item 23*, p. 259-269.
101. GOLDIE, L.F.E., The Contents of Davy Jones's Locker - A Proposed Regime for the Sea-bed and Subsoil, "*Rutgers Law Review*", vol. 22, 1968, No. 1, p. 1-66.
102. —, The Exploitability Test - Interpretation and Potentialities, "*Natural Resources Journal*", vol. 8, 1968, No. 3, p. 434.
103. —, The Geneva Conventions and the Need for Future Modifications, *see: item 3*, p. 273-293.
104. —, Sedentary Fisheries and Article 2 (4) of the Continental Shelf Convention, "*American Journal of International Law*", vol. 63, 1969, No. 1, p. 86-97.
105. —, The Society's Southern California Regional Meeting, *ibid.*, vol. 61, 1967, No. 1, p. 98-100.
106. —, "Submarine Zones of Special Jurisdiction" Under the High Seas - Some Military Aspects, *see: item 1*, p. 100-112.
107. GORSHKOV, G.S., Mezhdunarodnopravovoy rezhim kontinentalnogo shelfa, "*Morskoy Sbornik*", 1969, No. 5, p. 82-87.
108. GORALCZYK, WOJCIECH, Zagadnienia pokojowego wykorzystania dna róż i oceanów (in Polish), "*Nprawy Międzynarodowe*", 1969, No. 3, p. 52-68.
109. GRIFFIN, WILLIAM L., Accommodation of Conflicting Uses of Ocean Space with Special Reference to Navigation Safety Lanes, *see: item 1*, p. 73-83.
110. —, The Emerging Law of Ocean Space, "*The International Lawyer*", vol. 1, 1966/67, p. 548-587.
111. GROSS, AVRUM M., The Maritime Boundaries of the States, "*Michigan Law Review*", vol. 64, 1965/66, p. 639-670.
112. GRUNAWALT, RICHARD J., The Acquisition of the Resources of the Bottom of the Sea - A New Frontier of International Law, "*Military Law Review*", 1966, No. 34, p. 101-133.
113. GRZESKOWIAK, ANDRZEJ A., Podział szelfu kontynentalnego na Morzu Batyckim (in Polish), "*Sprawy Międzynarodowe*", 1969, No. 5, p. 63-76.
114. GULLION, EDMUND G., New Horizons at Sea, *see: item 8*, p. 1-16.
115. HAIGHT, WILFRIED A., United Nations Affairs: Ad Hoc Committee on Sea-Bed and Ocean Floor, "*The International Lawyer*", vol. 3, 1968, No. 1, p. 22-30.
116. HARTINGH, FRANCE DE, La position française à l'égard de la Convention de Genève sur le plateau continental, "*Annuaire française de droit international*", vol. 11, 1965, p. 725-732.
117. HEAD, IVAN L., Legal Clamour Over Canadian Off-shore Minerals, "*Alberta Law Review*", vol. 3, 1967, p. 312.

118. —, The Canadian Offshore Minerals Reference: The Application of International Law to a Federal Law to a Federal Constitution, " *University of Toronto Law Journal* ", vol. 18, 1968, No. 2, p. 131-157.
119. HEARN, WILFRED A., The Fourth Dimension of Seapower: Ocean Technology and International Law, " *Judge Advocate's General Journal* " vol. 22, 1967, p. 23-51.
120. —, The Role of the United States Navy in the Formulation of Federal Policy Regarding the Sea, " *Natural Resources Lawyer* " vol. 1, 1968, No. 2, p. 23-31.
121. HELLER, WERNER, Das internationale Seekalrecht in Friedenszeiten und seine Wandlungen durch die neue völkerrechtliche Entwicklung, Kiel, 1965, 237 p.
122. HENKIN, LOUIS, Changing Law for the Changing Seas, *see: item 8*, p. 69-97.
123. —, Law for the Seas' Mineral Resources, ISHA Monograph No. 1, New York, Columbia University, 1968.
124. HERSCH, SEYMOUR, An Arms Race on the Seabed, " *War/Peace Report* ", vol. 8, 1968, No. 7, p. 8-9.
125. HERSHMAN, MARC J., The Seaward Extension of States: A Boundary for New Jersey under the Submerged Lands Act, " *Temple Law Quarterly* ", vol. 40, 1966/67, p. 66-101.
126. HORTIG, F.J., Jurisdictional, Administrative, and Technical Problems Related to the Establishment of California Coastal and Offshore Boundaries, *see: item 3*, p. 230-243.
127. IBLER, VLADIMIR, Uz novi Zakon o obalnom moru, vanjskom morskom pjasu i epilontinentalnom pojasu Jugoslavije (in Serbo-Croatian), " *Jugoslovenska revija za medunarodno pravo* " vol. 12, 1965, p. 321-334.
128. IVANOV, I.V., Mezhdunarodnye soglasheniya v oblasti regulirovaniya pravovogo rezhima regionalnogo moria, " *Izvzstiya Vysshikh Ucebnykh Savedenii. Pravovedenie* ", vol. 10, 1966, p. 111-119.
129. JENKS, C. WILFRED, The New Science and the Law of Nations, " *International and Comparative Law Quarterly* ", vol. 17, Aprile 1968, p. 327.
130. JOHNSTON, DOUGLAS M., Law, Technology and the Sea, " *California Law Review* ", vol. 55, 1967, p. 449-472.
131. —, The International Law of Fisheries; A Framework for Policy-Oriented Inquires, New Haven, Yale University Press, 1965, xxiv, 554 p.
132. KALINKIN, G.F., Zapretit' ispolzovaniye morskogo dna wojennykh tselyakh, " *Mezhdunarodnaya Zhizn* ", 1969, No. 2, p. 62-67.

133. KEHDEN, M.J., Die Vereinten Nationen und die Nutzung des Bodens und Untergrundes des Hohen Meeres ausserhalb der Grenzen nationaler Hoheitsgewalt, " *Verfassung und Recht in Ubersee* ", 1969, Part 2, No. 2, p. 131-167.
134. KEILIN, A.D., Morsoye prav v aspekte sovremennykh mezdunarodnykh otnosheniy, " *Sovetskoye gosudarstvo i pravo* ", 1969, No. 1, p. 88-92.
135. KNAPP, G.H., Le régime des concessions de pétrole en Hollande, " *Revue pétrolière* ", 1965, No. 1071.
136. KOLODKIN, ANATOLY L., Kopublikovaniyu anglijskogo zakona o kontinentalnom shelfe, " *Morskoye pravo i praktika* ", Informatsionniy sbornik, No. 33, 1967.
137. KOLODKIN, A.L., VOLOSOV, M.E., Svoboda sudokhodstva i razrabotki estestvennykh bogatstv kontinentalnogo shelfa, " *Morskoy Flot* ", 1969, No. 4.
138. —, Kontinentalsokkeln. Betänkade avgivet av kontinentalsockel-utredningen (in Swedish), Stockholm, Svenska Reproduktions AB 1965, 145 p.
139. —, Kontinentalsokkelen; en bibliografi over juridisk litteratur (in Norwegian), Oslo, Norske Nobelinstitut, 1965.
140. KOPAL, VLADIMIR, Právní režim oblastí vykrazených mírovým cílům, (In Czech), " *Casopis pro mezinárodní právo* ", vol. 10, 1966, p. 205-225.
141. KRUEGER, R.B., The Convention on the Continental Shelf and the Need for its Revision and Some Comments Regarding the Regime for the Lands Beyond, " *Natural Resources Lawyer* " vol. 1, 1968, No. 3, p. 1-18.
142. KRUGER-SPRENGEL, FRIEDHELM, Rechtsfragen der militärischen Nutzung des Meeresbodens, " *Neue Zeitschrift für Wehrrecht* ", vol. 11, 1969, No. 5, p. 178-190.
143. LAWRENCE, KEITH D., Military Legal Considerations in the Extension of Territorial Seas, " *Military Law Review* ", vol. 29, 1965, p. 47-95.
144. LAZZARO, FORTUNATO, Il regime giuridico dei mezzi di ricerca e sfruttamento che operano in mare, Piacenza, La Tribuna, 1967, 137 p.
145. LENTZ, WALDEMAR, Die friedliche Nutzung des Meeresbodens, " *Dokumentation, Deutsche Welle* ", 1969, No. 2, p. 8-10.
146. LEPOTIER, R., La compétition pour l'exploitation des mers, " *Revue militaire générale* ", mars 1968, p. 362-376.
147. LEVY, JEAN-PAUL, Pour un droit des fonds océaniques, " *Chronique de politique étrangère* ", vol. XXI, 1968, No. 6, p. 721-738.
148. —, Rechtspolitische Schwerpunkte einer Regelung der Besitz- und Nutzungsrechte des Meeresgrundes, " *Osterrei-*

- chische Zeitschrift für Aussenpolitik*", vol. 8, 1968, No. 3, p. 135-148.
149. LILlich, RICHARD B., Whose is the bed of the sea? "*New York State Bar Journal*", vol. 40, December 1968, p. 601-604
 150. L Ø DDES Ø L, L.T., Norske regler on oljeutvinning (in Norwegian), "*Lov og Rett*", 1965, p. 154-160.
 151. LUMB, R.D., The Law of the Sea and the Australian Offshore Areas, University of Queensland Press, 1966, vi, 86 p.
 152. —, The Offshore Petroleum Agreement and Legislation, "*Australian Law Journal*", vol. 41, February 29, 1968, p. 453-461.
 153. LUCE, CHARLES F., The Development of Ocean Minerals and the Law of the Sea, *see: item 18*.
 154. MANGONE, World's Sea Bed, "*New York Times*", October 1, 1967, p. E13.
 155. MANN BORGESE, ELISABETH, The Ocean Regime: A Suggested Statute for the Peaceful Uses of the High Seas and the Seabed Beyond the Limits of National Jurisdiction, Santa Barbara, Cal., Center for the Study of Democratic Institutions, 1968.
 156. MANNER, E.J., Comments on Professor William T. Burje's Report, *see: item 23*, p. 271-277.
 157. MARTIN, LAURENCE W., The Sea in Modern Strategy, New York, Fred. A. Praeger, 1967, 190 p.
 158. MARX, WESLEY, The Deep-Sea Bed, "*Atlantic Monthly*", vol. 223, April 1969, pp. 24, 26, 28, 30, 32, 37-38.
 159. MELLO, Celso Duvivier de Albuquerque, Plataforma continental: principais aspectos (in Portuguese), Rio de Janeiro, Livraria Freitas Bastos, 1965, 160 p.
 160. MENZEL, EBERHARD, Der deutsche Festlandssockel in der Nordsee und seine rechtliche Ordnung, "*Archiv des öffentlichen Rechts*", vol. 90, 1965, No. 1. p. 1-61.
 161. —, Der Festlandssockel der Bundesrepublik Deutschland and das Urteil des Internationalen Gerichtshofes vom 20. Februar 1969, "*Jahrbuch für Internationales Recht*", vol. 14, 1969, p. 13-100.
 162. —, Nationalisierung oder Internationalisierung der Ozeane, "*Neue Juristische Wochenschrift*", 1969.
 163. MESERA, V.F. and IVANOV, I.V. Otnosno pravnata klasifikaciya na morskite prostranstva (in Bulgarian), "*Pravna Misl*", vol. 9, 1965, No. 5, p. 3-13.
 164. MICHAEL, D.N., Avoiding the Militarisation of the Seas, *see: item 7*, p. 167-170.
 165. MOREAU, LUCIEN E., International Law — Maritime Boundaries of California - Extent of Submerged Lands Granted to the

- States by Congress, " *Harvard International Law Club Journal* " vol. 7, 1966, No. 2, p. 339-349.
166. MORRIS, JOSEPH W., The North Sea Continental Shelf: Oil and Gas Legal Problems, " *The International Lawyer* ", vol. 2, 1967-1968, p. 191-214.
167. MUNCH, FRITZ, Die Anrufung des Internationalen Gerichtshofs durch die Bundesrepublik Deutschland und ihre Nachbarn in Fragen der Abgrenzung des Festlandsockels in der Nordsee, " *Zeitschrift für ausländisches öffentliches Recht und Völkerrecht* ", vol. 27, 1967, No. 4, p. 725-734.
168. —, Das Urteil des Internationalen Gerichtshofes vom 20. Februar 1969 über den deutschen Anteil am Festlandsockel in der Nordsee, *ibid.*, vol. 29, 1969, No. 3, p. 455-475.
169. VON MUNCH, INGO, Legal Aspects of Drilling for and Transportation of Oil and Gas on the High Seas. With Special Reference to the Situation in the North Sea and the Baltic Sea, " *La revue pétrolière* ", 1965, Mai, No. 1072.
170. NAKAMURA, KO, Continental Shelf Fishery Resource, " *Hogaku Kenkyu* " vol. 39, 1966, No. 2, p. 1-26.
171. NANDA, VED P., The "Torrey Canyon" Disaster: Some Legal Problems, " *Denver Law Journal* ", vol. 44, 1967, p. 400-425.
172. NEBELOG, HENRIK, I dag Danmarks tur i Haag (In Danish), " *Politiken* ", October 28, 1968.
173. NEILD, ROBERT R., Alternative Forms of International Regime for the Oceans, *see: item 23*, p. 279-292.
174. NIBLOCK, R.N., Bar Association Probes UN Undersea Role, " *Technology Week* ", June 19, 1967, p. 39-40.
175. NICKELSEN, W.M., A Navy View of Ocean Resources, " *Natural Resource Lawyer* ", vol. 1, 1968, No. 3, p. 77-81.
176. NIERENBERG, WILLIAM H., Militarized Oceans, in: N. Calder (ed.), *Unless Peace Comes; A Scientific Forecast of New Weapons*, London, The Penguin Press, 1968, p. 109-119.
177. —, NOA "Strongly Opposes" United Nations Take-Over of Ocean Minerals, " *National Oceanography Association News* ", vol. 1, No. 9 May 1967.
178. O'CONNELL, DANIEL P., Problems of Australian Coastal Jurisdiction " *Australian Law Journal* ", vol. 42, 1968, No. 2, p. 39-51.
179. ODA, SHIGERU, Boundary of the Continental Shelf, " *Japanese Annual of International Law* ", vol. 12, 1968, p. 264-284.
180. —, Comments on Professor William T. Burke's Report, *see: item 23*, p. 293-308.

181. —, Proposals for Revising the Convention on the Continental Shelf, " *The Columbia Journal of Transnational Law* ", vol. 7, 1968, No. 1, p. 1-31.
182. —, Some Observations on the International Law of the Sea, " *Japanese Annual of International Law* ", vol. 11, 1967, p. 37-50.
183. —, La zone de pêche de douze milles, " *Kokusaiho Gaiku Zassi* ", vol. 66, 1967-68, No. 5, p. 1-36 and No. 6, p. 15-30.
184. ONORATO, WILLIAM T., Apportionment of an International Common Petroleum Deposit, " *International and Comparative Law Quarterly* ", vol. 17, 1968, p. 85-102.
185. OSWALD, JAMES W., Toward a Political Theory of the Ocean, *see: item 6*.
186. PARDO, ARVID, Control of the Seabed, " *Survival* ", vol. 11, 1969, No. 1, p. 18-26.
187. —, Kold krig om havbunden, " *Fremtiden* ", 1968, No. 8.
188. —, Lo sfruttamento e il controllo degli oceani, " *Lo spettatore internazionale* ", vol. 4, 1969, No. 1, p. 21-34.
189. —, Sovereignty Under the Sea - The Threat of National Occupation, " *Round Table* ", October 1968, p. 341-355.
190. —, Who Will Control the Seabed?, " *Foreign Affairs* ", vol. 47, 1968, No. 1, p. 123-137.
191. —, Whose Is the Bed of the Sea?, " *Proceedings of the American Society of International Law* ", 1968, p. 216-229.
192. PELL, CLAIBORNE DE B. and GOODWIN, HAROLD L., Challenge of the Seven Seas, New York, Morrow, 1966, 306 p.
193. PEREZ VERA, ELISA, Las doce millas como limite maximo de las competencias del estado ribereño, " *Revista Española de Derecho Internacional* ", vol. 18, 1965, p. 529-543.
194. PETROWSKI, LAWRENCE C., Military Use of the Ocean Space and the Continental Shelf, " *The Columbia Journal of Transnational Law* ", Vol. 7, 1968, No. 2, p. 279-301.
195. PLOGVALL, HANS, Osternjönsdelning svar politisk frågan (in Swedish), " *Svenska Dagbladet* ", October 25, 1968.
196. POLLACK, HERMAN, United States Foreign Policy and the Marine Science, *see: item 17*, p. 137-153.
197. QUENEUEDEC, JEAN-PIERRE, Le rejet à la mer de déchets radioactifs " *Annuaire française de droit international* ", vol. 11, 1965, p. 750-782.
198. RAO, P. SREENIVASA, The Law of the Continental Shelf, " *The Indian Journal of International Law* ", vol. 6, 1966, p. 363-382.
199. —, Reaching a Long Arm to the Continental Shelf, " *Business Week* ", No. 2035, August 31, 1968, p. 48-50.

200. REINTANZ, GERHARD, Aktuálne problémy kontinentálnych podmorských plosin v Európe (in Czech), "Právny Obzor", vol. 48, 1965, p. 193-204.
201. —, Um das Nordsee- and Ostseeöl, "Deutsche Aussenpolitik", 1966, p. 458-466.
202. —, Zehn Jahre Genfer Seerechtskonventionen, "Staat und Recht", vol. 17, 1968, p. 424-444.
203. ROBERTSON, J.W., Security Interests and the Regimes of the Sea, *see: item 1*, p. 47-51.
204. ROUSSEAU, CHARLES, Adhésion de la France à la Convention de Genève du 29 avril 1958 sur le plateau continental, "Revue générale de droit international public", vol. 69, 1965, No. 4, p. 1136-1137.
205. —, Différend concernant la détermination de la frontière entre l'Irak et l'Iran et la délimitation de leur plateau continental, *ibid.*, vol. 70, 1966, No. 2, p. 488-494.
206. —, Octroi de nouveaux permis d'exploration du plateau continental en Grande-Bretagne, *ibid.*, No. 3, p. 781.
207. —, Plaintes des armateurs britanniques contre des travaux de gorgage et de prospection de pétrole dans la mer du nord, *ibid.*, p. 766-767.
208. —, Repartition de recettes provenant des ressources du plateau continental entre le gouvernement fédéral des Etats-Unis et les gouvernements des Etats particuliers, *ibid.*, No. 2, p. 460-470.
209. —, Signature d'accords entre l'Iran et certaines sociétés étrangères pour la prospection et l'exploitation des champs de pétrole sous-marins du Golf Persique, *ibid.*, vol. 69, 1965, p. 498-499.
210. SAPOZHNIKOV, VALENTIN IVANOVICH, Mizhnaordnopravovi problemi suverenitetu nad prirodnimi bagatstvami (in Ukrainian), Kiiiv, Naukova Dumka, 1966, 182 p.
211. SCHAEFFER, MILNER B., The Changing Law of the Sea - Effects on Freedom of Scientific Investigation, *see: item 1*, p. 113.
212. —, Freedom of Scientific Research and Exploitation in the Sea, "The Stanford Journal of International Studies", vol. 4, 1969, p. 46-70.
213. VON SCENK, DEDO, Die Festlandssockel-Proklamation des Bundesregierung vom 20-1-1964, "Festschrift für Peter Pfeiffer", 1965, p. 485-498.
214. —, Sea-Bed. Issues Before the 23rd Session of the General Assembly, "International Conciliation", No. 569, September 1968, p. 52-56.

215. SHAVELSON, J.L., The Administration of Offshore Mineral Leasing Statute in the Pacific Southwest (California, Oregon and Hawaii), "*Natural Resources Lawyer*", vol. 1, 1968, No. 3, p. 60.
216. SKOLNIKOFF, EUGENE B., National and International Organization for the Seas, *see: item 8*, p. 98-112.
217. SOHN, LOUIS B., Die Ausbeutung des Meeresgrundes jenseits des Kontinentalschelfs, "*Jahrbuch für Internationales Recht*", vol. 14, 1969, p. 101-127.
218. SOYER, J.C., Le "Torrey Canyon" et le droit de la mer, "*Il Foro Italiano*", vol. 92, 1967, p. 82-87.
219. SPINEDI, MARINA, Problemi di diritto internazionale sollevati dal naufragio della "Torrey Canyon", "*Rivista di diritto internazionale*", vol. L, 1967, No. 4, p. 653-674.
220. STABURZYNSKI, ANDRZEJ, Strefy rybolówcze, (in Polish), "*Ruch prawniczy, ekonomiczny i socjologiczny*", vol. 29, 1967, No. 2, p. 99-112.
221. STANG, DAVID P., Individual's Right to Question United States Administrative Jurisdiction over Continental Shelf Areas, *see: item 1*, p. 86-88.
222. STEFANOVA, SLAVA POPOVA, Mezhdunarodno praven rezhim na otkritoto more (in Bulgarian), Sofia, Nauka i izkustvo, 1965, 265 p.
223. STONE, OLIVER L., Legal Aspects of Offshore Oil and Gas Operations, "*Natural Resources Journal*", vol. 8, 1968, p. 478-504.
224. —, United States Legislation Relating to the Continental Shelf, "*International and Comparative Law Quarterly*", vol. 17, 1968, No. 1, p. 103-117.
225. SWYGARD, KLINE R., Implications for the Future Distribution of the Sea's Resources if Present Regimes Continue in Force, *see: item 1*, p. 65-69.
226. TAKABAYASHI, HIDEO, Gyoyo-kyotei no Mondaiten (in Japanese), "*Horitsu Jiho*", vol. 37, 1965, p. 12-17.
227. TAUBE, G., Militär und Meer, Das Ringen um die Vorherrschaft in der Tiefsee, "*Wehrkunde*", 1967, p. 462-494.
228. TECLAFF, LUDWIK A., Jurisdiction over Offshore Fisheries - How Far Into the High Seas, "*Fordham Law Review*", vol. 35, 1966-67, p. 409-424.
229. TEITEBOIM VOLOSKY SERGIO, Chile y la soberania en el mar, Santiago de Chile, Bello, 1966, 219 p.
230. THOMAS, J.B., The Offshore Mineral Resources Legislation, "*The Australian Law Journal*", vol. 38, 1965, p. 408-417.
231. VALENTINO SOBRINO, RAPHAEL, O problema das fontes reveladoras na doutrina da plataforma continental, (in Portu-

- guese) " *Revista Brasileira de Politica Internacional* ", vol. 8, 1965, p. 46-65.
232. VINOGRADOV, A.P., The Danger of Militarizing the Ocean and Sea-Bed. Paper presented to the 19th Pugwash Conference, Sochi, USSR, 1969, mimeo., 5 p.
233. VOLKOV, A.A., Mezhdunarodnopravovye voprosy ekspluatscii zhivyykh resursov kontinental'nogo shelfa, " *Sovetskiy Yezhegodnik Mezhdunarodnogo Prava* ", 1964-65, p. 213-229.
234. WARBRICK, C., Off-shore Petroleum Exploitation in Federal Systems - Canadian and Australian Action, " *International and Comparative Law Quarterly* ", vol. 17, 1968, No. 2, p. 501-512.
235. WEISSBERG, GUENTER, International Law Meets the Short-Term National Interest. The Maltese Proposal on the Sea-Bed and Ocean Floor - Its Fate in Two Cities, *ibid.*, vol. 18, 1969, No. 1, p. 41-102.
236. —, Recent Developments in the Law of the Sea and the Japanese - Korean Fishery Dispute, The Hague, Martinus Nijhoff, 1966, xiv 135 p.
237. WENGLER, WILHELM, Abgrenzung des Festlandsockels zwischen benachbarten Staaten, " *Neue Juristische Wochenschrift* ", vol. 22, 1969, No. 22, p. 965.
238. WENK, EDWARD, JR., A New National Policy for Marine Resources, " *Natural Resources Lawyer* ", vol. 1, 1968, No. 2, p. 3-13.
239. WILKIE, MALCOLM RICHARD, The Deep Sea: Its Potential Mineral Resources and Problems, " *The International Lawyer* " vol. 3, 1968, No. 1, p. 31-48.
240. WILLECKE, RAIMUND, Der Festlandsockel — seine völker — und verfassungsrechtliche Problematik, " *Deutsches Verwaltungsblatt* ", vol. 81, 1966, p. 461-468.
241. —, Who Rules the Sea: New Version of Old Problem, " *Chemical Engineering* ", January 1, 1968, p. 20-21.
242. YOUNG, RICHARD, Offshore Claims and Problems in the North Sea, " *American Journal of International Law* ", vol. 59, 1965, No. 3, p. 505-522
243. —, The Legal Regime of the Deep-Sea Floor, *ibid.*, vol. 62, 1968, No. 3, p. 641-653.
244. —, The Limits of the Continental Shelf - And Beyond, *see: item 15*, p. 229-236.
245. ZAORSKI, REMIGIUSZ, Eksploatacja biologicznych zasobów morza w swietle prawa miedzynarodowego, Gdynia, Wyd. Morskie, 1967, 263 p.

III. MONOGRAPHS AND ARTICLES - ECONOMIC, TECHNOLOGICAL AND SCIENTIFIC ASPECTS

246. ABEL, ROBERT B., and SULLIVAN, Gerhard E., Trends in the Marine Sciences, *see: item 1*, p. 42-46.
247. AUBERT, MAURICE, Cultiver l'océan Paris, Presses Universitaires de France, 1965, xii, 199 p.
248. AUSTIN, C.F., In the Rock. A Logical Approach for Undersea Mining of Resources, "Engineering and Mining Journal", August 1967, p. 82-88.
249. —, Autec Is Commissioned, "Undersea Technology", April 1967, p. 22-23.
250. BARDACH, JOHN E., Harvest of the Sea, New York, Harper and Row, 1968, 201 p.
251. BARNES, S., Mining Marine Resources, "Machine Design", April 25, 1968, p. 21-26.
252. BEALL, J.V., Ocean Mining Faces Problems, - Push in Oceanography May Yield Solutions, "Mining Engineering", August 1967, p. 52-57.
253. —, Beneath the Ocean Floor: Homes, Mines and Shops Can Now Be Built, "Machine Design", March 16, 1967, p. 14-16.
254. BERNFELD, SEYMOUR S., Exploitation of Minerals in and Under the Seas, "Symposium on Private Investors Abroad - Problems and Solutions", Southwestern Legal Foundation, 1967, p. 337-390.
255. BOND, Undersea Ambient Environmental Habitation and Manual Operations, in: Brautz, *Ocean Engineering*, 1968.
256. BOYER, ALBERT, La mise en valeur du plateau continental français et ses problèmes, "Journal de la marine marchande", No. 2414, Marche 24, 1966
257. BROOKS, DAVID B., Deep Sea Manganese Nodules: From Scientific Phenomenon to World Resource, *see: item 1*.
258. —, Low-Grade and Nonconventional Sources of Manganese, Washington, D.C., Resources for the Future, Inc., 1966, 136 p.
259. BRUUN, A., New Ideas in Deep Water Oil Production Systems, Part I, The Manual Approach, "World Oil", 1968, No. 167, p. 78-81.
260. CARLISLE, NORMAN V., Riches of the Sea: The New Science of Oceanology, New York, Sterling Publ. Co., 1967, 128 p.
261. CATHEY, P.J., Ocean Mining: Who Will Pay the Bill?, "Iron Age", July 18, 1968, p. 60-61.

262. CHAPMAN, WILBERT MCLEOD, Food Production from the Sea and the Nutritional Requirements of the World, *see: item 5*, mimeo., 19 p.
263. CHERADAME, H., L'océan, l'investissement de demain, "*Informations industrielles et commerciales*", January 20, 1969, p. 26-27, 29.
264. CHRISTY, FRANCIS T., JR., The Distribution of the Seas' Wealth in Fisheries, *see: item 2*, p. 106-121.
265. —, Realities of Ocean Resources, *see: item 17*, p. 59-73.
266. —, and BROOKS, DAVID B., Shared Resources of the World Community, *see: item 7*.
267. —, and SCOTT A., The Common Wealth in Ocean Fisheries, The John Hopkins Press, 1965, 352 p.
268. COENE, G.T., Profile of Marine Resources, *see: item 5*, mimeo, 55 p.
269. —, Composite Seems Best Set for Deep-Sea Housing Units, "*Product Engineering*", February 12, 1968, p. 98-101.
270. CRAVEN, JOHN P., Assessment of Future of Deep Ocean Technology, "*Astronautics and Aeronautics*", July 1967, p. 36-42.
271. CRUIKSHANK, M.J. and others, Offshore Mining: Present and Future, "*Engineering and Mining Journal*", January 1968, p. 84-91.
272. —, Deep-Sea Drilling Project JOIDES, "*American Association of Petroleum Geologists Bulletin*", September 9, 1967, p. 1787-1802.
273. DELORME, JEAN, La mer et l'espace, Paris, Hachette, 1966, 191 p.
274. DENNIS, W.H., Metal Potential of the Sea, "*Metallurgia*", November 1967, p. 199-200.
275. DOUMENGE JEAN. Géographie des mers, Paris, Presses Universitaires de France, 1965, 280 p.
276. —, Economics, Not Technology, Will Spur Development of Ocean's Resources, "*Chemical and Engineering News*", July 29, 1968, p. 18-19.
277. —, Engineers and the Ocean Bed, "*Engineering*", April 19, 1968, p. 589.
278. FAIRBRIDGE, R.W. (ed.), Encyclopedia of Oceanography, New York, Reinhold Publishing Corp., 1966.
279. FRIEDRICH H., Nahrung aus dem Meer, "*Universitas*", 1968, No. 6, p. 629-635.
280. FYE, PAUL M. and others, Ocean Science and Marine Resources, *see: item 8*, p. 17-68.
281. GABER, N.H. and REYNOLDS, D.F., JR., Economic Opportunities in Oceans, "*Battelle Technical Review*", December 1965, p. 5-11.

282. GASKELL, T.F., North Sea Gas, "*Endeavour*", vol. 26, September 1967, p. 140-143.
283. GOLDIN, AUGUSTE R., The Bottom of the Sea, New York, Crowell, 1967 (unpaged).
284. HINDE, PETER, Fortune in the North Sea: The Story of Oil and Gas Off the East Coast of Britain, London, Foulis, 1966, xiv, 244 p.
285. KASAHARA, HIROSHI, Food Production from the Ocean, *see: item 5*, mimeo., 43 p.
286. KNAUSS, JOHN A., Unsolved Problems in Marine Science - 1977, *see: ibid.*, mimeo, 14 p.
287. KOVALIK, VLADIMIR and KOVALIK, NADA, The Ocean World, New York, Holiday House, 1966, 191 p.
288. KLIMA, OTTO and WOLFE, GIBSON M., The Oceans: Organising for Action, "*Harvard Business Review*", vol. 46, 1968, No. 3, p. 98-112.
289. —, The Oceans: Unexploited Opportunities, *ibid.*, No. 2, p. 140-156.
290. KRUEGER, R.B., Mineral Development on the Continental Shelf and Beyond, "*California SB Journal*", vol. 42, 1967, p. 550.
291. LEARY, FRANK, Vehicles for Deep Submergence, "*Space Aeronautics*", vol. 49, April 1968, p. 52-65.
292. LENSE, A.H., Sampling Minerals of the Ocean Floor, "*Mining Engineering*", August 1968, p. 54-57.
293. LITTLE, C.H., Off-shore Explorations for Gas and Oil, "*Canadian Geographic Magazine*", vol. 77, 1968, No. 4, p. 108-115.
294. LOFTAS, TONY, Wealth from the Oceans, London, Phoenix House, 1967, 69 p.
295. MABIRE, JEAN, La Marée noire du Torrey Canyon, Paris, A. Michel, 1967, 256 p.
296. MACANDER, A., Deep Sea Arrays for Materials Exposure, "*Naval Engineers Journal*", April 1968, p. 287-293.
297. MACDONALD, GORDON F.J., An American Strategy for the Oceans *see item 8*, p. 163-194.
298. —, What's in the Ocean?, "*International Science and Technology*", vol. 64, April 1967.
299. MCILHENNY, W.F., The Oceans - Technology's New Challenge, "*Chemical Engineering*", October 10, 1966, p. 191-198.
300. MCKEE, ALEXANDER, Farming the Sea; First Steps into Inner Space, London, Souvenir Press, 1967, 314 p.
301. MCKELVEY, VINCENT E., Mineral Potential of the Submerged Parts of the U.S., "*Ocean Industry*", vol. III, No. 9.
302. —, Marine Mineral Exploration and Speculative Leasing Continue World-Wide, "*Undersea Technology*", January 1969.

303. MARX, WESLEY, *The Frail Ocean*, New York, Coward-McCann, 1967, 248 p.
304. MERO, JOHN L., *The Mineral Resources of the Sea*, New York, Elsevier, 1965, (also in French: *Les ressources minerales de la mer*, Elsevier, 1965).
305. —, Ocean Mining - Here's Where We Stand, "*Steel*", May 15, 1967, p. 45-49.
306. —, Seafloor Minerals: A Chemical Engineering Challenge, "*Chemical Engineering*", July 1, 1968, p. 73-80.
307. MIKHAILOV, STEFAN V., *Ekonomika mirovogo okeana*, Moskva, Ekonomika, 1966, 272 p.
308. NIGHTINGALE, CHARLES, *Exploiting the Oceans*, London-New York, 1968, 93 p.
309. —, Oceanography: Minerals on the Shelf, "*Chemical and Engineering News*", July 22, 1968, p. 12-13.
310. —, *Oceanography 1966 - Achievements and Opportunities*, Washington, D.C., National Academy of Sciences/National Research Council, 1967.
311. —, Probing the Sea's Bottom, "*Mechanical Engineering*", December 1967, p. 45.
312. REVELLE, ROGER, *Man and the Sea in the 21st Century*, mimeo., 16 p.
313. —, *The Oceans Fifteen and Fifty Years from Now*, mimeo., 22 p.
314. RICH, ALEXANDER and ENGELGARDT, VLADIMIR A., A Proposal from a U.S. and a Soviet Scientist: Oceanic Resources and Developing Nations, "*Bulletin of the Atomic Scientists*", vol. 24, February 1968, p. 2-3.
315. ROGERS, LESLIE C., North Sea Report, "*Oil and Gas Journal*", February 27, 1967.
316. SCHAEFER, MILNER B., Economic and Social Needs for Marine Resources, in Brahtz, "*Ocean Engineering*", 1968.
317. —, The Potential Harvest of the Sea, "*Transactions of the American Fisheries Society*", vol. 94, 1965, No. 2, p. 123-128.
318. —, Some Comments on Interaction Between the Exploitation of the Food Resources and Other Uses of the Ocean, *see: item 5*, mimeo, 15 p.
319. —, and ALVERSON, *World Fish Potentials*, University of Washington Publications in Fisheries, 1968, No. 4.
320. —, Sealab III, "*Undersea Technology*", vol. 8, August 1968, p. 25-29, 33-40, 44-52.
321. —, Sea Plow Starts Bringing Ocean Resources to the Surface, "*Product Engineering*", September 25, 1967, p. 28-30.

322. —, Shelf-Bottom Work Needs Man-in-the-Sea Technology, " *Space Aeronautics* ", vol. 49, April 1968, p. 30, 35-36. 39-40.
323. SHEPARD, FRANCIS P., *The Earth Beneath the Sea*, Rev. ed., Baltimore, John Hopkins Press, 1967, 242 p.
324. SORENSEN, PHILIP E. and MEAD, WALTER J., A Cost-Benefit Analysis of Ocean Mineral Resource Development: The Case of Manganese Nodules, " *American Journal of Agricultural Economics* ", vol. 50, 1968, No. 5, p. 1611-1620.
325. SPILHAUS, ATHELSTAN F., *The Ocean Laboratory*, Mankato, Minn., Creative Educational Society, 1967, 112 p.
326. STEPHAN, J.G., Mapping Ocean Floor, " *Battelle Technical Review* ", July-August 1966, p. 7-11.
327. SUMMERHAYES, C.P., Marine Environments of Economic Mineral Depositions Around New Zealand: A Review, " *Marine Technology Society Journal* ", vol. III, No. 2.
328. TERRY, RICHARD D., *Ocean Engineering. A Preliminary Report Submitted to the Chairman of the Interagency Committee of Oceanography by the National Security Industrial Association*, North Hollywood, Cal., 1966, 4 vols.
329. THOMAS, T.M., The North Sea Gas Bonanza, " *Tijdschrift voor Economische en Sociale Geografie* ". Vol. 59, 1968, No. 2, p. 57-70.
330. TOURNIER L., Recherches américaines sur des matériaux nouveaux pour coques des sous-marins à grande profondeur, " *Revue de défense nationale* ", January 1969, p. 130-144.
331. —, U.N. Reports on Sea Resources, " *Mechanical Engineering* ", September 1968, p. 96-97.
332. WALTHIER, THOMAS N., Remarks on the Mining of Deep Oceans Mineral Deposits, see: *item 1*, p. 98-99.
333. WEEKS, LOUIS G., Marine Geology: Economic Problems and Prospects, " *Annals of the New York Academy of Sciences* ", vol. 136, 1967, p. 549-574.
334. —, Offshore Operations Around the World, " *Offshore* ", June 20, 1967
335. WELLING, C.G., Undersea Mineral Exploration, " *Mining Congress Journal* ", January 1966, p. 32-35.
336. WILSON, THOMAS A., Harnessing System for Undersea Mining, " *Engineering and Mining Journal* ", 1965, No. 7, p. 64-67.
337. —, Offshore Mining Paves the Way to Ocean Mineral Wealth. *ibid.* No. 5, p. 124-132.

LIST OF PARTICIPANTS *

AMALDI, Edoardo (II).

Professor of Physics,

Viale Parioli 50, 00197 Roma, Italy.

AMERASINGHE, Hamilton Shirley (I).

Ambassador, Permanent Representative of Ceylon to the United Nations

Permanent Mission of Ceylon to the United Nations, 630 Third Avenue (20th floor), New York. N.Y. 10017, U.S.A.

ANDRASSY Juraj (II)

Professor of International Law, University of Zagreb

Opaticka 9, Zagreb, Yugoslavia.

ARANGIO-RUIZ, Gaetano (III)

Professor of International Law, University of Bologna and the John Hopkins University Center

Corso Trieste 51, 00198 Rome, Italy.

BETTINI, Emilio (I)

Deputy Permanent Representative of Italy to International Organisations

Geneva, Switzerland.

BOUCHEZ, Leo J. (I)

Reader in International Law, Utrecht University

Narberlaan 16, Utrecht, Netherlands

BRENNAN, Donald G. (I)

Expert on National Security Affairs, Hudson Institute

Quaker Ridge Road, Croton-on-Hudson, N.Y., 10520, U.S.A.

BROWN, Edward Duncan (I)

Senior Lecturer in International Law, University College London

4-8, Endsleigh Gardens, London W.C. 1, Great Britain.

CARROZ, J.E. (I)

Department of Fisheries, F.A.O.

00153 Rome, Italy

(*) Roman figures after names indicate the numbers of the respective Working Groups.

CHRISTY, Francis T., Jr. (I)
Social Scientist, Resources for the Future, Inc.
1755 Massachusetts Avenue, N.W., Washington, D.C., 20036, U.S.A.

CRAVEN, John P. (II)
Chief Scientist, Strategic Systems Project Office
Department of the Navy, Washington, D.C. 20360, U.S.A.

DURANTE, Francesco (II)
Professor of International Law, The University of Catania
Via Gibilmanna 13, 00146 Rome, Italy

EEK, Hilding (I)
Professor of International Law, Stockholm University
Tegnérsgatan 57, Stockholm, Sweden.

EICHELBERGER, Clark M. (III)
Director, Commission to Study the Organisation of Peace
866 United Nations Plaza, New York, N.Y., 10017, U.S.A.

EMERY, Kenneth O. (II)
Senior Scientist, Woods Hole Oceanographic Institution
Woods Hole, Mass., 02543, U.S.A.

EVENSEN, Jens (III)
Director General, Legal Department
Royal Ministry of Foreign Affairs, Oslo, Norway.

FEIGL, Hubert (III)
Physicist, Doctor of Nat. Sc., Stiftung Wissenschaft und Politik
Forschungsinstitut für Internationale Politik und Sicherheit, Haus Eggenberg,
8026 Ebenhausen/Isartal, Fed. Rep. of Germany.

GARDNER, Richard N. (III)
Henry L. Moses Professor of Law and International Organisation
Columbia University, New York, N.Y., 10027, U.S.A.

GASKELL, T.F. (II)
Marine Geologist, Scientific Adviser, British Petroleum Ltd.
Britannic House, Moor Lane, London E.C. 2, Great Britain.

GUILCHER, André J. (II)
Professor of Oceanography, Institute of Geography, University of Paris
191, rue Saint Jacques, Paris 5, France.

HAWKINS, G.R.S. (III)
Executive Director, Canadian Institute of International Affairs
31 Wellesley St. East, Toronto, Ontario, Canada.

HOLT, Sidney J. (III)
FAO Marine Science and Fishery Coordinator with UNESCO
Department of Fisheries, F.A.O., 00153 Rome, Italy.

HOUSSIN, J.P. (I)

Legal Adviser, Compagnie Française des Pétroles
5, rue Michel-Ange, Paris 16, France.

HUNT, Kenneth (II)

Deputy Director, Institute for Strategic Studies
18 Adam Street, London W.C. 2, Great Britain.

KOLODKIN, Anatoly L. (III)

Chief of Section, Research Institute of Maritime Transport
Bolshoy Koptevsky 6, Moskva A-319, U.S.S.R.

KOPAL, Vladimir (I)

Senior Scientist, Institute of State and Law, Czechoslovak Academy of Sciences
Narodni 18, Praha 1, Czechoslovakia.

KUSUMA-ATMADJA, M. (I)

Professor of Law, University of Bandung
Djalan Padjadjaran 2, Bandung, Indonesia.

MARTENSON Jan (II)

Assistant Director, SIPRI
Sveavägen 166, 113 46 Stockholm, Sweden.

McILQUHAM-SCHMIDT, W.F. (III)

Assistant Under-Secretary of State, Political and Legal Affairs
Royal Ministry of Foreign Affairs, Christianborg, København, Denmark

MENARD, H.W. *

Marine Geologist and Geophysicist, Scripps Institution of Oceanography
P.O.B. 109, La Jolla, Calif., 92037, U.S.A.

MENZEL Eberhard (II)

*Professor of International Law, Institute of International Law, The University
of Kiel*
Olshausenstrasse 40-60, 23 Kiel, Fed. Rep. of Germany.

MÜNCH Fritz (III)

Professor of International Law
Berlinerstrasse 48, 69 Heidelberg, Fed. Rep. of Germany.

VON MÜNCH, Ingo (I)

Professor of International Law
Wilhelmstrasse 44, 4324 Blankenstein/Ruhr, Fed. Rep. of Germany

MUSCARELLA, Giuseppe (III)

Manager, Technical Service, AGIP, S.p.A., Direzione Mineraria
C.P. 4174, 20110 Milan, Italy.

(*). Prof. Menard sent a written contribution but was unable to attend.

NIINO, Hiroshi (III)

Professor of Oceanography, Tokai University
42-7 Miyasaka 1 Chome, Setagayaku, Tokyo, Japan.

O'CONNELL, Daniel P. (III)

Professor of International Law, Faculty of Law,
University of Adelaide, Adelaide, Australia.

ODA, Shigeru (II)

Professor of International Law, Tohoku University
113 Kawauchi-Jutaku, Kawauchi, Sendai, Japan.

PARDO, Arvid (III)

Ambassador, Permanent Representative of Malta to the United Nations
Permanent Mission of Malta to the United Nations, 155 East 44th Street, New
York, N.Y., 10017, U.S.A.

POLVANI, Carlo (III)

*Director, Division of Radiation Protection, C.N.E.N. (National Committee for Nu-
clear Energy)*
Viale Regina Margherita 125, 00198 Rome, Italy.

REVELLE, Roger (III)

Richard Saltonstall Professor of Population Policy, Harvard University
Cambridge, Mass., 02138, U.S.A.

ROSENNE, Shabtai (III)

Ambassador, Permanent Mission of Israel to the United Nations
15 East 70th Street, New York, N.Y., 10021, U.S.A.

RUIVO, Mario (II)

Acting Director, Fishery Resources and Exploitation Division,
Department of Fisheries, F.A.O., 00153 Rome, Italy.

SCERNI, Mario (I)

Professor of International Law, University of Genoa
Viale Causa 6, 16145 Genova, Italy.

SCHAEFER, Milner B. (II)

*Professor of Oceanography; Director, Institute of Marine Resources, University of
California*
P.O.B. 109, La Jolla, Calif., 92037, U.S.A.

SCHWEBEL, Stephen M. (II)

Executive Vice-President and Director, American Society of International Law
2223 Massachusetts Avenue, N.W., Washington, D.C., 2008, U.S.A.

SCIOLLA LAGRANGE, A. (II)

Servizio del Contenzioso Diplomatico, Ministero degli Affari Esteri
Farnesina, 00194 Rome, Italy.

SELLI, A. (I)

Professor of Geology, University of Bologna.
Via Zamboni 33, 40126 Bologna, Italy.

SOHN, Louis B. (I)
*Bemis Professor of International Law, Harvard University; Chairman, Commission
to Study the Organization of Peace.*
866 United Nations Plaza, New York, N.Y., 10017, U.S.A.

SPINELLI, Altiero
Director, Istituto Affari Internazionali
Viale Mazzini 88, 00195 Rome, Italy.

TIRTAAMIDJAJA, N. (II)
United Nations Institute for Training and Research
801 United Nations Plaza, New York, N.Y. 10017, U.S.A.

YANKOV, Alexander (II)
Professor of International Law, State University of Sofia
Rakovski 153-A, Sofia, Bulgaria.

ZHUDRO, Andrey K. (I)
Head of Department, Research Institute of Maritime Transport,
Bolshoy Koptevsky 6, Moskva A-319, U.S.S.R.

Scientific Secretary of the Symposium:

SZTUCKI, Jerzy
Jur. dr., Institute of Law, University of Lund
Magistratsvägen 41 c, 222 43 Lund, Sweden.

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