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SEABED MINING

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Compiled by the Editors

of

Ocean Science News

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Editor's Note

The documents contained in this volume are in all cases reproductions of the originals -- as delivered in Caracas, the summer of 1974; made available in New York City by the U. N.; or gathered in various places by the reporters and editors of Ocean Science News.

No attempt has been made to edit the documents, merely to shorten them where the repetition is obvious.

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Office of Public Information
United Nations, N.Y.

(FOR USE OF INFORMATION MEDIA -- NOT AN OFFICIAL RECORD)

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Press Release SEA/18
28 May 1974

THIRD UNITED NATIONS CONFERENCE ON LAW OF SEA TO MEET AT CARACAS, 20 JUNE-29 AUGUST

Goal is to Adopt Comprehensive Convention and Set Up Machinery To Regulate International Sea-Bed Area

Nearly 150 nations have been invited to gather in June at Caracas in an effort to write a new set of binding international rules governing human activities in the two thirds of the earth's area covered by oceans.

The Third United Nations Conference on the Law of the Sea, meeting in the Venezuelan capital for 10 weeks from 20 June to 29 August, has been convened by the United Nations General Assembly "to adopt a convention dealing with all matters relating to the law of the sea".

As part of this task, the Conference will seek to create a body of rules and an international machinery governing the area and resources of the vast reaches of ocean bottom that lie beyond the jurisdiction of any State. The aim will be to write laws acceptable to all nations for the once impenetrable ocean depths that have been called the last frontier of man on earth -- a vast storehouse of minerals and energy that humanity is quickly learning how to exploit.

The subjects for the Conference were set out by the General Assembly in 1970, in resolution 2750 C (XXV). They are, in the words of the resolution:

-- The establishment of an equitable international regime -- including an international machinery -- for the area and the resources of the sea-bed and the ocean floor, and the subsoil thereof, beyond the limits of national jurisdiction;

-- A precise definition of the area;

-- A broad range of related issues including those concerning:

  -- The regimes of the high seas, the continental shelf, the territorial sea (including the question of its breadth and the question of international straits) and contiguous zone;

(more)

-- Fishing and conservation of the living resources of the high seas (including the question of the preferential rights of coastal States);

-- The preservation of the marine environment (including the prevention of pollution);

-- Scientific research.

In deciding last November that the mandate of the Conference should be to adopt a convention dealing with all matters relating to the law of the sea, the Assembly asked the Conference to bear in mind "that the problems of ocean space are closely interrelated and need to be considered as a whole".

Five years of preparatory work have gone into this Conference, beginning with studies on an international regime for the sea-bed and later expanding into all of the other highly complex and interrelated aspects of sea law. Hundreds of draft treaty articles, submitted by dozens of States, have been sifted by a preparatory body set up by the General Assembly in 1968 -- the Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor beyond the Limits of National Jurisdiction.

One of the main documents before the Conference will be the six-volume, 1,060-page report of the Sea-Bed Committee on its 13 weeks of meetings at New York and Geneva last year. The report sets out the Committee's attempts to consolidate these proposals into draft articles -- mostly in several alternative versions for each article -- on which the Conference can base its work.

The Conference held an organizational session at United Nations Headquarters from 3 to 15 December, at which it elected its officers, decided on its committee structure and began discussing its draft rules of procedure. H. Shirley Amerasinghe (Sri Lanka), who was Chairman of the Sea-Bed Committee from 1969 until it was dissolved last December, was unanimously elected President of the Conference.

Most of the substantive work of the Conference is to be carried on in three main committees of the entire membership. According to present plans which await formal approval by the Conference, Committee I will deal with the international regime and machinery for the sea-bed, Committee II with other aspects of the law of the sea, and Committee III with preservation of the marine environment and scientific research.

(The officers of the Conference and its committees are listed at the end of this release.)

Foreseeing that still more work might be needed after the Caracas session, the Assembly decided last November, "if necessary, to convene not later than 1975 any subsequent session or sessions as may be decided upon by the Conference and approved by the General Assembly" /resolution 3067 (XXVIII)/. The Government of Vienna, as noted in the Assembly resolution, has offered Vienna as the site for the Conference in 1975.

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Earlier Conferences on Sea Law

The first United Nations Conference on the Law of the Sea met at Geneva in 1958, with 86 States participating, and produced four international conventions. They cover the territorial sea and contiguous zone, the high seas, fishing and conservation of the living resources of the high seas, and the continental shelf. There is also an Optional Protocol of Signature concerning the Compulsory Settlement of Disputes.

The Convention on the Territorial Sea and Contiguous Zone provides that the sovereignty of a State extends over its territorial sea. It includes rules for determining the baseline from which the territorial sea is measured, but does not specify the width of this zone. It also deals with the jurisdiction of the coastal State over the zone contiguous to the territorial sea. (46 States are parties; in force since 1964.)

The Convention on the High Seas provides for freedom of the high seas and deals with specific problems, including the nationality of ships, piracy, pollution and submarine cables. (54 parties; in force since 1962.)

The Convention on Fishing and Conservation of the Living Resources of the High Seas contains a general obligation to adopt conservation measures when necessary, supplemented by other specific obligations. (35 parties; in force since 1966.)

The Convention on the Continental Shelf gives coastal States exclusive rights to exploitation of the mineral and other non-living resources of the continental shelf, but specifies that those rights shall not affect the high seas lying above the shelf. (53 parties; in force since 1964.)

The Optional Protocol of Signature concerning the Compulsory Settlement of Disputes provides for resort to arbitration, conciliation or the International Court of Justice to settle disputes over the interpretation of any of the Conventions on the Law of the Sea. (34 parties; in force since 1962.)

A second Conference was called by the General Assembly in Geneva in 1960 to seek to resolve disagreements over the breadth of the territorial sea and fishery limits. However, the 82 States represented were unable to adopt any substantive proposal on these matters.

Sea-Bed Committees Established

It was not until 1967 that legal questions involving the sea were again the subject of an Assembly resolution. At that time the Assembly created the first Committee on the sea-bed, a 35-member ad hoc body which was replaced the following year by the Committee that later became the preparatory body for the Law of the Sea Conference. Originally consisting of 42 members, the second Committee was twice enlarged until it became a 91-member body in 1971.

(more)

One of the initial tasks of the Committee when it was set up under Assembly resolution 2467 A (XXIII) of 1968 was to elaborate legal principles and norms for international co-operation in the exploration and use of the sea-bed and ocean floor. The Committee devoted most of its first two years to this effort, leading up to the adoption by the Assembly in 1970 of the Declaration of Principles Governing the Sea-Bed and the Ocean Floor, and the Subsoil Thereof, beyond the Limits of National Jurisdiction (resolution 2749 (XXV)).

The Declaration, the first internationally agreed set of principles covering this vast area of ocean space, begins with the principle that the international area of the sea-bed and its resources "are the common heritage of mankind" and shall not be subject to appropriation by any means by States or persons". (For further details of the Declaration, see the section on the sea-bed below.)

The Committee's discussions on the Declaration of Principles brought out clearly that the issues of the law of the sea are closely intertwined -- that it is impossible to consider one part of ocean space without reference to the other parts. Accordingly, at the same time that it adopted the Declaration the Assembly decided that it would convene the Third United Nations Conference on the Law of the Sea.

Beginning in 1971, therefore, the Committee's work was broadened to cover all aspects of the law of the sea, focusing on preparations for the Conference. It conducted much of its work in three sub-committees of the whole, with the following mandates:

Sub-Committee I -- to prepare draft treaty articles embodying the international regime, including an international machinery, for the area and resources of the sea-bed beyond the limits of national jurisdiction.

Sub-Committee II -- to prepare a comprehensive list of subjects and issues relating to the law of the sea and to prepare draft treaty articles thereon.

Sub-Committee III -- to deal with the preservation of the marine environment (including the prevention of pollution) and scientific research, and to prepare draft treaty articles thereon.

(This sub-committee structure provided the model followed by the Conference in dividing its work among three main committees.)

The pattern of work followed by each sub-committee was roughly the same: a general debate on the main issues, followed by the creation of working groups which attempted to prepare draft treaty articles on the basis of proposals and working papers submitted by delegations. Politicians, lawyers, economists, technicians and scientists held no fewer than 469 formal meetings and countless informal ones between 1970 and 1973, including 104 meetings of the Committee, 204 meetings of the sub-committees and 161 meetings of working groups.

(more)

List of Subjects and Issues

Before the treaty drafting work could begin in earnest, however, the Committee had first to agree on a list of subjects and issues relating to the law of the sea -- a kind of skeleton on which to hang the flesh of treaty articles. This assignment, given to the Committee by the Assembly in 1970, took two years to accomplish -- another reflection of the complexity and interrelatedness of the issues involved. The result was a list of 25 main headings and a number of subheadings, drafted by Sub-Committee II and approved by the Committee in 1972 (document A/8721, pages 5-8). The Assembly decided last year that this list should be taken into account by the Conference when it goes about its task of adopting a convention.

The 25 main headings follow, with an indication of the issues which the Committee singled out under each one:

1. International regime for the sea-bed and the ocean floor beyond national jurisdiction: Six issues are listed under this heading: nature and characteristics; structure, functions and powers of the international machinery; economic implications; equitable sharing of benefits bearing in mind the special interests and needs of the developing countries, whether coastal or land-locked; definition and limits of the area; and its use exclusively for peaceful purposes.

2. Territorial sea: The list identifies four main aspects for study in regard to this area (the zone which is closest to the coast and subject to the coastal State's sovereignty): nature and characteristics, including the question of the unity or plurality of regimes in the territorial sea; historic waters (those traditionally belonging to a particular State); limits; innocent passage in the territorial sea; and freedom of navigation and overflight resulting from the question of plurality of regimes in the territorial sea.

The issue of limits is further subdivided into two parts: first, question of the delimitation of the territorial sea and the various aspects involved; and second, breadth of the territorial sea, whether global or regional criteria should be used, and the different issues raised by open seas and oceans, semi-enclosed seas and enclosed seas.

3. Contiguous zone: This was defined in the 1958 Convention on the Territorial Sea and the Contiguous Zone as an area beyond the territorial sea but no more than 12 miles from the coast. The list of subjects and issues gives three subheadings: nature and characteristics; limits; and rights of coastal States with regard to national security, customs and fiscal control.

4. Straits used for international navigation: To be dealt with under this heading are innocent passage as well as other related matters including the question of the right of transit.

(more)

5. Continental shelf: The 1958 Convention on the Continental Shelf says this term is used as referring "(a) to the sea-bed 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 admits of the exploration 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".

The list of subjects and issues cites five aspects of this topic: nature and scope of the sovereign rights of coastal States over the continental shelf, and duties of States; applicable criteria for the outer limit of the continental shelf; question of the delimitation between States and various aspects involved; natural resources of the continental shelf; and scientific research.

6. Exclusive economic zone beyond the territorial sea: This concept, also referred to as "patrimonial sea" by many Latin American States, is not mentioned in the 1958 Law of the Sea Conventions. Nine aspects are cited in the list of subjects and issues: nature and characteristics, including rights and jurisdiction of coastal States in relation to resources, pollution control and scientific research in the zone, as well as duties of States; resources of the zone; freedom of navigation and overflight; regional arrangements; applicable criteria for limits; fisheries; sea-bed within national jurisdiction; prevention and control of pollution and other hazards to the marine environment, including rights and responsibilities of coastal States; and scientific research.

The fisheries aspect is further broken down into exclusive fishery zone, preferential rights of coastal States, management and conservation, protection of coastal States' fisheries in enclosed and semi-enclosed seas, and regime of islands under foreign domination and control in relation to zones of exclusive fishing jurisdiction. The subtopic of the sea-bed within national jurisdiction is also subdivided -- into nature and characteristics, delineation between adjacent and opposite States, sovereign rights over natural resources, and applicable criteria for limits.

7. Coastal State preferential rights or other non-exclusive jurisdiction over resources beyond the territorial sea: Seven aspects of this topic are recognized in the list of subjects and issues: nature, scope and characteristics; sea-bed resources; fisheries; prevention and control of pollution and other hazards to the marine environment; international co-operation in the study and rational exploitation of marine resources; settlement of disputes; and other rights and obligations.

8. High seas: The broad area of the sea beyond national jurisdiction is to be looked at from six aspects, according to the list of subjects and issues: nature and characteristics; rights and duties of States; question of the freedom of the high seas and their regulation; management and conservation of living resources; slavery, piracy and drugs; and hot pursuit.

(more)

9. Land-locked countries: The list singles out four aspects of this topic: general principles of the law of the sea concerning the land-locked countries, rights and interests of land-locked countries, particular interests and needs of developing land-locked countries in the international regime for the sea-bed, and rights and interests of land-locked countries in regard to living resources of the sea.

Rights and interests of land-locked countries include free access to and from the sea through freedom of transit as well as means and facilities for transport and communications; equality of treatment in the ports of transit States; free access to the international sea-bed area beyond national jurisdiction; and participation in the international regime, including the machinery and the equitable sharing in the benefits of the area.

10. Rights and interests of shelf-locked States and States with narrow shelves or short coastlines: Shelf-locked States are those whose continental shelves do not open out onto the high seas; examples are countries bordering certain large seas such as the Mediterranean and Caribbean. These and other categories of "disadvantaged" States dealt with under this topic would have their rights and interests examined from four aspects, according to the list of subjects and issues: international regime, fisheries, special interests and needs of developing shelf-locked States and States with narrow shelves or short coastlines, and free access to and from the high seas.

11. Rights and interests of States with broad shelves.

12. Preservation of the marine environment: Five subheadings are given: sources of pollution and other hazards and measures to combat them, measures to preserve the ecological balance of the marine environment, responsibility and liability for damage to the marine environment, rights and duties of coastal States, and international co-operation.

13. Scientific research: Nature, characteristics and objectives of scientific research of the oceans is the first of three subheadings. The others are access to scientific information and international co-operation.

14. Development and Transfer of technology: The subject matter, as set out in the list of subjects and issues, concerns the development of technological capabilities of developing countries through sharing of knowledge and technology between developed and developing countries, training of personnel from developing countries and transfer of technology to developing countries.

15. Regional arrangements.

16. Archipelagos.

17. Enclosed and semi-enclosed seas.

18. Artificial islands and installations.

(more)

19. Regime of islands: This covers islands under colonial dependence or foreign domination or control as well as other related matters.

20. Responsibility and liability for damage resulting from the use of the marine environment.

21. Settlement of disputes.

22. Peaceful uses of the ocean space; zones of peace and security.

23. Archaeological and historical treasures on the sea-bed and ocean floor beyond the limits of national jurisdiction.

24. Transmission from the high seas.

25. Enhancing the universal participation of States in multilateral conventions relating to the law of the sea.

Sea-Bed Regime and Machinery

The foundation for the Sea-Bed Committee's work in seeking agreement on a body of rules and an organization for the international sea-bed area was the General Assembly's 1970 Declaration of Principles. In condensed form, these are as follows:

1. The area and its resources "are the common heritage of mankind".

2. "The area shall not be subject to appropriation by any means by States or persons, natural or juridical, and no State shall claim or exercise sovereignty or sovereign rights over any part thereof."

3. No State or person shall claim, exercise or acquire rights with respect to the area or its resources incompatible with the international regime to be established and the principles of this Declaration.

4. All exploration and exploitation activities shall be governed by the international regime.

5. "The area shall be open to use exclusively for peaceful purposes by all States, whether coastal or land-locked, without discrimination, in accordance with the international regime to be established."

6. "States shall act in the area in accordance with the applicable principles and rules of international law ... and the interests of maintaining international peace and security and promoting international co-operation and mutual understanding."

(more)

7. Exploration and exploitation "shall be carried out for the benefit of mankind as a whole, irrespective of the geographical location of States, whether land-locked or coastal, and taking into particular consideration the interests and needs of the developing countries".

8. "The area shall be reserved exclusively for peaceful purposes" and agreements shall be concluded as soon as possible to constitute a step towards the exclusion of the area from the arms race.

9. On the basis of these principles, an international regime for the area and its resources, including international machinery to give effect to its provisions, shall be established by "an international treaty of a universal character, generally agreed upon". "The regime shall, inter alia, provide for the orderly and safe development and rational management of the area and its resources and for expanding opportunities in the use thereof, and ensure the equitable sharing by States in the benefits derived therefrom, taking into particular consideration the interests and needs of the developing countries, whether land-locked or coastal."

10. States shall promote international co-operation in scientific research exclusively for peaceful purposes.

11. States shall co-operate in the adoption and implementation of international rules, standards and procedures for the prevention of pollution and other hazards to the marine environment as well as for the protection and conservation of natural resources and the prevention of damage to flora and fauna.

12. States shall pay due regard to the rights and legitimate interests of coastal and other States affected by their activities in the area. Coastal States shall be consulted with a view to avoiding infringement of their rights and interests.

13. Nothing in the Declaration shall affect the legal status of the waters or air space above the international sea-bed area, or the rights of coastal States to prevent, mitigate or eliminate grave and imminent danger to their coastline or related interests from pollution or other hazardous occurrences, subject to the international regime to be established.

14. Every State and international organization is responsible for ensuring that activities in the area by those under its jurisdiction or acting on its behalf shall conform to the international regime. "Damage caused by such activities shall entail liability."

15. The parties to any dispute relating to activities in the area and its resources shall resolve such dispute by the measures for peaceful settlement mentioned in Article 33 of the United Nations Charter and such procedures for settling disputes as may be agreed on in the international regime.

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Drafting work for treaty articles on an international regime and machinery for the sea-bed began in a working group of Sub-Committee I in 1972. Starting from an informal working paper intended to reflect areas of agreement and disagreement, the drafting process was carried out in two stages -- a first reading designed to ensure that the opinions of members were fully and accurately reflected in the paper, and a second reading in which members sought to narrow the areas of disagreement as far as possible and to merge alternative texts where there was no fundamental difference of approach.

As regards the international regime, the Working Group carried out a first reading of texts relating to the limits of the sea-bed area, and completed a second reading of texts concerning the following 20 subjects: the common heritage of mankind; activities regarding exploration and exploitation; non-appropriation or claim or exercise of sovereignty or sovereign rights, or of rights incompatible with the treaty rights, and the non-recognition of any such claims or exercise of rights; use of the area by all States without discrimination; general conduct in the area and in relation to the area; benefit of mankind as a whole; preservation of the area exclusively for peaceful purposes; who may exploit the area; general norms regarding exploitation; scientific research; transfer of technology; protection of the marine environment; protection of human life; due regard to the rights of coastal States; legal status of waters superjacent to the area;accommodation of activities in the marine environment and in the area; responsibility to ensure observance of the international regime and liability for damages; access to and from the area; archaeological and historical objects; and settlement of disputes.

With regard to international machinery, the Working Group completed its second reading of texts concerning the following subjects: the Assembly and its powers and functions; the Council and its powers and functions; the system of settlement of disputes (including the Tribunal); and an operating agency or bodies, variously called the Enterprise, operations commission, permanent board, management and development commission, international sea-bed operations organization, exploration and production agency, and exploitation commission.

A first reading was completed of texts relating to the following aspects of the machinery: establishment of the machinery; nature of the sea-bed authority; status of the authority; operation of vessels and emplacement of installations by the authority; installations and other facilities for the exploration of the area and the exploitation of its resources; privileges and immunities; relationships with other organizations; fundamental principles of the functioning of the authority; purposes of the authority; powers and functions of the authority; principal organs of the authority; the secretariat; various proposed bodies, including a rules and recommended practices commission, planning/price stabilization commission, scientific and technological commission, legal commission, international sea-bed boundary review commission, and inspection and conservation commission; and miscellaneous provisions.

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The texts produced by the Working Group of Sub-Committee I, "illustrating areas of agreement and disagreement", occupy 127 pages of the Committee's final report (document A/9021, volume II, pages 39-165). In most cases, two or more alternative texts are given for each draft article.

In addition to these subjects, delegations in the Working Group suggested a number of other matters which might need to be dealt with, including general rules and regulations regarding exploration of the area and exploitation of its resources, integrity of investments, regional arrangements, the participation of disadvantaged countries, a statute for the Tribunal, criteria for the sharing of benefits, the parties to the treaty, and transitional provisions. Not all delegations accepted this list in its entirety.

The Secretary-General will submit to the Conference a study on the economic implications of sea-bed mining. This will be a follow-up to earlier papers presented to the Sea-Bed Committee in response to Assembly resolution 2750 A (XXV) of 1970.

The first of these papers, issued in 1971, noted that technological developments would eventually make deep-sea petroleum and manganese nodule exploitation not only technically possible but also commercially feasible. It predicted that petroleum markets were unlikely to be affected significantly by such developments, because of the higher costs of deep-water production and the abundance of on-shore and shallow-water petroleum. However, it held that future exploitation of manganese nodules lying on the ocean bottom might become an important source of the world's nickel requirements and might eventually become a major source of cobalt supply as well, in addition to supplying a minor proportion of copper needs.

General Aspects of Sea Law

Sub-Committee II, which drew up the list of issues and topics in 1972, began work on draft articles in March 1973, when its Working Group started meeting. After a preliminary discussion on how to go about the drafting, the Group decided that the subjects and issues assigned to it would not be examined one by one or in groups, but should be regarded as forming part of one whole.

A comparative table was drawn up for the Group in July, setting out all 70 texts submitted by delegations, arranged according to the headings and subheadings in the list of subjects and issues (document A/9021, Vol. V). For some of these subjects consolidated texts were prepared, making possible a more direct comparison of the various proposals provision by provision (document A/9021, Vol. VI).

Using these two compilations as a tool, the Working Group decided to present variant (alternative) texts which might, where appropriate, form the basis of draft articles. Delegations presented many variants during the Group's last few meetings in August, and informal consultations made it possible to effect some reduction in the number of variants (document A/9021, Vol. IV). However, it was recognized in the Working Group that the presentation or non-presentation of variants by delegations did not commit them to a particular position or signify support for one or the other variants presented, inasmuch as Governments' official proposals were lodged individually with Sub-Committee II.

The 161 pages of variants deal with such subjects and issues as the nature and characteristics of the territorial sea, the delimitation of the territorial sea, the breadth of the territorial sea, innocent passage, straits, archipelagos, the exclusive economic zone, the continental shelf, preferential rights and duties of coastal States, rights and interests of land-locked and geographically disadvantaged countries, regional arrangements, and certain aspects of fishing on the high seas.

Marine Environment, Science and Technology

The main subjects examined by Sub-Committee III were preservation of the marine environment, scientific research, and the development and transfer of technology.

The group known as Working Group 2 began its drafting on the marine environment in March 1973. Basing itself on proposals submitted to the Sub-Committee by delegations, the Working Group discussed the following subjects: general obligation to preserve and protect the marine environment; general obligation of States to adopt measures to prevent pollution of the marine environment, irrespective of the source of pollution; obligation of States to prevent damage from marine pollution; particular obligation of States to adopt specific measures in connexion with certain sources of marine pollution, and the relation between such measures and generally accepted international standards; global and regional co-operation; technical assistance; monitoring; standards; and enforcement.

Informal consultations were then held under the Working Group's auspices, between sponsors of the various proposals and other delegations. They were able to produce a number of texts -- usually in alternative versions -- for draft articles on many of these subjects, but the Working Group as a whole did not have time to examine those texts, which are reproduced in the Committee's 1973 report (document A/9021, Vol. I, pages 86-89 and 91-105).

Working Group 3 of Sub-Committee III began discussing the various proposals on scientific research in April 1973. Its discussions covered the definition and objectives of marine scientific research, the conduct and promotion of marine scientific research, and the prerequisites for the conduct of such research. Informal consultations produced several alternative versions of texts for draft articles on this subject (document A/9021, Vol. I, pages 103-105), but the Working Group as a whole did not have time to examine them.

As to development and transfer of technology, Sub-Committee III completed a general debate on this topic but its Working Group 3 did not have time to begin work on draft articles.

Conference Procedure

The second session of the Conference is to be opened by its President at 3 p.m. Thursday, 20 June, at Parque Central, a new complex of commercial and residential buildings near the centre of Caracas. Following a minute of silence for prayer or meditation, the Conference will hear an address by the President of Venezuela, Carlos Andres Perez.

Press Release SEA/18
28 May 1974

The next order of business will be adoption of the rules of procedure. This was to have taken place during the organizational session held in New York last December, but disagreements persisted over the question of how decisions are to be taken by the Conference, including rules for voting.

The question of decision-making at the Conference had been discussed by the General Assembly, which approved last November the following "gentlemen's agreement" reached between delegations:

"Recognizing that the Conference at its inaugural session will adopt its procedures, including its rules regarding methods of voting, and bearing in mind that the problems of ocean space are closely interrelated and need to be considered as a whole and the desirability of adopting a Convention on the Law of the Sea which will secure the widest possible acceptance,

"The General Assembly expresses the view that the Conference should make every effort to reach agreement on substantive matters by way of consensus; that there should be no voting on such matters until all efforts at consensus have been exhausted; and further expresses the view that the Conference at its inaugural session will consider devising appropriate means to that end."

When it proved impossible to reach agreement on this issue in December, the Conference agreed to a proposal by its President that he hold informal consultations on the matter in New York from 25 February to 1 March 1974. It further agreed that the decision in regard to the rules should be taken by the Conference in Caracas not later than 27 June, if necessary by voting. The understanding agreed to by the Conference was that the rules would be adopted by a simple majority unless the Conference decided that this constituted an important question requiring a two-thirds majority.

Informal consultations were held as scheduled from 25 February to 1 March, and it was agreed at that time that the contacts would resume in New York from 12 to 14 June.

Draft rules of procedure were drawn up last November by the Secretariat (document A/CONF.62/2 and Add.1-3), "designed to facilitate as far as possible the search for the broadest possible agreement on any matter of substance, before a formal vote is taken by a committee or by the Conference". To this end, what has been described in the debate as a "cooling-off period" is provided for in the draft rules, under the requirement that, if there is any objection to taking a vote, a main committee would secure the permission of the Conference before voting. Both in the Conference and in any committee the presiding officer would have authority to defer taking a vote for a given period.

The draft rules follow the rules of the General Assembly in requiring a simple majority vote for the adoption of proposals in committee and a two-thirds majority in plenary. Abstaining or absent delegations would not be counted in determining whether a majority exists.

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Several amendments to this procedure have been proposed. Two of them would require larger majorities for substantive decisions: a two-thirds majority of States participating in the Conference and not just of those voting "yes" or "no" (United States), and a nine-tenths majority of those present and voting (Soviet Union). Other proposed amendments would change the "cooling-off" procedure in a variety of ways.

On other matters, the draft rules provide for a 48-member General Committee to assist the President in the conduct of the business of the Conference, ensure the co-ordination of its work, and make recommendations to further the progress of the Conference. Its members are the President, Vice-Presidents and Rapporteur-General of the Conference and the officers of the three main committees; the Chairman of the Drafting Committee may participate in the General Committee without the right to vote.

There is also a 23-member Drafting Committee and a nine-member Credentials Committee.

Conference Participants

The General Assembly has invited to the Conference the 135 Members of the United Nations and the other States (now numbering 13) which are members of one or more specialized agencies. It also invited the Republic of Guinea-Bissau (which has since become a member of a specialized agency -- the Food and Agriculture Organization) and the Democratic Republic of Viet-Nam. The latter declined the invitation last November, however, because the Provisional Government of the Republic of South Viet-Nam had not been invited (document A/9350).

In addition to these 149 States, the Assembly requested the Secretary-General to invite the United Nations Council for Namibia, the specialized agencies of the United Nations, and the International Atomic Energy Agency. Other intergovernmental bodies and interested non-governmental organizations having consultative status with the Economic and Social Council are also to be invited to attend.

The draft rules of procedure provide that observers for intergovernmental organizations may participate without vote in the Conference and its main committees and subsidiary organs, on the invitation of the presiding officer and on questions within the scope of their activities. They may also have written statements distributed to delegations. International non-governmental organizations would have the right, under the draft rules, to designate observers who could attend public meetings of the Conference and its main committees, make oral statements on the presiding officer's invitation and subject to the approval of the body concerned, and have written statements distributed.

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Press Release SEA/18
28 May 1974

Officers of Conference

The officers of the Conference, elected at the organizational session in December, are as follows:

President: H. Shirley Amerasinghe* (Sri Lanka)

Vice-Presidents (31): Algeria, Belgium, Bolivia, Chile, China, Dominican Republic, Egypt, France, Iceland, Indonesia, Iran, Iraq, Kuwait, Liberia, Madagascar, Nepal, Nigeria, Norway, Pakistan, Peru, Poland, Singapore, Trinidad and Tobago, Tunisia, Uganda, USSR, United Kingdom, United States, Yugoslavia, Zaire and Zambia.

Rapporteur-General: Kenneth Rattray (Jamaica)

Committee I (international sea-bed regime and machinery):

Chairman: Paul Bamela Engo (United Republic of Cameroon)

Vice-Chairmen: Brazil, German Democratic Republic and Japan

Rapporteur: H. Charles Mott (Australia)

Committee II (general aspects of law of the sea):

Chairman: Andres Aguilar (Venezuela)

Vice-Chairmen: Czechoslovakia, Kenya and Turkey

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Constantin A. Stavropoulos has been appointed by Secretary-General Kurt Waldheim as his Special Representative to the Conference (biographical note in Press Release BIO/1102 of 24 May). The Executive Secretary of the Conference is David L.D. Hall.

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* For biographical note see Press Release BIO/1074-SEA/4 of 3 December 1973.

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FIRST COMMITTEE

Note by the Chairman

In order to assist the Committee in the consideration of the questions relating to economic implications of sea-bed mining, the Chairman of the First Committee has prepared the following note containing the major summaries and conclusions of the pertinent documents presented to the Conference.

1. Basic documents

- Economic Implications of Sea-Bed Mineral Development in the International Area: Report of the Secretary-General (A/CONF.62/25)
- Statement made by G. D. Arsenis on behalf of the Secretary-General of UNCTAD (A/CONF.62/32)
- The effects of possible exploitation of the sea-bed on the earnings of developing countries from copper exports: Report of the UNCTAD secretariat (TD/B/484)
- The effects of production of manganese from the sea-bed, with particular reference to effects on developing countries producers of manganese ore (TD/B/483)
- Exploitation of the mineral resources of the sea-bed beyond national jurisdiction: case study of cobalt (TD/B/449/Add.1)
- Exploitation of the mineral resources of the sea-bed beyond national jurisdiction: issues of international commodity policy. Note by the UNCTAD secretariat (TD/B/449)
- Mineral production from the area of the sea-bed beyond national jurisdiction: issues of international commodity policy (TD/113/Supp.4).

II. Summary and conclusions of the Report of the Secretary-General (A/CONF.62/25)

1. This summary provides a brief review of the contents of the report. In view of the complexity of the subject, however, it necessarily omits much of the analyses and accordingly should not in any sense be taken as a substitute for the text of the report itself.

2. Manganese nodules are the most likely deep-sea minerals to be exploited in the foreseeable future. Nodules are composed of fine-grained oxide material and are distributed widely over the floor of the world ocean. They vary widely in their composition, as well as in their physical and chemical properties. There is now considerable commercial interest in exploiting them for their component metals, chiefly nickel, copper, cobalt and manganese.

3. Only about 3 per cent of the sea floor has been extensively surveyed. However, intensive exploration in recent years has revealed enough about the extent and location of deposits to permit commercial exploitation of nodules. Potential commercial deposits exist in the Pacific and Indian Oceans, while none have yet been located in the Atlantic Ocean.

4. Various commercial groups have completed the exploration or prospecting phase and are now evaluating potential mine sites. Site evaluation focuses on estimating the average concentrations of the constituent metals in nodules and on the nodule density per unit area of the mine site. These are the key parameters which, with bottom topography, affect the potential profitability of a mine site. There is great interest in the central Pacific region, which contains extensive concentrations of higher value nodules. Within this region, some evidence suggests that nodules with the highest potential value are concentrated in an east-west belt between 6°N and 20°N latitude and extending between 110°W and 180°W longitude.

5. The physical problem of recovering the nodules from the sea floor is proving to be a difficult one. As surficial deposits, nodules will be dredged and either pumped or hoisted from the sea floor. At the surface facility the nodules will then be loaded into barges or ore carriers for transportation to a processing plant. Under hydraulic lifting systems the nodules must be concentrated within a relatively small area so that the suction system can operate efficiently; this gathering process seems to be one of the most serious stumbling blocks in test operations.

6. Several national Governments have been and are involved in nodule mining through various forms of direct and indirect subsidization of mining activities. They have funded research on exploration, offered tax relief and the use of government facilities for research on processing, and in some cases Governments are contemplating direct participation in mining ventures.

7. By most estimates, it appears that nodule mining will prove to be a commercially profitable operation. Although the physical, technical and logistic problems are formidable, the existing technological capability can allow the industry to work. The question of the probable impact of sea-bed mining on world markets centres on the degree of competitiveness between marine and land-based sources of metal supply. To be

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rigorous, a study of this question would require a comparison of the relative supply costs of these two sources. This is not practicable for the following reasons: (a) most information on estimated costs of individual firms or consortia is still proprietary and closely guarded; (b) as the industry matures costs will drop from initial levels due to a "learning-by-doing" effect. Also, technical progress in engineering, materials, and design will serve to further reduce costs over time; (c) the range of costs among land-based producers is extremely wide, making it difficult to find a uniform supply price for land-based producers as a whole; (d) the profitability of nodule mining, the volume of production, and the impact on prices will be affected by the nature and extent of any regulation of the industry by the Sea-Bed Authority.

8. Therefore, in order to approximate the likely impact of nodule mining, certain assumptions must be made to facilitate the analysis. In this report, the assumptions made are based on the latest information available, on the discernible trends, and on the known plans of sea-bed miners.

9. Given the state of preparedness of the industry, commercial metal production from nodules could commence toward the end of the decade, though nodule mining might start as early as 1976. The decision to go ahead and begin production will depend on whether: (a) the firms feel that their mining and metallurgical processing technology is economically viable; (b) that they are on safe legal grounds with security of investment and assurance of exclusive access to their chosen mine sites; and (c) that they have adequate financing for their ventures. Once the go-ahead decision is made, it is assumed that commercial operations can commence within three to five years.

10. Perhaps the most critical assumptions deal with the expected rate of development of the nodule industry, the average grade of nodules processed, the constituent metals to be recovered and the metallurgical yields. Metal production from nodules will be affected by the pattern in which new operations enter the field each year and by increases in capacity of existing operations. Economies of scale will dictate the size of individual operations; the likely sizes being of 1 and 3 million ton capacities. Six groups are expected to be in operation by 1985, the total volume of dry nodules being processed in that year amounting to 15 million tons.

11. According to most experts, nickel will be the mainstay of the nodule industry. Copper, cobalt and nickel will be produced jointly, with manganese and several trade metals probably being produced as by-products from the tailings. As a guideline for their own planning, nodule miners look for a combined nickel and copper content equal to 3 per cent of the dry weight of nodules. Other metals will be recovered if the additional costs of processing are covered by the additional revenues from these metals, which in turn depends on their prices. Thus, there can be no uniform, industry-wide assumptions about production of other metals. For example, industry plans vary widely with respect to manganese production, not only regarding its volume but also its form, i.e. ore, ferromanganese or manganese metal.

12. For nickel, a minimum 6 per cent per annum long-term growth rate is assumed. In 1972, the share of developing countries in world production of nickel was only 13 per cent, although this share is expanding rapidly. Production from nodules might amount to 18 per cent of the total world demand in 1985. This volume of production would depress prices somewhat, but the impact would be lessened by the good growth prospects for

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nickel, and by the fact that developing producers account for a small share of the total market. Nickel production from nodules might cause some high cost laterite projects under consideration to be abandoned, but it should not have a serious effect on land-based production as a whole.

13. The world market for copper is huge compared to that for nickel, being about 14 times the size of the nickel market in 1972. Copper prices rose dramatically from 1970-1974, reaching a record level of $US 1.10/lb. in early 1974. Of the metals contained in nodules, copper production is the least concentrated among producers. It is expected that the demand for copper will show an annual percentage growth rate of 4-5 per cent to the end of the century. Production from nodules might supply about 1.3 per cent of world consumption in 1985 and would displace only 5.5 per cent of the net import requirements of developed countries by that time. Copper production from nodules is expected to have a minimum impact on a relatively large, growing and somewhat diffuse market.

14. Manganese might be recovered from nodules in two forms, either as pure metal or as ore-equivalent. More than 90 per cent of the manganese produced is used in the form of ferromanganese in the manufacture of steel; thus the rate of growth in its consumption will tend to parallel that of steel production. On the other hand, the market for manganese metal is relatively small. Metal production from one operation of 1 million tons/year in 1985 might amount to twice the volume of projected demand. Therefore, manganese metal supply from nodules would depress prices. Depending on the form and volume of manganese recovery from nodules, the export earnings of developing country producers might drop significantly. However, with just one exception, developing countries are not dependent upon manganese exports to a great degree.

15. Cobalt is a relatively expensive metal with a small market, and its value in world commodity trade is rather small. By 1985, production from nodules could account for about half the volume of world output while effecting a drop in price to about two thirds of current levels.

16. The long-term prospects of the nodule industry are tied closely to nickel and copper. In the long-term, if capacity expansion in sea-bed mining was sufficiently large to depress the price of nickel to approximately the price of copper, this would open up some important substitution possibilities of nickel for copper. In this case, the prospects for the industry might warrant a large second-round expansion. This scenario is somewhat speculative, and possible only in the absence of any form of regulation.

17. Although everyone agrees that nodule resources should be developed in a rational manner, opinions differ on what specific objectives come under this very general goal. In the Sea-Bed Committee, several policy objectives were proposed and discussed, in particular: to encourage nodule development so as to enlarge the world resource base, to minimize the impact of nodule exploitation on developing countries exporters of minerals, to ensure the participation of developing countries in sea-bed mining activities, to promote the conservation of nodule resources and to preserve the marine environment.

18. Some of these objectives and the conflicts between them indicate the need for a trade-off between efficiency and equity, which is one of the fundamental issues under any form of economic organization. Some would argue that the nodule industry should be free to operate without restraint, since under conditions of competition and free entry, the nodule resources would then be developed at minimum cost. Others contend that unrestricted nodule exploitation would benefit primarily those countries developing the necessary technology which are also the largest consumers of minerals; thus many developing countries mineral exporters might be harmed by nodule exploitation.

19. Two different approaches are examined in the report for balancing the objectives of efficiency and equity: the compensatory approach, whereby the nodule industry would be allowed to operate with little or no explicit regulation, but some forms of compensation would be paid to developing countries if they experienced a loss in export revenues; and the preventive approach, which would involve some form of direct regulation of the nodule industry by an International Authority. The second approach only is discussed in detail in the report.

20. Under a general preventive approach, many specific regulatory formulae would be possible, depending on what the Authority chooses as the basis of regulation. The report considers the effects of choosing nickel as the basis for regulation. In this case, the Authority would allow new ventures to come on board and production from nodules to proceed so as to supply part or all of the increase in demand for nickel in each year. This type of scheme would recognize the complementarity between land and marine sources, since production from both sources would be growing. It would also recognize the need of the industry to remain viable, and since nickel would be one of the main generators of industry revenue, this would be assured.

21. Metal production from nodules could, for example, be geared to supplying between 50 and 100 per cent of the increase in demand for nickel, with possible additional restrictions on recovery of other component metals, such as manganese. Assuming that the demand for all these metals would be growing at their long-term rates by 1985, and the maximum production is authorized, sea-bed mining could make considerable inroads into the cobalt market, accounting for 66 per cent of world demand. The share of world demand for nickel supplied by nodules could be 28.6 per cent by 1985, under these assumptions.

22. Even taking into account a share of revenues for the International Authority, it appears that nodule mining would still show a financial return commensurate with that of other investments. On the basis of a wide range of analytical assumptions, some estimates are contained in the report. If, for example, the Authority were to take a 50 per cent share of net revenues, the medium estimate of the take from a single mining operation of 3 million tons/year would be $96 million. This would still allow the miners a 36 per cent return on total investment after payment of the Authority's share. This is more than commensurate with the average return on investment in mining in the United States which was 10.4 per cent in 1972.

23. Whatever specific form regulation by the sea-bed Authority might take, the régime must have sufficient flexibility to adapt its mode of operation to the changing conditions of world markets and of the industry itself. Without this flexibility, the Authority would be severely hampered, and it would be extremely difficult to ensure that

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the objectives discussed under the goal of rational development would be achieved. A more practical problem will be to determine on which stage of production the take of the Authority would be based. If the value of nodules on board ship were to be used as the base, then the lion's share of the benefits from the common heritage of mankind would accrue to the producing countries. Nodules on board ship would represent only 6 to 10 per cent of the value of nodules after the processing stage. The Authority must be able to capture some of the value added by processing, since the significant spinoffs from establishing the processing plants will again go to the producing countries.

24. One possible way to tackle the objective of conservation of nodule resources would be to employ a grid system for demarcating the area of potential mining operations. Within the grid system, only selected blocks might be auctioned by the Authority to potential producers in any one year. The take of the Authority might, for example, consist of two parts: the proceeds from the auction plus a levy on net or gross revenues. The highest bidder would acquire control over the mine site for a fixed period which would be long enough to allow him to recoup his investment, after which the site would be returned, in a specified condition, to the Authority. Certain blocks would not be auctioned off immediately, but reserved for future use.

25. The range of possible policy alternatives open to the International Authority is quite wide. The regulatory options discussed in the report are by no means the only feasible alternatives. For example, it is not necessary that the Authority license commercial exploitation of nodules by private companies. Alternatively, the Authority might enter into joint ventures, or it might choose to undertake the entire operation of sea-bed mining by itself.

26. In any case, it appears that even after paying the levies of an International Authority, sea-bed mining will be a commercially profitable operation. There are concrete policy options which can balance the interests of the mineral producing and consuming nations, and some of these possible options are discussed at length in the report. It should be emphasized that the pace of change in world economic affairs - especially in regard to exchange rates, commercial policies and inflation - can significantly alter the economic picture within a few years. Any form of international regulation of sea-bed mining must be sufficiently flexible to adapt itself, its methods and objectives to the changing economic order.

III. Summary and conclusions of UNCTAD's reports

A. Summary of the statement made by Mr. G. D. Arsenis on behalf of the Secretary-General of the United Nations Conference on Trade and Development (A/CONF.62/32)

1. It is now generally agreed that greater availabilities and presumed lower costs associated with the production of minerals from the sea-bed would bring benefits to the world as a whole. How could these benefits be distributed among Member States? This is the central question.

2. The Conference would wish to take account of the following principles in answering this question:

(a) the sea-bed resources are the "common heritage of mankind";

(b) their exploitation should be "for the benefit of mankind as a whole, taking into account the special interests and needs of developing countries";

(c) the need for concerted international action to underpin the development of developing countries and to reduce the economic gap between developed and developing countries;

(d) the convergence of interests of producing and consuming countries, and consequently, of the need for a new strategy that would meet the legitimate needs of consuming countries for assured supplies and of producers for strengthened earnings and assured markets: both producers and consumers have an interest in an orderly price situation and in the rational exploitation of non-renewable resources.

3. One important result of sea-bed mineral exploitation would be that it would bring direct benefits to consumers of the minerals concerned which are, by and large, mineral using industries in developed countries.

4. The chief consequence of sea-bed production for land-based producers of the minerals concerned would be that their total earnings from the minerals would grow less rapidly than they would have done otherwise, and in some instances, they might even decline from previously realized levels. In 1980, on the level sea-bed production might reach in that year, export earnings of developing countries in that year would be about $360 million lower than in the absence of sea-bed mining.

5. Income likely to accrue to the proposed international sea-bed authority would fall short of the potential export earnings foregone by established developing countries. The likely revenue of the authority would be insufficient to compensate those countries, nor would funds be available for the benefit of other developing countries.

6. It would appear that in the absence of special arrangements to protect the interests of developing countries, mineral production from the sea-bed while contributing to world development, may also result in a widening of the income gap between developed and developing countries.

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7. There is, therefore, an imperative need for the international community to make firm arrangements to ensure that such activity would not adversely affect the interests of developing exporting countries.

8. A compensatory approach is conceivable, but would require additional funds to meet the shortfall of the revenues of the authority in relation to the loss in export earnings of developing countries.

9. An alternative approach would consist of arrangements to ensure that output from the sea-bed will not result in prices which are not equitable and remunerative to the reasonably efficient countries which are established producers of the minerals concerned. For this purpose, strict control over production or selling prices should be exercised by the proposed international authority.

10. The establishment of a properly constituted international authority either able to undertake sea-bed mining itself or alternatively equipped with the full regulatory and taxing powers, appears to be a prerequisite to the equitable utilization of these resources.

B. Case study of copper (TD/B/484): Summary and conclusions

1. The consumption of copper has increased in the last two decades at an average annual rate of 5 per cent, and in the non-socialist world reached an annual average of 8 million metric tons in the period 1969-1971.

2. Mine production over that period totalled about 5 million tons of copper content, corresponding to a value of $6,000 million, the difference between mine production and consumption being accounted for largely by the use of secondary copper. The share of the developing countries in that output was about 40 per cent.

3. The characteristics of the copper market, and in particular the existence of two relatively independent sub-markets, were taken into account in an econometric model which was used to simulate the behaviour of the market in the event of exploitation of the sea-bed. As in the UNCTAD secretariat's previous reports, four assumptions were made concerning the intensity of exploitation of the sea-bed. On the low assumption 14,100 tons of copper would be extracted from the sea-bed in 1980, on the medium-low assumption 42,300 tons, on the medium-high assumption 98,800 tons, and on the high assumption 141,000 tons.

4. On the assumption that in 1980, 141,000 tons of refined copper will reach world markets, the volume of copper extracted from the sea-bed would not account for more than 2 per cent of mine production, or for more than 1 per cent of consumption in the non-socialist world. According to the results of the quantitative analysis, the effect of this production might be summarized as follows, by comparison with the case of no exploitation of the sea-bed: contraction of mine production on land by 0.7 per cent, expansion of total mine production (on land and on the sea-bed) by 1.2 per cent, and expansion of consumption by 0.4 per cent in the non-socialist world. London Metal Exchange prices would drop by 2.2 per cent and United States producer prices by 1 per cent. The export earnings of the developing countries would shrink by about $200 million, or about 3 per cent of the total.

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5. This figure may be compared with the value of the copper that would be extracted from the sea-bed on the same assumption - about $300 million. Assuming that the profits of firms engaging in that activity is not likely to exceed half their gross receipts, it will be seen that a transfer of all or part of those profits to the developing countries would not offset the shrinkage of their potential export earnings.

C. Case study of manganese (TD/B/483): Summary and conclusions

1. This paper presents the results of an analysis of the effects of the mining of manganese nodules from the ocean floor on the land-based manganese ore industry and, in particular, on the developing country producers of such ore. These results are based on an econometric model of the manganese ore industry - summarized on page 15 - and fully described in TD/B/483/Add.1.

2. The analysis is related to a base case set of premises, which can be summarized as follows:

(a) The range of sea-bed production levels which can realistically be anticipated over the projection period (1974-80), is taken to run from a low of about 442,000 metric tons of manganese ore in 1980 to a high of about 4,420,000 metric tons of ore in the same year.

(b) Production of manganese ore from the sea-bed is assumed to be planned, broadly, on principles similar to those relating to land-based production. This will lead to a partial, though not pound-for-pound, displacement of land-source supplies by ocean-source supplies.

(c) The share of the developing countries in aggregate land-based production will remain approximately constant at its current level over the period.

(d) Real gross national product in the industrialized countries which are the principal consumers of manganese ore is assumed to grow during the projection period at recently observed rates. Further details of these assumptions and information about other assumptions made are provided in chapter II. The base case premises just summarized should be regarded as merely a reasonable reference case for study. Alternatives to certain key assumptions and the effects of these alternatives on the analytical results are considered in chapter V.

3. The principal results which flow from the base case premises and which pertain to the manganese ore industry as a whole are as follows (see chapter III for details).

4. Aggregate consumption of manganese ore in the developed market economies and in the developing countries is expected to increase at an average annual rate of about

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5.3 per cent between 1974 and 1980. 1/ This is a somewhat higher rate of increase than the average over, say, the last two decades. It reflects the anticipated relatively high rate of growth of steel production in the developing countries and an increase in the share of production by such countries in the total. Sea-bed output of manganese ore will affect the price of such ore. However, since consumption of manganese ore is very price-inelastic, consumption is unlikely to vary with sea-bed production.

5. Production of manganese ore from land sources will, of course, be affected by ocean mining operations. In the absence of sea-bed production, land-based output is anticipated to grow at an annual average rate of 4.2 per cent. Given a moderate level of sea-bed production, 2/ this rate will probably drop to about 1.5 per cent per year. In the last year of the forecast period (1980), the reduction in land volume will be from 12.6 million metric tons to 10.4 million metric tons, a reduction of about 18 per cent. 3/

6. The price of manganese ore is expected to be fairly insensitive to the level of sea-bed production. Without production from the ocean floor, price is expected to decline by about 1.1 per cent per year under the influence of continuing high production capacity, United States Government stockpile deliveries, and imports from the socialist countries. This rate of decline will accelerate to only about 1.6 per cent per annum under the assumption of a medium level of sea-bed output. The difference in prices between the two situations in 1980 is the difference between $17.3 per metric ton and $16.8 per metric ton. 4/ The effect of ocean mining development on the price of manganese ore is moderated by the fact that sea-bed production will to some extent supplant land-based production. Hence the effect of the former on total supplies will be mitigated.

1/ All physical quantities and values are aggregates of the developed market economies and developing countries. Published data on the manganese economies of the socialist countries were insufficient to permit representation of these countries in the econometric model on which the analysis is based. All quantities and values refer to manganese ore of metallurgical grade. Data limitations prevented inclusion of chemical-grade, battery-grade, or ferruginous manganese ore within the model. Consumption of metallurgical-grade ore, however, represents about 90 per cent of total consumption of all types of manganese ore.

2/ This is the "medium 2" sea-bed production case shown in table 1 below.

3/ All quantities are gross weight of ore. An analysis in terms of weight of metal content would also have been of interest but was precluded by data limitations.

4/ This is a world average f.o.b. price per ton of metallurgical-grade ore, gross weight.

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7. The base set of assumptions also has implications for the export earnings of developing country producers of manganese ore. 5/ In the absence of an ocean mining development, the export earnings of the developing countries from the sale of manganese ore are expected to rise at an annual rate of about 3.1 per cent over the forecast period. This gain reflects the conflicting effects of an anticipated slight decline in price, offset by a moderate rise in export volume. With a medium level of sea-bed production of manganese ore, export earnings would probably decline by about 2.0 per cent per year between 1974 and 1980. These differential rates of change imply a very substantial difference in export earnings in 1980 as between the no sea-bed production case and the medium sea-bed production case, the difference between $93.7 million in the first case and $65.6 million in the second, a reduction of approximately 30 per cent (see chapter IV for further details).

8. As noted, the results given above rest upon a particular set of assumptions, the base set. It is of interest to determine how the figures of developing country export earnings might change in response to plausible variations in certain key assumptions. (See chapter V).

9. It could, for example, be assumed that the developing countries' share of aggregate land-based production would decline because they would feel the full effect of the displacement of land supplies of manganese ore by sea-bed production. This would be the probable result, for example, if sea-bed production were to be utilized mainly in the United States which is a distinct possibility, at least over the first few years of the forecast period. Under these circumstances, and with a medium level of sea-bed output, the export revenues of developing countries from the sale of manganese ore would decline at an annual average rate of 6.3 per cent falling to $48.5 million by 1980. In that year, such earnings would be about 21 per cent lower than if the impact of sea-bed production had been shared equally with the developed market economies and 48 per cent lower than if there were no ocean mining.

10. Similarly, it might be assumed that the average growth rate of the industrial countries, which are at present the principal consumers of manganese ore, would be less than historically experienced. Under the influence of a temporary (two-year) reduction of growth in these countries, and given a medium level of sea-bed production, export earnings of developing countries from the sale of manganese ore would be relatively lightly affected. Under a sustained reduction of growth (one-half the recent historical rate) - once again with a medium sea-bed output - such earnings would suffer quite drastically, however, falling to $54.2 million in 1980, a decline of 4.5 per cent per year between 1974 and 1980. In the latter year, earnings would be approximately 17 per cent less than if growth had been sustained at its historical rate. Such earnings would be 42 per cent less than if growth had been sustained and the sea-bed development had not occurred.

5/ Figures on another indicator of the impact on developing country producers, namely value of annual production, are given in table 7 below.

11. All the above results obtain under an assumption of a fairly moderate scale of ocean mining operations. Under an assumption of a high - but not impossibly high - scale of operations, the effects would be even more severe.

12. The table below draws together the main analytical results relating to the effects of sea-bed production on export earnings of developing country producers of manganese ore.

Export earnings of developing countries from manganese ore in 1980

Under the base set of assumptions		Under alternative assumptions regarding:			
		Developing countries share of land production		Reduced growth in the industrialized countries a/	
No sea-bed production	Moderate sea-bed production	Developed countries' production displaced	Developing countries' production displaced	Temporary reduction	Sustained reduction
($US million)					
93.7	65.6	86.5	48.5	62.8	54.2

a/ Taken here as the 11 major consumers of manganese ore.

13. The figures presented in the table above suggest that some sort of sea-bed regulatory régime will probably be required in order to protect the export earnings of developing country producers of manganese ore. Regulations could pertain to offering prices, production, or offers to sell the output from mining operations, or some combination of these. On the other hand, a compensatory approach to protecting the export earnings of developing countries would probably not be successful. Under any sea-bed case considered, losses in export earnings of the developing countries amount to about 50 per cent of the value of sea-bed production. Since the latter represents gross revenues, without deduction for operating costs, depreciation and amortization, and return on capital, the prospects for compensating the developing countries for loss of export earnings solely from the sale of sea-bed production of manganese ore do not appear bright. Thus, a system of regulation in which losses are prevented, rather than compensated after the fact, would seem to be indicated. Definitive statements on these matters, however, must await a joint analysis of all four principal sea-bed metals, an analysis in which interactions among the various metals and between land and ocean operations can be systematically examined.

D. Case study of cobalt (TD/B/449/Add.1): Summary and conclusions

1. Relative to other non-ferrous metal markets, the market for cobalt may be considerably more affected by the exploitation of mineral deposits on the ocean floor. For those sea-bed operations presently envisaged, although larger quantities of both manganese and nickel would be extracted, the amount of by-product cobalt recovered would represent a far greater proportion of current land-based production than would be the case for any other metal. It is estimated, for example, that one commercial, deep-sea mining operation could add each year around 30 per cent to current land-based cobalt production levels, while comparable proportions for manganese or nickel would be less than 5 per cent.

2. Cobalt is at present a relatively scarce, expensive metal which is nevertheless used in a wide variety of industrial products, both metallic and non-metallic. Its special properties make it particularly suited to a number of rapidly expanding, advanced-technology industries, and in these uses there are few other metals which could be substituted for it. At considerably lower prices, cobalt itself could probably be substituted for various other non-ferrous metals. In these circumstances the addition to the cobalt market of large quantities of sea-bed supplies could alter and enlarge the structure of cobalt consumption.

3. The available data relating to cobalt production, especially to production costs and pricing strategies, are insufficient to allow a quantitative assessment of production frontiers at price levels outside the range observed in the recent past. This is especially pertinent with respect to sea-bed operations and the indirect effect of lower cobalt prices on the economics of exploitation. The justification for sea-bed production depends on the recovery of other metals in addition to cobalt, particularly manganese and nickel, and the interaction effect on the various markets of sea-bed supplies of these metals has not yet been analysed. This may be particularly important in the case of the nickel-cobalt markets. Within a limited range around the current cobalt price level, however, it has been possible to undertake an econometric analysis of the cobalt market and to draw some hypothetical conclusions regarding the impact of sea-bed production.

4. According to this analysis, the impact of sea-bed production would be most evident in the drastic redistribution of production and production revenues which would result if compared with current patterns of production and trade. Gross revenues presently accruing to developing countries from cobalt production amount to approximately $95 million annually in terms of 1970 prices. By 1980, if there were no production from the sea-bed, this latter amount is projected to increase to $240 million, again at 1970 prices. In the event of sea-bed production, however, developing countries' revenues would be less, between $120-$220 million for 1980, depending on the level of sea-bed production assumed.

5. The national revenue loss to developing countries in the event of sea-bed production is thus projected - for 1980 - to be in the region of $19 to $120 million at 1970 prices, depending on the assumptions made. Under these same assumptions, the revenue accruing to sea-bed production in 1980 would be $16 to $100 million, at 1970 prices, while developed countries' revenues would remain substantially unchanged in the region of $10 million.

E. Exploitation of the mineral resources of the sea-bed beyond national jurisdiction: issues of international commodity policy (TD/B/449): Summary

1. In the formulation of appropriate commodity policies in relation to the exploitation of the mineral resources of the sea-bed, the international community should bear in mind the following major considerations:

(a) The potential exploitation of the mineral resources of the area of the sea-bed beyond the limits of national jurisdiction has implications of great importance for international trade and development in the minerals sector.

(b) One important result of such exploitation would be that it would bring direct benefits to the consumers of the minerals concerned who are, by and large, the mineral-using industries in developed countries.

(c) On the other hand, the chief consequence of sea-bed production for land-based producers of the minerals concerned would be that their total export earnings from those minerals would grow less rapidly than they would have done otherwise, and might even decline from previously realized levels.

(d) The impact of sea-bed production would be likely to be particularly adverse for developing producing countries, because they typically depend more heavily on the minerals concerned for their export earnings and government revenues than do developed producing countries, and for other reasons.

(e) The restrictive impact of mineral production from the sea-bed on the scope for the growth of the export earnings of the developing producing countries would be the more serious since the relatively rapid rate of growth in international trade in minerals and metals affords developing countries an opportunity of partially compensating for the stagnation of their export trade in many agricultural commodities. Curtailment of this opportunity would impair the prospects for the developing countries of achieving the targets laid down in the International Development Strategy for the Second United Nations Development Strategy for the Second United Nations Development Decade for the over-all growth of their export earnings.

(f) A compensatory approach, under which the developing producing countries affected by sea-bed production would receive compensation for the estimated adverse impact upon their export earnings, would be unworkable on account of the insufficiency of funds on the part of the sea-bed authority if these were confined to the net revenues accruing from the exploitation of the sea-bed.

(g) Therefore, firm preventive arrangements would be required in advance of the production of minerals from the sea-bed in order to ensure that such activity would not adversely affect the interests of developing producing countries. In practice, this would imply the exercise of strict controls so that the market prices of the minerals concerned are not depressed below levels declared by the international community as remunerative and equitable.

/...

(h) Finally, whatever organizational arrangements are made with regard to the utilization of the resources of the sea-bed - which are recognized as "the common heritage of mankind" 1/ - the international community will presumably take care that they are fully consistent with the established role of the United Nations in the formulation and implementation of appropriate international commodity policies as an integral component of an over-all strategy for development, particularly of the developing countries. 2/

F. Mineral production from the area of the sea-bed beyond national jurisdiction: issues of international commodity policy (TD/113/Supp.4): Summary

1. The economic impact of competing production of minerals from the sea-bed, which might be expected to be adverse to varying extents for the export incomes of all established producers (in relation to the incomes which they would otherwise earn), might be particularly adverse for typical developing producing countries. This could be so for a variety of reasons:

(a) Developing producing countries typically depend more heavily on the minerals concerned (such as copper and manganese ore) for their export incomes and government revenues than do developed producing countries.

(b) The share of developing countries in world trade in certain minerals (notably manganese ore) has been declining owing to the more rapid progress made in the developed countries' production for export.

(c) The developing countries are likely to participate directly to only a small degree in the production of minerals from the sea-bed, for, because of its technically sophisticated nature and its high capital requirements, this production will no doubt be undertaken principally by interests from the affluent and technologically advanced countries.

(d) Developing countries, which are increasingly processing land minerals before export, would lose such potential export income to the extent that minerals produced from the sea-bed were processed on the mainland of the producing enterprise's "home country". Moreover, the stimulus which sea-bed production would undoubtedly impart to the existing technological trend towards the direct processing of mineral concentrates, and the avoidance of intermediate processes which are now partly carried out in developing producing countries, would aggravate the loss of potential export income on the part of developing countries.

1/ General Assembly resolution 2750 A (XXV),

2/ The International Development Strategy for the Second United Nations Development Decade makes no reference to the resources of the sea-bed presumably because, at the time it was drawn up, the potential utilization of those resources seemed remote.

(e) The need for large-scale capital investments for the exploration and mining of sea-bed resources might adversely affect the flow of private investment into similar activities in developing countries.

(f) Because fewer alternative investment and employment opportunities exist in developing than in developed countries, particularly heavy economic and social costs will be incurred in any re-allocation of resources that may be necessitated by the competition from sea-bed production.

Some implications for policy

2. The essential problem which would arise from the production of minerals from the sea-bed would thus be the adverse impact of such production - in the absence of special arrangements - on the economic well-being of the developing producing countries concerned, and the consequential difference between the social costs and benefits of sea-bed production and its costs and benefits judged simply in terms of normal commercial criteria. The implication of this conclusion for international policy is that firm arrangements would be required in advance of the production of minerals from the sea-bed in order to ensure that such activity would not adversely affect the interests of developing producing countries or, better, would bring them, and to other developing countries, positive benefits.

3. There would appear to be two possible approaches to the problem of protecting the trade interests of the developing countries which are established exporters of the minerals in question: (a) an approach designed to obviate or minimize any potential adverse effects, and (b) an approach under which the affected countries would receive compensation for the estimated adverse impact upon their export earnings.

UNITED NATIONS

THIRD CONFERENCE
ON THE LAW OF THE SEA

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ECONOMIC IMPLICATIONS OF SEA-BED MINERAL DEVELOPMENT IN THE INTERNATIONAL AREA: REPORT OF THE SECRETARY-GENERAL

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PREFACE

This report was prepared in response to General Assembly resolution 2750 A (XXV) of 17 December 1970 as a follow-up of two previous reports on the economic implications of sea-bed mining submitted to the Sea-Bed Committee in 1971 1/ and 1972. 2/ It responds in particular to the operative paragraph of this resolution, which requested the Secretary-General to:

> "(a) Identify the problems arising from the production of certain minerals from the area beyond the limits of national jurisdiction and examine the impact they will have on the economic well-being of the developing countries, in particular on prices of mineral exports on the world market;
>
> "(b) Study these problems in the light of the scale of possible exploitation of the sea-bed, taking into account the world demand for raw materials and the evolution of costs and prices;
>
> "(c) Propose effective solutions for dealing with these problems;"

Following past practice, the Secretariat of UNCTAD made some comments and suggestions on an earlier draft of this report. Moreover, the findings 3/ of UNCTAD's report on manganese ore (TD/B/483 of 23 April 1974) were also taken into account.

The first section, "Review of sea-bed mining activities", up-dates a previous report 4/ presented in 1973. In the second section, an analysis is made of the probable impact of sea-bed mining on world metal markets and on developing country exporters of minerals, during the period 1976-1985. The final section deals with a number of policy questions, with special emphasis given to the objectives of minimizing the impact of nodule mining on mineral exports of developing countries and of maximizing revenues for the international authority.

1/ United Nations, "Possible impact of sea-bed mineral production in the area beyond national jurisdiction on world markets, with special reference to the problems of developing countries: a preliminary approach" (A/AC.138/36), May 1971.

2/ United Nations, "Additional notes on the possible economic implications of mineral production from the international sea-bed area" (A/AC.138/73), May 1972.

3/ Although its projections were based on somewhat different assumptions, the conclusions reached in the UNCTAD report on the impact of nodule mining on manganese markets are essentially similar to those in this report.

4/ United Nations, "Sea-bed mineral resources: recent developments" (A/AC.138/90), July 1973.

The only resource studied in this report is manganese nodules. Hydrocarbons were not considered because very little production is expected in the foreseeable future from the deep sea-bed, and in any case the possible impact of such production is likely to be minimal. Nor were other minerals such as phosphorites, metalliferrous muds and brines, and deposits in the bedrock taken into account in this study.

It should be borne in mind that the materials and observations contained in this report are based on available information on future market conditions and the technology being developed for nodule exploitation. Considering the nature of long-term market forecasts 5/ and the limited knowledge of nodule technology outside the few groups engaged in research and development work, the analyses and observations should be considered as tentative and as calling for periodic review. It should be clearly understood that the ideas put forward are merely illustrations of the policy implications of some of the possible mechanisms which could be employed under the international régime.

5/ For example, it is possible that the actions of organizations of mineral exporting countries might result in metal prices considerably different from those assumed in the report. Some of the recommendations of the Special General Assembly on Raw Materials could also change the existing perspective of future mineral markets.

/...

Summary of report on economic impact of sea-bed mining

This summary provides a brief review of the contents of the report. In view of the complexity of the subject, however, it necessarily omits much of the analyses and accordingly should not in any sense be taken as a substitute for the text of the report itself.

Manganese nodules are the most likely deep-sea minerals to be exploited in the foreseeable future. Nodules are composed of fine-grained oxide material and are distributed widely over the floor of the world ocean. They vary widely in their composition, as well as in their physical and chemical properties. There is now considerable commercial interest in exploiting them for their component metals, chiefly nickel, copper, cobalt and manganese.

Only about 3 per cent of the sea floor has been extensively surveyed. However, intensive exploration in recent years has revealed enough about the extent and location of deposits to permit commercial exploitation of nodules. Potential commercial deposits exist in the Pacific and Indian Oceans, while none have yet been located in the Atlantic Ocean,

Various commercial groups have completed the exploration or prospecting phase and are now evaluating potential mine sites. Site evaluation focuses on estimating the average concentrations of the constituent metals in nodules and on the nodule density per unit area of the mine site. These are the key parameters which, with bottom topography, affect the potential profitability of a mine site. There is great interest in the central Pacific region, which contains extensive concentrations of higher value nodules. Within this region, some evidence suggests that nodules with the highest potential value are concentrated in an east-west belt between 6°N and 20°N latitude and extending between 110°W and 180°W longitude.

The physical problem of recovering the nodules from the sea floor is proving to be a difficult one. As surficial deposits, nodules will be dredged and either pumped or hoisted from the sea floor. At the surface facility the nodules will then be loaded into barges or ore carriers for transportation to a processing plant. Under hydraulic lifting systems the nodules must be concentrated within a relatively small area so that the suction system can operate efficiently; this gathering process seems to be one of the most serious stumbling blocks in test operations.

Several national governments have been and are involved in nodule mining through various forms of direct and indirect subsidization of mining activities. They have funded research on exploration, offered tax relief and the use of government facilities for research on processing, and in some cases governments are contemplating direct participation in mining ventures.

By most estimates, it appears that nodule mining will prove to be a commercially profitable operation. Although the physical, technical and logistic problems are formidable, the existing technological capability can allow the industry to work. The question of the probable impact of sea-bed mining on world markets centres on the degree of competitiveness between marine and land-based sources of metal supply. To be rigorous, a study of this question would require a comparison of the relative supply costs of these two sources. This is not practicable for the following reasons: (a) most information on estimated costs of individual firms or consortia is still proprietary and closely guarded; (b) as the industry matures costs will drop from initial levels due to a "learning-by-doing" effect. Also, technical progress in engineering, materials, and design will serve to further reduce costs over time; (c) the range of costs among land-based producers is extremely wide, making it difficult to find a uniform supply price for land-based producers as a whole; (d) the profitability of nodule mining, the volume of production, and the impact on prices will be affected by the nature and extent of any regulation of the industry by the Sea-Bed Authority.

Therefore, in order to approximate the likely impact of nodule mining, certain assumptions must be made to facilitate the analysis. In this report, the assumptions made are based on the latest information available, on the discernible trends, and on the known plans of sea-bed miners.

Given the state of preparedness of the industry, commercial metal production from nodules could commence toward the end of the decade, though nodule mining might start as early as 1976. 6/ The decision to go ahead and begin production will depend on whether: (a) the firms feel that their mining and metallurgical processing technology is economically viable; (b) that they are on safe legal grounds with security of investment and assurance of exclusive access to their chosen mine sites; and (c) that they have adequate financing for their ventures. Once the go-ahead decision is made, it is assumed that commercial operations can commence within three to five years.

Perhaps the most critical assumptions deal with the expected rate of development of the nodule industry, the average grade of nodules processed, the constituent metals to be recovered and the metallurgical yields. Metal production from nodules will be affected by the pattern in which new operations enter the field each year and by increases in capacity of existing operations. Economies of scale will dictate the size of individual operations; the likely sizes being of one and three million ton capacities. Six groups are expected to be in operation by 1985, the total volume of dry nodules being processed in that year amounting to 15 million tons.

According to most experts, nickel will be the mainstay of the nodule industry. Copper, cobalt and nickel will be produced jointly, with manganese and several trade metals probably being produced as by-products from the tailings. As a guideline for their own planning, nodule miners look for a combined nickel and copper content equal to three per cent of the dry weight of nodules. Other metals will be recovered if the additional costs of processing are covered by the additional revenues from these metals, which in turn depends on their prices. Thus, there can be no uniform, industry-wide assumptions about production of other metals. For example, industry plans vary widely with respect to manganese production, not only regarding its volume but also its form, i.e. ore, ferromanganese or manganese metal.

For nickel, a minimum six per cent per annum long-term growth rate is assumed. In 1972, the share of developing countries in world production of nickel was only 13 per cent, although this share is expanding rapidly. Production from nodules might amount to 18 per cent of the total world demand in 1985. This

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6/ The assumed timing of entry of nodule operations is shown in figure 5.

volume of production would depress prices somewhat, but the impact would be lessened by the good growth prospects for nickel, and by the fact that developing producers account for a small share of the total market. Nickel production from nodules might cause some high cost laterite projects under consideration to be abandoned, but it should not have a serious effect on land-based production as a whole.

The world market for copper is huge compared to that for nickel, being about 14 times the size of the nickel market in 1972. Copper prices rose dramatically from 1970-1974, reaching a record level of $US 1.10/lb. in early 1974. Of the metals contained in nodules, copper production is the least concentrated among producers. It is expected that the demand for copper will show an annual percentage growth rate of 4-5% to the end of the century. Production from nodules might supply about 1.3% of world consumption in 1985 and would displace only 5.5% of the net import requirements of developed countries by that time. Copper production from nodules is expected to have a minimum impact on a relatively large, growing and somewhat diffuse market.

Manganese might be recovered from nodules in two forms, either as pure metal or as ore-equivalent. More than 90% of the manganese produced is used in the form of ferromanganese in the manufacture of steel; thus the rate of growth in its consumption will tend to parallel that of steel production. On the other hand, the market for manganese metal is relatively small. Metal production from one operation of one million tons/year in 1985 might amount to twice the volume of projected demand. Therefore, manganese metal supply from nodules would depress prices. Depending on the form and volume of manganese recovery from nodules, the export earnings of developing country producers might drop significantly. However, with just one exception, developing countries are not dependent upon manganese exports to a great degree.

Cobalt is a relatively expensive metal with a small market, and its value in world commodity trade is rather small. By 1985, production from nodules could account for about half the volume of world output while effecting a drop in price to about two-thirds of current levels.

The long-term prospects of the nodule industry are tied closely to nickel and copper. In the long-term, if capacity expansion in sea-bed mining was sufficiently large to depress the price of nickel to approximately the price of copper, this would open up some important substitution possibilities of nickel for copper. In this case, the prospects for the industry might warrant a large second-round expansion. This scenario is somewhat speculative, and possible only in the absence of any form of regulation.

Although everyone agrees that nodule resources should be developed in a rational manner, opinions differ on what specific objectives come under this very general goal. In the Sea-Bed Committee, several policy objectives were proposed and discussed, in particular: to encourage nodule development so as to enlarge the world resource base, to minimize the impact of nodule exploitation on developing countries exporters of minerals, to ensure the participation of developing countries in sea-bed mining activities, to promote the conservation of nodule resources and to preserve the marine environment.

/...

Some of these objectives and the conflicts between them indicate the need for a trade-off between efficiency and equity, which is one of the fundamental issues under any form of economic organization. Some would argue that the nodule industry should be free to operate without restraint, since under conditions of competition and free entry, the nodule resources would then be developed at minimum cost. Others contend that unrestricted nodule exploitation would benefit primarily those countries developing the necessary technology which are also the largest consumers of minerals; thus many developing countries mineral exporters might be harmed by nodule exploitation.

Two different approaches are examined in the report for balancing the objectives of efficiency and equity: the compensatory approach, whereby the nodule industry would be allowed to operate with little or no explicit regulation, but some form of compensation would be paid to developing countries if they experienced a loss in export revenues; and the preventive approach, which would involve some form of direct regulation of the nodule industry by an International Authority. The second approach only is discussed in detail in the report.

Under a general preventive approach, many specific regulatory formulae would be possible, depending on what the Authority chooses as the basis of regulation. The report considers the effects of choosing nickel as the basis for regulation. In this case, the Authority would allow new ventures to come on board and production from nodules to proceed so as to supply part or all of the increase in demand for nickel in each year. This type of scheme would recognize the complementarity between land and marine sources, since production from both sources would be growing. It would also recognize the need of the industry to remain viable, and since nickel would be one of the main generators of industry revenue, this would be assured.

Metal production from nodules could, for example, be geared to supplying between 50 and 100 per cent of the increase in demand for nickel, with possible additional restrictions on recovery of other component metals, such as manganese. Assuming that the demand for all these metals would be growing at their long-term rates by 1985, and the maximum production is authorized, sea-bed mining could make considerable inroads into the cobalt market, accounting for 66 per cent of world demand. The share of world demand for nickel supplied by nodules could be 28.6 per cent by 1985, under these assumptions. 7/

Even taking into account a share of revenues for the International Authority, it appears that nodule mining would still show a financial return commensurate with that of other investments. On the basis of a wide range of analytical assumptions, some estimates are contained in the report. If, for example, the Authority were to take a 50 per cent share of net revenues, the medium estimate of the take from a single mining operation of 3 million tons/year would be $96 million. This would still allow the miners a 36 per cent return on total investment after payment of the

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7/ Detailed presentation of hypothetical production from nodules, following these guidelines, is found in table 8.

/...

Authority's share. This is more than commensurate with the average return on investment in mining in the United States which was 10.4 per cent in 1972. 8/

Whatever specific form regulation by the sea-bed Authority might take, the régime must have sufficient flexibility to adapt its mode of operation to the changing conditions of world markets and of the industry itself. Without this flexibility, the Authority would be severely hampered, and it would be extremely difficult to ensure that the objectives discussed under the goal of rational development would be achieved. A more practical problem will be to determine on which stage of production the take of the Authority would be based. If the value of nodules on board ship were to be used as the base, then the lion's share of the benefits from the common heritage of mankind would accrue to the producing countries. Nodules on board ship would represent only 6 to 10 per cent of the value of nodules after the processing stage. The Authority must be able to capture some of the value added by processing, since the significant spinoffs from establishing the processing plants will again go to the producing countries.

One possible way to tackle the objective of conservation of nodule resources would be to employ a grid system for demarcating the area of potential mining operations. Within the grid system, only selected blocks might be auctioned by the Authority to potential producers in any one year. The take of the Authority might, for example, consist of two parts: the proceeds from the auction plus a levy on net or gross revenues. The highest bidder would acquire control over the mine site for a fixed period which would be long enough to allow him to recoup his investment, after which the site would be returned, in a specified condition, to the Authority. Certain blocks would not be auctioned off immediately, but reserved for future use.

The range of possible policy alternatives open to the International Authority is quite wide. The regulatory options discussed in the report are by no means the only feasible alternatives. For example, it is not necessary that the Authority license commercial exploitation of nodules by private companies. Alternatively, the Authority might enter into joint ventures, or it might choose to undertake the entire operation of sea-bed mining by itself.

In any case, it appears that even after paying the levies of an International Authority, sea-bed mining will be a commercially profitable operation. There are concrete policy options which can balance the interests of the mineral producing and consuming nations, and some of these possible options are discussed at length in the report. It should be emphasized that the pace of change in world economic affairs - especially in regard to exchange rates, commercial policies and inflation - can significantly alter the economic picture within a few years. Any form of international regulation of sea-bed mining must be sufficiently flexible to adapt itself, its methods and objectives to the changing economic order.

8/ The detailed estimates of revenues per mining operation of the Authority are given in table 11.

I. REVIEW OF SEA-BED MINING ACTIVITIES 9/

Deep sea-bed mining is a complex, multifaceted undertaking. Exploitation of nodules may be classified into three broad stages, namely: (1) the search for nodule deposits, (2) mining, and (3) metallurgical processing. A summary of the most important steps involved in each stage along with the most recent activities of companies and other institutions involved in research and development is presented below.

1. The search for nodule deposits

In the search for nodules, activities of a scientific character can generally be distinguished from the stages of exploration and evaluation because of their different objectives. Together they form a continuum in the accumulation of knowledge about sea-bed resources needed prior to commencement of commercial mining operations, and it is difficult to define where the scientific inquiry ends and the stage of exploration begins and where this stage ends and evaluation starts.

(a) Procedures used

Exploration is the broadly based survey using all available methods: the search generally begins over a large area and progressively narrows down to sites with mining potential. 10/ In industry circles this stage is generally referred to as "prospecting". It requires mapping, sampling of surficial and sub-bottom materials and making geophysical and geochemical measurements, and is best approached as a phased programme of increasingly more detailed surveys. 11/

A large array of scientific instruments and devices are required to collect the necessary data (see figure 1). Exploration vessels must carry sophisticated positioning equipment (satellite, celestial) and computers to correlate all sample data and other observations with precise co-ordinates. Acoustic and magnetic systems are used to obtain geophysical information about the nature of the sea bottom. The actual search for nodule deposits is made through optical systems such as closed-circuit T.V. and still and movie cameras.

9/ Since no official communication or information on recent sea-bed mining activities was available, this section was prepared on the basis of publications, such as journals, technical periodicals and company press releases. Accordingly, the Secretary-General cannot vouch for the accuracy of all the material covered in this report.

10/ United Nations, 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 (A/7230) New York, 1968, p. 25.

11/ See J. E. Flipse, M. A. Dubs, and R. J. Greenwald, "Pre-Production Manganese Nodule Mining Activities and Requirements", Mineral Resources of the Deep Seabed, Hearings of the Subcommittee on Minerals, Materials and Fuels of the United States Senate on Senate Bill 1134, May-June 1973, pp. 607-614.

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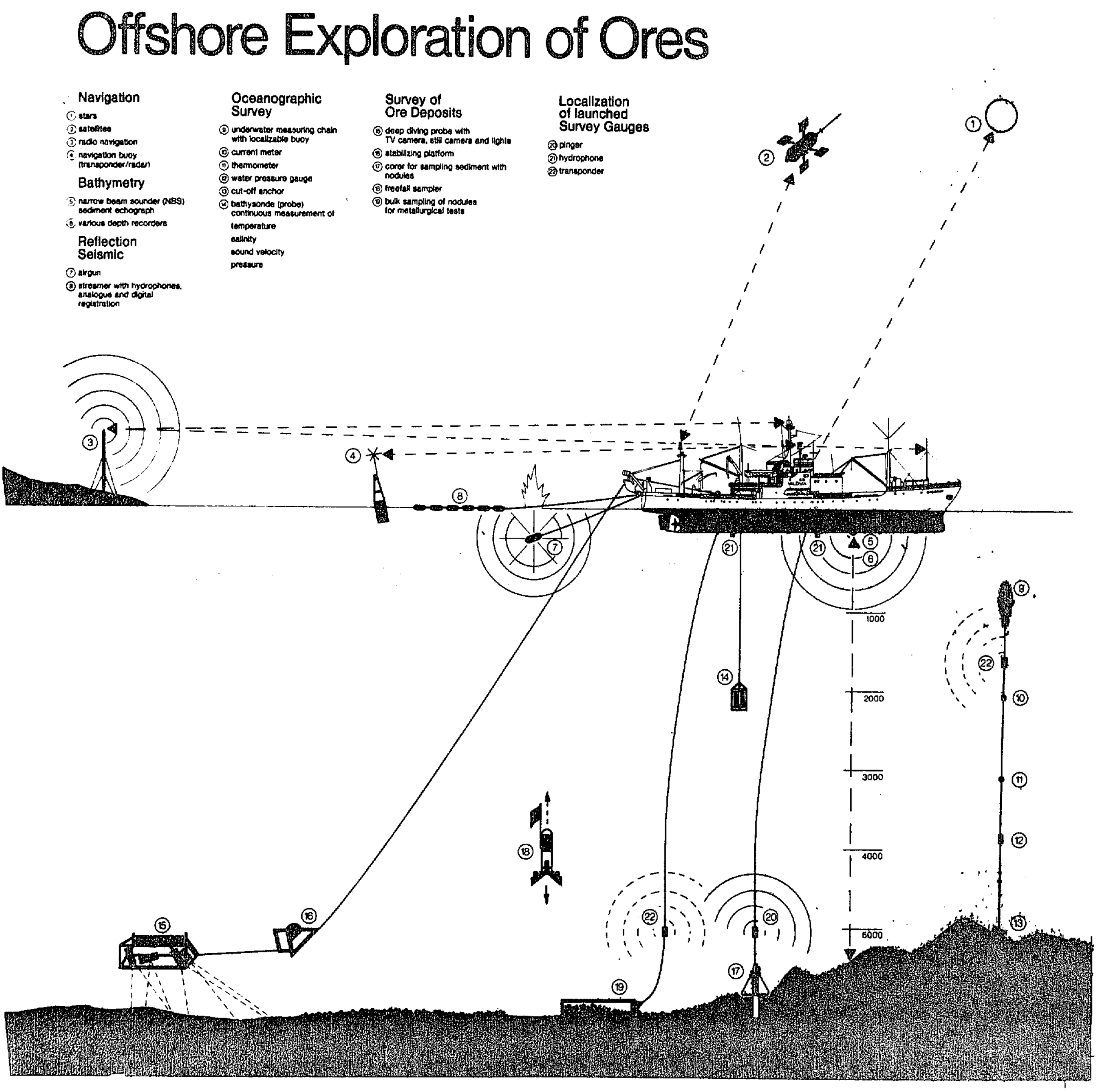
Figure 1. Offshore exploration of nodules



Courtesy of A. M. R. from the F. R. of Germany.

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The spacing at which samples are taken depends on results obtained, and generally range from 5 to 50 miles. The devices most commonly used for collecting samples are the free-fall sampler also called "boomerang", gravity-corer, piston-corer and dredge. The free-fall sampler is extensively used by institutions and industry groups such as Kennecott, Centre national pour l'exploitation des oceans (CNEXO), Preussag and Global Marine. These free-fall devices grab a small sample of nodules from an area of about 1 square foot. 12/ Corers are used to derive information on the sediments underlying the nodule deposit. Dredge sampling is used to collect a large volume of nodules for metallurgical testing from areas known to contain attractive nodule deposits.

A detailed appraisal follows the discovery and outlining of a potential mine site. The objective is to provide information upon which to base feasibility studies. 13/ Recoverable nodule grade and concentration estimates are the key parameters sought in evaluation surveys. The equipment required for evaluation is similar to that needed for the exploration stage. However, greater attention must be given to the precise correlation of sample data and other observations with their geographic location.

(b) Recent activities

Given the difficulty of differentiating in practice between the activities of exploration and evaluation, they will be described jointly. Most of the major groups involved in manganese nodule mining investigations have completed the exploration stage and are aware of a number of potential manganese nodule mining sites. 14/ Some groups are believed to have virtually completed the evaluation stage.

Deepsea Ventures has carried out 33 cruises in the Pacific with the R/V Prospector in three and a half years of work at sea. Kennecott Copper sponsored exploration cruises before initiating its own surveys in 1967. 15/ The company has dredged about 250 tons of nodules for processing research. Global Marine has been conducting nodule surveys on behalf of Summa Corporation. International Nickel has undertaken several cruises in recent years using chartered vessels.

12/ The operation cycle of these devices is approximately three hours. It is reported in French and German expeditions that up to 10 per cent of the devices may be lost during a cruise. W. Kollwentz, "Exploration Methods and Techniques - Experiences with R. V. Valdivia", in Meerestechnik, December 1973, p. 192.

13/ United Nations, Mineral Resources Development with Particular Reference to the Developing Countries (E.70.II.B.3), New York, 1970, pp. 3-5.

14/ A. J. Rothstein and R. Kaufman, "The Approaching Maturity of Deep Ocean Mining - The Pace Quickens", in Offshore Technology Conference Preprints 1973, vol. I, pp. 323-344.

15/ Kennecott Management Communication, vol. 2, No. 10, November 1970, p. 1.

/...

The West German Arbeitsgemeinschaft Meerestechnischgewinnbare Rohstoffe (AMR) group has carried out a number of cruises in the Pacific since 1971. This group chartered for two years Deepsea Venture's R/V Prospector and has been using since 1972 the well-equipped R/V Valdivia (see figure 1). The AMR group plans five expeditions south-east of Hawaii in 1974. CNEXO of France, in association with Le Nickel, has undertaken surveys in the South Pacific since 1970. CNEXO has established an oceanographic centre in Tahiti which supports its extensive nodule programme in the general vicinity of French Polynesia. 16/

The Sumitomo - DOMA (Deep Ocean Minerals Association) group has carried out extensive nodule surveys in the Pacific and has dredged nodule tonnage for processing research. DOMA, which is made up of 27 leading Japanese companies, completed an advanced vessel specifically designed for sea-bed resource exploration. The Soviet Union has conducted several cruises using the R/V Vityaz and has reported a number of interesting nodule grades from the South Pacific. 17/

2. Nodule mining technology

The mining systems under development comprise four major components: the mining/loading head; materials elevation/hoisting system; surface facility; and product transportation to shore plant. A schematic presentation of the major components of deep-ocean mining systems is given in figure 2.

(a) Nodule collection

Several forms of nodule gathering apparatus are under development. The dredge variety currently is thought to have the best potential for use in commercial production. Typically the dredge incorporates a sizing system to pick up nodules within a certain size range while excluding very large pieces as well as fine bottom silt. It is usually sufficient to drag the dredge head across the ocean floor to loosen the nodules from the substratum. The mining equipment must be kept as mechanically simple as possible to minimize maintenance. One problem encountered, however, is the construction and operation of the very wide dredge head needed to collect the desired volume of nodules per hour (200 to 400 tons). The large dredge size is required because of the relatively low nodule concentration at the sea floor (1.5 to 5 lb/sq. ft.) and the maximum practical speed for operation of the system (1 to 3 knots).

Three miner/loaders are shown in figure 3. The Deepsea Ventures and the AMR are both airlift systems with mining heads of the towed dredges type. The bottom crawler has a tracked drum for nodule pick-up. 18/

16/ CNEXO annual report, Paris, 1972.

17/ N. S. Skornyakova and P. F. Andrushchenko, "Iron Manganese Nodules From the Central Part of the South Pacific", Oceanology, vol. 8, No. 5, 1968, pp. 692-701.

18/ G. W. Sheary and J. E. Steele, "Mechanical Deep Sea Nodule Harvester", United States Patent 3,480,326, 25 November 1969.

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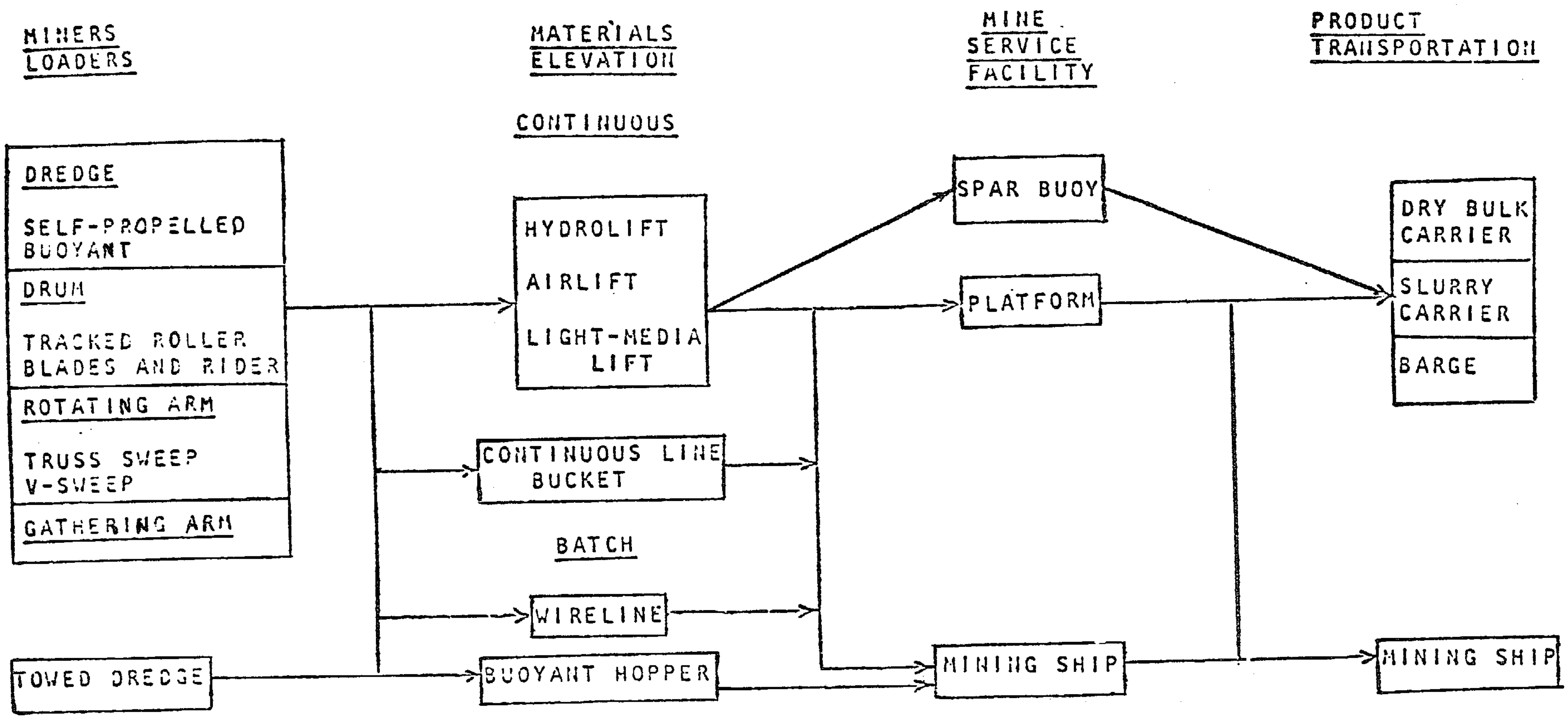
F-gure 2. Components of nodule mining system



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(b) Materials elevation

Another critical factor in nodule mining is the materials elevation/hoisting system. Continuous systems can be based on: air lift, hydrolift (hydraulic hoisting), light-media lift and mechanical lift such as the CLB system. Batch systems include wireline dredging which, although useful for collecting tonnage samples, is not regarded as an economic large-scale production system due to its high cost when used at great depths. A bouyant hopper (submersible hopper) system has been proposed. 19/20/ Whether this system is being developed for materials elevation is not known, although the concept is somewhat akin to the Summa Corporation barge. 21/

An air-lift is technically a three phase flow - air, nodules, and water. Compressed air is injected into the main pipe at various water depths to sustain the lifting action. Deepsea Ventures successfully tested an airlift device in 2,500 feet of water over the Blake Plateau in 1970. On 6 May 1974, Tenneco, Inc. announced the formation of a new consortium with three Japanese companies: Nichimen Co. Ltd., C. Itoh and Co. Ltd., and Kanematsu-Gosho Ltd. An additional European partner will be announced shortly. The five companies will have an equal equity participation in Deepsea Ventures. They will invest about $US 20 million over the next three years to test mining and processing systems and to evaluate an ore body in the Pacific Ocean.

A hydrolift is technically a two-phase flow - nodules and water. The pump can be located close to the bottom or at an intermediate depth 22/ (see figure 3) The Technology for hydraulic and hydrolift pumping is well-developed and is used, for instance, in the coal industry. But working at such depths and lifting such volumes as required in nodule mining represent giant steps beyond current capability. The hydrolift technique seems to be favoured by Kennecott, 23/ which has recently announced the formation of a multinational group including, in addition to Kennecott (50 per cent equity), Rio-Tinto Zinc (20 per cent) and Gold Fields (10 per cent) of the United Kingdom, Norande Mines (10 per cent) of Canada and Mitsubishi Corp. (10 per cent) of Japan. They announced plans for a large-scale mining test as part of a $US 50 million, five-year mining and processing development programme. 24/

19/ G. W. Lehmann, "Submersible Mining, Lifting, and Towing Barge", United States Patent No. 3,220,372, 30 November 1965.

20/ J. C. Wenzel, "Systems - Development Planning", chapter in Ocean Engineering, Brahtz, J. F. (editor), J. Wiley, 1968, p. 110.

21/ Business Week, 16 June 1973, pp. 47, 50.

22/ J. L. Mero, "Dredge Underwater Pick-Up Head Assembly", United States Patent No. 3,226,854, 4 January 1966.

23/ C. R. Tinsley, "In Search for Commercial Nodules, Odds Look Best in Miocene-Age Pacific Tertiary System", Engineering and Mining Journal, June 1973, pp. 114-116.

24/ Metals Week, 4 February 1974, p. 6.

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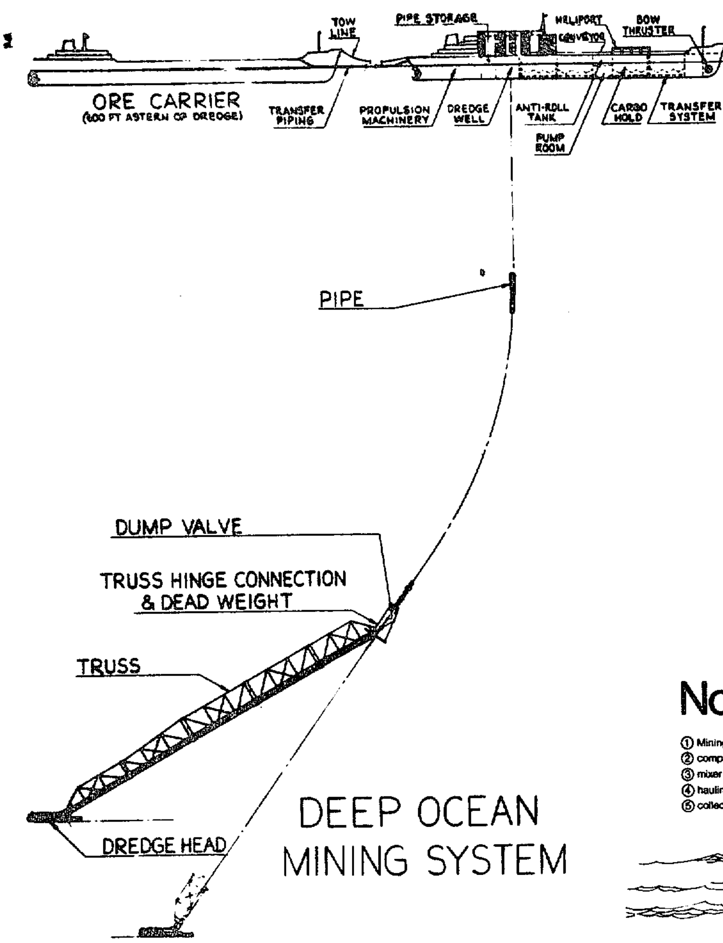
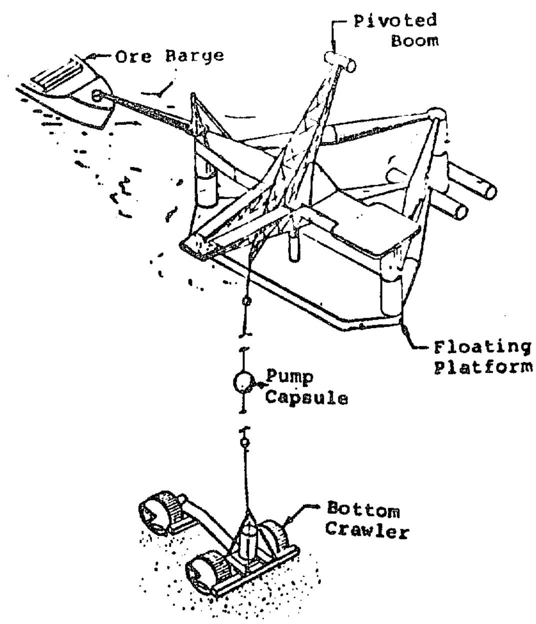
Figure 3. Artist's conception of the likely operation of three systems proposed for mining nodules

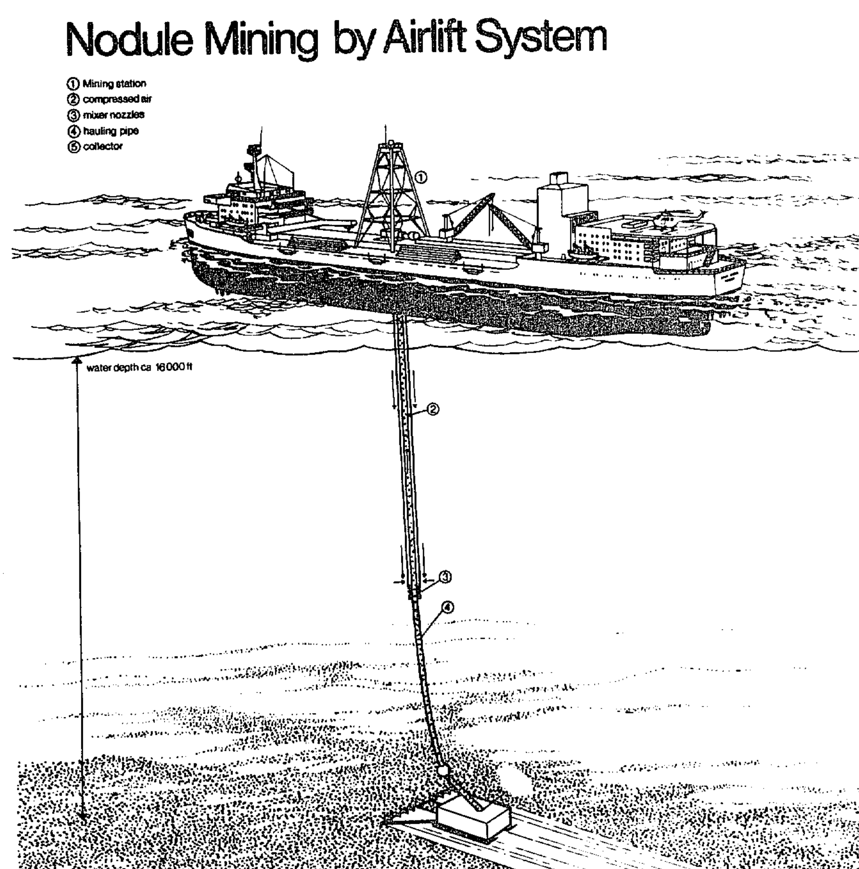
DEEPSEA VENTURES
OCEAN MINING SYSTEM



Courtesy of Deepsea Ventures

BOTTOM CRAWLER/
SEMISUBMERSIBLE
SURFACE FACILITY
CONCEPT





00051 Courtesy of A. M. R. /...

The Hughes system is thought to operate on the hydrolift principle. The major components of the system are the 36,000-ton Hughes Glomar Explorer and a sea floor mining vehicle which is connected to the ship by a string of 16-inch pipe and an umbilical cable that supplies electric power and control circuits. A large submersible barge plays a key role in the system. The mining vehicle is too large and heavy to be handled by the ship's gear in a conventional manner and must be installed from beneath the ship. The unit is loaded onto the submersible barge which meets the ship in calm waters of a specified depth. There, the barge submerges and the docking legs of the ship engage the mining vehicle which is then connected to pipestring lowered from the ship's rugged derrick. 25/ The Hughes ship (figure 5) left the west coast of the United States in January 1974 to join the barge for tests off Baja California. 26/ Actual mining on a pilot scale may begin in late 1974 or early 1975.

The CLB system uses a continuous polypropelene braided rope with dredge buckets attached. At the top, the loop is wound through traction motors while the bottom part of the loop drags along the ocean bottom. The CLB system was tested off Tahiti in August 1970. 27/ A later CLB test in August/September 1972 recovered seven tons of nodules off Hawaii. 28/ Several participants of the CLB consortium under the leadership of CNEXO of France, are continuing work on a modification of the CLB, 29/ which would use two ships working in tandem (see figure 4); the main components of this modified system are expected to be ready for tests in 1974. 30/ Sumitomo is developing continuous ship handling equipment for the dredge baskets and is also doing additional research in the operation of the CLB system. The participants of the CLB consortium met in Houston, Texas, in early May 1974 to plan the financing and construction of the modified two ship system, which is expected to be ready for tests in late 1975. The system will be built in France by Ateliers et Chantiers de Bretagne. 31/

The Sumitomo group, in co-operation with MITI is now proposing a large-scale manganese nodule venture with possible commercial operations by 1980. 32/ Sumitomo would probably use the CLB mining technique.

25/ "Hughes Glomar Explorer begins sea tests of mining systems", Ocean Industry, March 1974, pp. 32-34.

26/ Ocean Science News, 11 January 1974, p. 1.

27/ Y. Masuda, M. J. Cruickshank and J. L. Mero, "Continuous Bucket-Line Dredging at 12,000 Feet", Offshore Technology Conference, 1971, Paper No. 1410.

28/ Mining Magazine, January 1973, p. 7.

29/ CNEXO, Annual Report, 1972, Paris.

30/ CNEXO, Bulletin d'Information, No. 61, January 1974, p. 5.

31/ Ibid.

32/ Metals Week, 11 June 1973, p. 2.

/...

(c) Surface vessel

The so-called first generation mining systems are likely to use the mining ship itself as the surface platform. Tug assistance may be used for directional movement in some systems. A pipe system for nodule lifting will require a derrick on board ship. Alternatives to a mine ship are a spar buoy or a semi-submersible platform. A spar buoy is a long cigar-shaped semi-submersible which when tilted on one end creates a small but highly stable working platform on its other end. 33/ Semi-submersible floating platforms are extensively used in the off-shore oil industry for work in deeper waters (figure 3). Both the spar buoy and the semi-submersibles, however, have a poor capability for lateral movement.

The first generation of mining ships will do minimal processing at sea - perhaps crushing and/or drying the nodules - and the nodules will be transported in bulk by the mining ship itself (particularly a CLB mining ship 34/) or transferred at sea to a dry or bulk carrier.

3. Metallurgical processing

Nodules have a complex microscopic structure and are composed of fine-grained oxide material. 35/ They can vary widely in chemical and physical properties according to location, e.g. Blake Plateau nodules from the Atlantic are high in calcium, whereas those from the North Pacific are more siliceous. As a result, processing technology and costs for one type of nodule may not apply elsewhere.

Kennecott, Deepsea Ventures and Inco are expected to have completed nodule processing research. 36/ Other groups - Summa Corp., AMR, DOMA - are fairly advanced in their process development programmes. Kennecott has operated a half-ton per day pilot plant for over a year. Inco has been carrying out laboratory tests at its Sudbury plant in Canada. Deepsea Ventures has completed a phase of its tests in a one-ton per day pilot plant and plans to build a larger pilot plant, possibly in 1974.

The two basic approaches to nodule processing can be classified as pyrometallurgical and hydrometallurgical, the latter based on chloride, ammonia or sulfur oxide reaction. Some of these processes are considered technically possible, but not necessarily economically feasible. Heavy emphasis is being placed on the development of hydrometallurgical nodule processing systems.

33/ D. M. Taylor, "New Concepts in Offshore Production", Ocean Industry, February 1969, pp. 66-70.

34/ J. L. Mero, "Recent Concepts in Undersea Mining", American Mining Congress, 1971 Mining Show, Las Vegas, Nevada, 4 August 1971.

35/ P. H. Cardwell, "Extractive Metallurgy of Ocean Nodules", Mining Congress Journal, November 1973, pp. 38-43.

36/ Metals Week, 21 January 1974, p. 10.

4. Government activities

Government activity can take several forms, such as in particular: (1) direct sponsorship or funding of research and development; (2) direct venture in mining or processing; and (3) indirect sponsorship through use of government facilities, taxation advantages, or university aid. A brief review of the activities reported in recent years is given below. 37/

Australia's Bureau of Mineral Resources used the Navy vessel R/V Diamantina to dredge for nodules along a 200-mile stretch of the 39th parallel in June 1972. In New Zealand, the Department of Scientific and Industrial Research is giving increasing emphasis to studies on the distribution and chemical composition of manganese nodules and coatings. 38/

In France, CNEXO has been conducting extensive exploration for nodules and is sponsoring engineering research for a modification of the CLB mining system. 39/ Research on nodule processing is being done by the French Atomic Energy Commission.

The Japanese Government has been very active in the sponsorship of exploration programmes and development of mining and metallurgical processing. Its Science and Technology Agency subsidized Sumitomo Shoji and Sumitomo Shipbuilding and Machinery to conduct tests of a small-scale CLB system in 1968. 40/ MITI subsidized the Sumitomo group in 1970 to carry out research 41/and conduct a 1/10-scale CLB test off Tahiti. 42/ MITI again subsidized Sumitomo in 1971 to develop automatically detachable buckets for the CLB. 43/ In mid-1972, the Industrial Science and Technology Agency gave a subsidy to Sumitomo Metal Mining to assist the construction of a $106,000 test plant which would be partially used to conduct research and development on nodules processing. 44/

37/ See also United Nations "Sea-bed mineral resources: recent developments", document A/AC.138/90, July 1973.

38/ ECAFE, Report of the Committee for Co-ordination of Joint Prospecting for Mineral Resources in South Pacific Off-shore Areas (CCOP/SOPAC), first session, 7-13 November 1972 (E/CN.11/L.343), p. 34.

39/ CNEXO annual report, Paris, 1972.

40/ Sumitomo Shoji Kaisha, "Historical Review of Manganese Nodule Development by the Sumitomo Group", 25 September 1972.

41/ J. E. Flipse, M. A. Dubs and R. J. Greenwald, op. cit., pp. 602-700.

42/ Y. Masuda, "Development Work to Deep Sea Resources of Manganese Nodule Using Continuous Line Bucket System (CLB) by Japanese Group and its Future". 2nd International Ocean Development Conference Preprints, Tokyo, 5-7 October 1972.

43/ Sumitomo Shoji Kaisha, op. cit.

44/ Japan Metal Journal, 26 June 1972, p. 8.

/...

Governmental participation will increase with MITI's proposed creation of a large semi-public venture for nodule mining and processing called Deep Ocean Mining Association (DOMA). Funds would be allocated by industry and Government starting in 1976 or 1977. 45/ MITI has subsidized the construction of a sophisticated new vessel which should be ready to conduct manganese nodule surveys by mid-1974.

In the United Kingdom, the Department of Trade and Industry has offered financial support of up to $US 1.8 million to Rio Tinto Zinc and Consolidated Gold Fields, which are two British members of the recently created - five company - Kennecott group. These funds would be repaid if the project proves commercial. These companies have, in turn, agreed that British firms would have first call on their 30 per cent share of the metals to be produced by the Kennecott group. 46/

In the United States, government activity in nodule research has been carried out by the United States Bureau of Mines, the United States Geological Survey and by the National Oceanic and Atmospheric Agency (NOAA). However, the only federal research centre dealing solely with marine minerals was closed by NOAA in March 1973. The United States Geological Survey maintains an active nodule programme. The United States National Science Foundation is sponsoring a $500,000 a year interuniversity programme under the auspices of the International Decade of Ocean Exploration. The money is being spent primarily in studying the origins and chemistry of the nodules. The programme's financial commitment is due to be expanded to $1 million/annum in the second phase. The University of Hawaii will receive some United States government support for nodule exploration and environmental impact surveys in 1974.

The Soviet Union has been actively engaged in nodule research and prospecting since the early 1950s. Large numbers of photos and samples of nodules have been obtained. 47/ A Marine Geological Prospecting Board was formed in early 1971 to promote better co-ordination of activities in marine minerals. A COMECON meeting in Riga discussed geological prospecting and greater use of ocean resources. 48/

The Government of the Federal Republic of Germany granted support for a Preussag-Metallgesellschaft joint venture to study and explore for nodules in 1969. In 1970 and 1971 the Government provided funds to charter Deepsea Ventures' R/V Prospector for Pacific nodule exploration cruises. Private firms converted

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45/ Metals Week, 15 January 1973, p. 9.

46/ Metals Week, 4 February 1974, p. 6.

47/ N. S. Skornyakova and P. F. Andrushchenko, "Iron Manganese Nodules form the Central Part of the South Pacific", Oceanology, vol. 8, No. 5, 1968, pp. 692-701.

48/ New York Times, 24 April 1971, "Soviet Bloc Plans Big Sea-Bed Study".

/...

a stern trawler to the deep-ocean exploration vessel R/V Valdivia, which is now used for nodule surveys. The West German Federal Ministry for Education and Science has chartered this ship for four years, thus providing substantial support for a comprehensive nodule survey programme. It is reported that a sister ship is being built with the help of a government subsidy. 49/

The AMR group - Preussag, Metallgesellschaft, Salzgitter and Rheinbraun - has received a $US 3 million subsidy for a feasibility study on the mining of manganese nodules. 50/ The AMR group is spending about $3.1 million a year on nodule research and development with $700,000 annually coming from the Bonn Government. 51/

Tonga, Western Samoa and Fiji have shown great interest in locating commercial grade nodule deposits close to their shores. The United Nations Economic Commission for Asia and the Far East (ECAFE), through its Committee for Co-ordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas, is sponsoring two nodule survey projects in this area. 52/

5. Proposals for government legislation

A bill before the United States Congress, usually referred to as S.2801 (now S.1134) has been the subject of hearings before the Subcommittee on Minerals, Materials and Fuels of the United States Senate Committee on Interior and Insular Affairs. The bill basically provides for the United States Secretary of the Interior to register deep-ocean mining leases of 40,000 sq.km on a first-in-time, first-in-right basis. The 15 year lease could be held for a total expenditure of $US 6.2 million. Three-quarters of the lease would be relinquished within 10 years of the issue date or at the start of commercial production. An escrow fund established from a portion of United States taxes would be distributed to certain "reciprocating" developing States designated by the President. The bill would also give protection, to licensed United States companies, against possible adverse effects on their financial position that might be brought about by regulations of an international régime. The United States Government would indemnify such losses to licensed operators under this "interim" legislation until the fortieth anniversary of the issuance of the licence. 53/

49/ D. R. Horn, B. M. Horn and M. N. Delach, "Ocean Manganese Nodules Metal Values and Mining Sites", Technical Report No. 4, International Decade of Ocean Exploration, N. S. F. Washington, D. C., 1973.

50/ Metals Week, 18 December 1972, p. 3.

51/ Metals Week, 12 March 1973, p. 10.

52/ Project (CCSP-1/TG.1) "Seabed investigations for manganese nodules on the deep submarine shelf on east side of Tonga platform"; and Project (CCSP-1/WS.2) "Seabed investigations for manganese nodules in oceanic areas surrounding Western Samoa"; see ECAFE (document E/CN.11/L.343) op. cit., pp. 33-38.

53/ Senate Hearings, op. cit.

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II. THE PROBABLE IMPACT OF NODULE MINING

1. Forecasting future production of metals from nodules: the problems involved

The accuracy of a forecast is far less dependent on the complexity of the mathematical model used than on the quantification of the major parameters and the assumptions regarding their behaviour. It is important, therefore, to stress the uncertainties involved in trying to forecast the probable production of metals from nodules, which in itself is the first step in any attempt to assess the future impact of the nodule industry on world market in general and on the mineral exports of the developing countries in particular.

At the risk of stating the obvious, it must be recalled that the "nodule industry" is not yet an ongoing reality. On the contrary, nodule mining technology and metallurgical processing are still in the developmental stage. Considerable uncertainties therefore becloud any estimates of performance by the future industry.

It is natural that officials of firms developing nodule systems should be optimistic about the future. Indeed all available information tends to confirm the industry contention that nodule mining will be a very profitable proposition (see section III.5.b, below). On the other hand, one should not minimize the potential hazards involved in the continuous operation of mine ships in the high seas with sophisticated equipment for gathering and lifting nodules from about 5,000 metres water depth. The vagaries of the weather at the surface, resistance of materials subject to the high pressures and corrosion of the water column, topographic hazards at the sea-floor, the logistics of maintaining a large crew out at sea for an extended time, are some of the factors that will bear on the operational results of nodule mining once it starts on a commercial scale. It remains to be seen how attractive the economic returns of the industry will actually turn out to be.

2. The probable scenario for the next decade

Considering the problems involved in forecasting future production of metals from nodules, the projections presented in this section must be interpreted as orders of magnitude, based on the best information available. In order to facilitate the periodic revision of these projections, their underlying assumptions are explained below.

(a) The methodology used

Estimates of metal production from nodules are attempted for the arbitrarily selected decade 1976-1985. For the purpose of these projections, it is assumed that an internationally agreed régime would come provisionally into force by 1976, thus providing the legal framework enabling the interested companies and groups to go ahead with their nodule programmes. The projections are based on an evaluation of the probable time that it is likely to take for the various groups to conclude successfully all activities in their implementation programmes and start commercial production. Assumptions are made regarding metal production per ton of dry nodules, size of projects and the schedule of start-up operations. 54/

(i) Metal production per ton of nodules

Metal output per ton of dry 55/ nodules is a function of nodule grade and of metallurgical recovery. The figures used are a combination of data: information made public by industry officials; published scientific data; and information provided directly by geologists and other officials associated with the industry.

Some European and American geologists working for the nodule industry have suggested that their companies' targets to identify ore bodies containing over 3 per cent combined nickel and copper have already been met. Metal recovery depends on the metallurgical process adopted, but it seems that the industry might obtain a 95 per cent yield on the recovered metals. 56/ The preliminary assumptions made on the grade of ore-bodies likely to be exploited by the first generation of nodule miners and metal production, including the recovery of several trace metals (molybdenum, vanadium, zinc, silver, etc.), 57/ are summarized in table 1.

54/ Implicit in all these assumptions is that costs of metals produced from nodules will be competitive with alternative land sources of these metals.

55/ Since most metallurgical processes under consideration require the prior drying of nodules, plant capacity is generally referred to in terms of dry nodules. On the other hand, the capacity of mining systems is expressed in terms of wet nodules, since water accounts for about one third of the weight of wet nodules.

56/ "Studies to date indicate the practicality of process yields of 98 per cent plus purity manganese, nickel, cobalt and metallic copper." R. Kaufman and A. J. Rothstein, "Recent Developments in Deep Ocean Mining", in 6th Annual Preprints of Marine Technology Society, 29 June-1 July 1970, Washington, D.C. It is possible that some metallurgical processes will yield lower recovery rates than 95 per cent. These processes, requiring much lower total investments, are designed to optimize return on investment and not metal recovery.

57/ Deepsea Ventures, Inc. "Pilot plant operation of a process to produce metals from manganese nodules", mimeograph; and Undersea Technology, April 1973, pp. 26-27.

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Table 1. Estimated metal production per million tons of high grade nodules (metric tons)

Metal	Metal content per weight of dry nodules	Approximate Metal production per million tons of dry nodules* a/
Manganese (if recovered)	24%	230,000 tons
Nickel	1.6%	15,000 tons
Copper	1.4%	13,000 tons
Cobalt	0.21%	2,000 tons
Other metals	0.3%	2,500 tons

* Assuming 95 per cent metallurgical recovery except for trace metals where an 80 per cent rate is assumed.

a/ The estimated metal production from nodules used in the recent UNCTAD report (TD/B/483) are different: they were based on data from a previous United Nations publication (A/AC.138/36) of 1971.

These estimated volumes of production are confirmed by separate company statements. The volume of nickel and copper coincide with the estimates of Kennecott Copper, Inc. 58/ The volumes of manganese, cobalt and trace metal recovery are the figures indicated by Deepsea Ventures, 59/ which some experts think to be on the low side.

58/ Marne Dubs, Director of the Ocean Resources Department of Kennecott stated that "One such /nodule/ plant of 3 million /ton/ size might produce on the order of 100 million pounds per year of nickel and 85 million pounds of copper along with other products mentioned". (This would amount to 15,150 tons of nickel and 12,880 tons of copper for each 1 million tons of nodules.) Mineral Resources of the Deep Seabed, hearings before the Sub-committee on Minerals, Materials and Fuels on S.1134. 17 May 1973, p. 109.

59/ Statement by Mr. N. W. Freeman, Chairman of the Boards of Tenneco, Inc. and Deepsea Ventures, Inc. before hearing on Senate Bill 2801, of the Sub-committee on Minerals, Materials and Fuels of the United States Senate, on 2 June 1972. Mr. Freeman indicated that the expected metal output from a production unit of 1 million tons of dry nodules per year would be:

Manganese	-	230,000 metric tons
Nickel	-	11,400 metric tons
Copper	-	9,100 metric tons
Cobalt	-	2,000 metric tons
Other metals	-	2,500 metric tons

(including molybdenum, vanadium, zinc and silver)

/...

(ii) Size of operations

Like most mining and metallurgical operations, nodule systems are subject to considerable economies of scale. Decisions regarding the size of the total system are based on market considerations and the size relationship between the mining and processing stages.

It is known, for instance, that economies of scale are much stronger at the stage of processing. As a result, unit costs are probably still decreasing for plant sizes of 3 to 4 million tons of dry nodules per year. On the other hand, it seems that mining rigs, of the hydraulic lift type, reach their optimum size at a capacity of between 5,000 to 10,000 tons of wet nodules per day, which is equivalent to 1-2 million tons of dry nodules per year. It may be expected, therefore, that most nodule systems will be designed to process 3 to 4 million tons of dry nodules per year with the use of 2 or 3 mining rigs. Deepsea Ventures is planning to recover manganese in metal form, the world market for which is rather small, and envisages a plant of 1 million tons of nodules per year.

The projections of this report assume that nodule systems until 1985 will be of two sizes: 1 million tons/year and 3 million tons/year. 60/ This assumption is in fact an extension of the situation of American companies to companies and groups in other countries. 61/

(iii) Entry of new nodule operations

The timing question is likely to prove one of the most speculative in the projections equation. A multitude of factors can affect the entry of new nodule operations, more likely postponing the start of commercial production to a later date. Consequently, the timing schedule, compiled for the six companies (Figure 6) or groups known to be most advanced in developing nodule systems, could be taken as a rather optimistic assumption that no major problems would unduly delay the plans of the industry.

The time-table was derived from an assessment of companies' stated plans and an evaluation of the most probable time for implementation of construction facilities for those companies or groups that have not publicized their

60/ It must be understood that these figures are mere approximations in the absence of extensive tests of large-scale mining rigs.

61/ "American mining companies at present are considering production rates of about 1 to 3 million tons of manganese nodules per year.", Leigh S. Ratiner, op. cit., p. 27.

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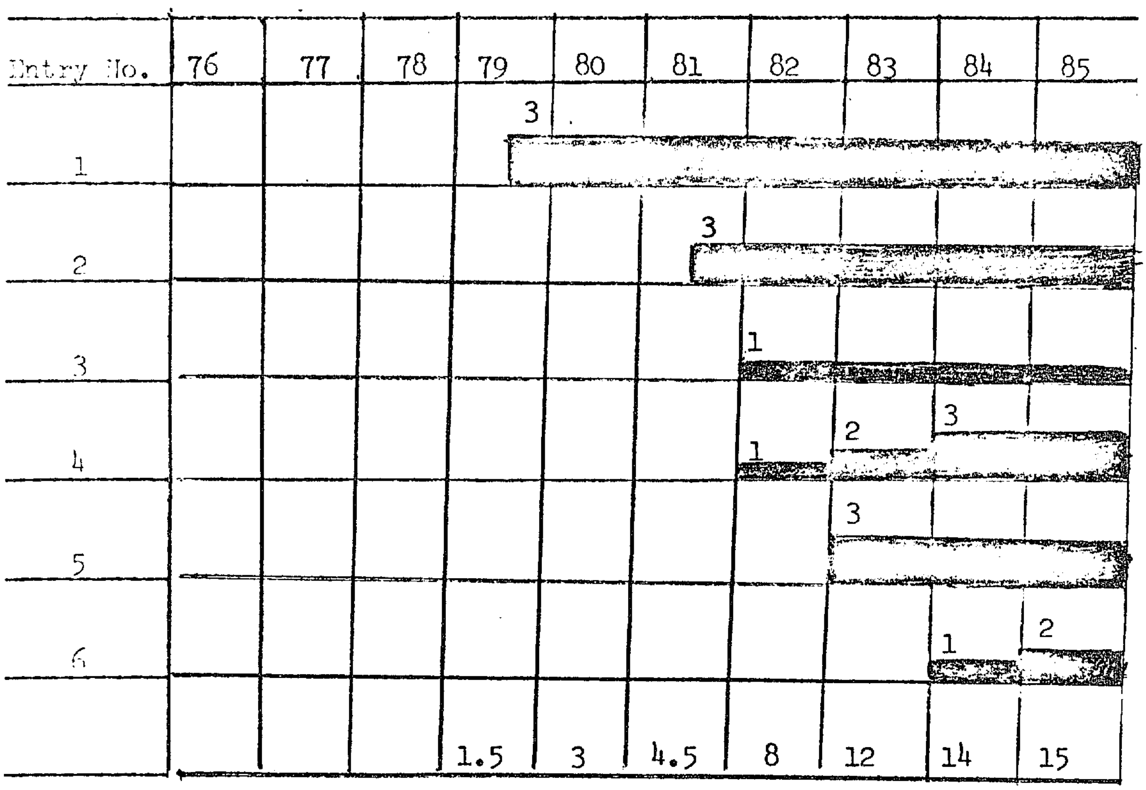
Figure 6. Forecast of entries into nodule mining: 1976-1985 1/

(in million metric tons of dry nodules)



1/ In UNCTAD reports TD/B/449.Add.1 and TD/B/483 different assumptions were used with alternate entry schedules, some starting as early as 1974.

intentions. 62/ Some projects are assumed to start operating at full capacity. This would happen as a result of the implementation schedule of these projects: the decision to build the processing plant would have to await the successful testing of large-scale mining systems. Once the mining tests are concluded and the "go-ahead" is given for plant construction, some 2 to 3 years would elapse before metal production could start. In the meanwhile the original mine equipment would in all likelihood be used for mining nodules which would be stockpiled until processing could start. If it is assumed that a second mine ship might be commissioned around the time the processing plant starts operation, the 3 million ton/year projects could commence production at full capacity. For the sake of simplicity it is assumed that output will be equal to a mining rig's total annual capacity, even in the first year of operation.

The timing of entry might be affected by the degree of control over the pace of nodule mining that may be exercised by the international authority, in particular for the first few operations. The assumptions on timing of entry made in figure 6 are based on the absence of controls. If powers such as control over the pace of exploitation are exercised by the authority, a delay of perhaps one or two years might occur for the projects assumed to enter into operation up to 1981, though the total tonnage of nodules that is likely to be mined by 1985 would probably be unaffected if the control scheme were established along the lines discussed in section III.3 below. The global figure of 15 million tons of nodules likely to be mined by 1985 is therefore more meaningful than the precise timing of individual entries in the intervening period.

(b) Forecasting probable metal recovery from nodules by 1985

Based on the assumptions developed in the previous section, a forecast of metal production from nodules in 1985 becomes a straightforward exercise. It would amount to a multiplication of the estimated metal recovery per ton of dry nodules by 15 million tons. Considering however, that only two companies or groups have indicated their intention to recover manganese from nodules, the calculation for this metal will instead be based on 4 million tons.

It should be stressed that the estimates for production of manganese, as well as cobalt and other minor metals have a lower degree of confidence than the estimates for nickel and copper.

62/ The implementation of a project requires the successful completion of work in a number of stages. Many activities can only start once some preceding activities are completed. From the time a decision is reached to go ahead with a nodule project, it would probably take some three years of accelerated construction work before commercial mining and processing could start. But the implementation stage presupposes the resolution of a number of questions, such as: (1) the general legal framework relating to commercial operations in the international area; (2) obtaining exclusive rights for exploitation of the desired mine site; and (3) approval of the financing scheme for the whole project. The resolution of the financial question in turn, would require considerable prior progress in nodule exploration and equipment development programmes.

Table 2. Estimated metal production from nodules in 1985 a/

Metal	Estimated production (in metric tons)
Manganese	920,000
Nickel	220,000
Copper	200,000
Cobalt	30,000
Others	38,000

Source: Data from table 1 and figure 6 (except manganese, for which recovery is assumed from only 4 million tons of nodules).

a/ See foot-note to table 1.

The latter two metals will constitute the mainstay of the nodule industry; thus the effort to locate attractive mine sites is directed primarily at the nickel and copper content of the nodules. The content of manganese, cobalt and trace metals is probably of secondary importance except for nodules that contain heavy metals of the platinum group. 63/ Cobalt and the minor metals occur in varying quantities in nodules. It is known, for instance, that in some areas in the vicinity of French territories of the South Pacific extensive deposits are found with high cobalt content (above 1.5 per cent). Considering the low average cobalt content assumed for these projections (0.21 per cent), it is quite possible that the actual tonnage of cobalt output may be considerably greater than the 30,000 tons projected for 1985. Similar considerations are applicable to other minor metals.

A wide range of variance can also be expected in the total recovery of manganese from nodules. Only one firm in the United States has publicly affirmed its intention to produce manganese metal from 1 million tons of nodules. In Japan, research in nodule metallurgy is directed at finding an economic process to recover manganese. While it is possible that only the American firm will be producing manganese from nodules by 1985, it is also conceivable that advances in process research might make it possible for three or more ventures to recover manganese by that date. Hence, the uncertainty attached to the projected figure of 920,000 tons of manganese production by 1985.

63/ The recently reported occurrence of heavy metals of the platinum group in some manganese nodules could be very significant since the value of the trace elements of the platinum group might substantially exceed the value of copper, nickel and cobalt contained in nodules, ECAFE/CCOP, op. cit., (E/CN.11/L.343), p. 42.

3. The likely impact of nodule mining

An attempt to assess the likely impact of sea-bed mining, on world markets and on the exports of developing countries, requires in addition to the forecast of metal production from nodules, a forecast of metal production from traditional sources as well as a projection of demand for these metals. From the interaction of these variables it should be possible to assess the likely effect on prices of these metals. Demand and supply, however, are in turn dependent on prices. A rather complex econometric model would be required to indicate the likely impact of nodule mining on prices, and vice-versa, of prices on nodule mining and on traditional land-based mining. Given the uncertainties involving the major variables projected over a 10-year span, a similar approach is used in this report.

The degree of market penetration is used to provide a first approximation of the impact of nodule mining. The procedure involved is to estimate the share of the market for each metal which is likely to be supplied by the nodule industry. Based on the degree of market penetration it is possible to evaluate the probable influence on metal prices and to assess the implications for mineral exports of developing countries.

This approach amounts to treating the supply of metals from nodules as an independent variable. Such a method is acceptable if it is assumed that nodule mining will remain profitable throughout the period, and if the joint product and by-product nature of the nodule industry 64/ is taken into account. Considering the drawbacks of alternative methods, the market penetration approach would seem to provide a useful first approximation to the magnitude of the problems involved. 65/

64/ The most fundamental fact about the economics of nodules is the joint-product and by-product nature of the industry. Nodule processing will result in the simultaneous production of a number of minerals. Depending on the particular metallurgical process used, some minerals will constitute the primary output of the process (joint-products), while other minerals may also be recovered if additional stages of processing are included in the plant design (by-products). The minor metals in nodules, such as molybdenum, vanadium, zinc, silver and others, could either be produced as joint-products or as by-products. In most processes under consideration manganese could be recovered as a by-product. This distinction is important in that by-product recovery must consider only the additional (marginal) cost involved in the subsequent processing of the tailings disregarding all other previous costs such as mining, transportation, and initial stages of processing. By-product recovery will only be undertaken if the additional revenue derived from the sale of these products is greater than the additional costs involved in the subsequent processing needed, after the major minerals are recovered.

65/ Refinements to this approach might warrant additional studies.

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(a) Nickel

The most important uses of nickel are in the manufacture of stainless steel, alloys, and for electroplating. Nickel imparts certain properties to alloys, such as increase in strength and resistance to corrosion, that cannot be economically obtained by other means. New steels and alloys are constantly being developed. Over 40 per cent of nickel consumption is in the manufacture of stainless steel, the market for which has very good prospects for future growth. 66/ Nickel also has many other minor uses and its application is constantly increasing. World-wide consumption increased at the average rate of 6.5 per cent compounded annually from 1947 to 1970. A number of factors combined to make for a drop in demand in 1971, but the market has recovered since then and future prospects are for a minimum rate of 6 per cent long-term growth.

Supply is highly concentrated in a few industrial countries. Canada's dominant position, however, has been declining from some 94 per cent of the total mined in market economy countries in 1950 to 73 per cent in 1960 and approximately 58 per cent in 1970. Just three countries, Canada, France (New Caledonia) and the Soviet Union, accounted for 74 per cent of world mine production in 1972. Production of developing countries has been increasing but still accounted for less than 13 per cent of the world total by 1972.

For the purpose of evaluating the probable impact of nodule mining, a number of assumptions were made: (1) demand will increase at a cumulative annual rate of 6 per cent until 1985; (2) the share of developing countries in world mine production will increase to 20 per cent (13 per cent in 1972); 67/ (3) metal production from nodules plus smelter production from land ores will equal total consumption; (4) smelter production will represent, as in 1972, 94 per cent of the tonnage of land ores.

On the basis of these assumptions, it is estimated that production from nodules might account for about 18 per cent of total demand by 1985. This substantial market penetration may tend to depress nickel prices somewhat. Some high-cost laterite projects under consideration might be abandoned, but for the most part traditional producers are not likely to be seriously affected. In fact, production from land sources would need to increase by some 70 per cent from the level of 1972 mine production, in order to meet world demand. Most of this increase, however, would be required before 1980; from that time on almost all additional increases in demand would be satisfied by the nodule industry. In view of the mounting environmental difficulties with resulting rising costs in industrial countries and the various projects under consideration in developing countries, it is possible that the share of mine production from developing countries in 1985 will in fact be larger than 20 per cent.

66/ In particular in the auto industry, pollution control equipment, desalination plants, chemical industry, petroleum refining, liquefied gas industry and several ocean-related industries.

67/ A comprehensive survey of planned mine capacity is not available. Considering, however, the large projects under construction or in the planning stage in the Philippines, Indonesia, Guatemala, Dominican Republic, Colombia, Venezuela, Brazil, Botswana and Burundi, it is reasonable to expect that the share of mine production from developing countries by 1985 is likely to account for at least 20 per cent of the world total.

Table 3. Estimated market share of nickel production from nodules by 1985
(thousand metric tons)

	1972 1/	1985 2/ Tonnage	Percentage
World mine production:			
Developing countries	79.5	210 (c)	(17) (d)
Industrial countries	545.6	850 (c)	(65) (d)
Total	625.1	1,060 (a)	(82) (d)
Total smelter production (land ores)	587.5	1,000 (a)(b)	82
Production from nodules	-	220 (b)	18
Total consumption*	573.6 (e)	1,220 (e)	100

Source: 1/ World Metal Statistics, January 1974.

2/ Estimates.

* Excludes direct utilization of nickel in scrap form.

Notes: (a) Average recovery efficiency of metal from ore same as in 1972 (94 per cent).

(b) Smelter production from land ores plus production from nodules equal total consumption (long-run equilibrium of supply and demand).

(c) Developing countries producing approximately 20 per cent of world mine output.

(d) Reduced by 94 per cent.

(e) Excludes the substantial volume of direct use of nickel in scrap form.

(b) Copper

Electrical conductivity and resistance to corrosion make copper invaluable in the manufacture of electrical equipment, cables and wires for communication and electricial transmission lines, electrical appliances, tubing and sheeting for the construction and chemical industries, alloys and in a number of other uses. Despite competition in certain areas from aluminium, plastics, glass and other materials, demand for copper has been growing by an average of 5 per cent per annum

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for the past two decades. Demand has been particularly strong since 1972 and as supply failed to keep up with the pace of demand, prices rose reaching in late 1973 and early 1974 record levels of over $US 1.10 per pound. 68/

Long-term market prospects are quite attractive. Demand is expected to grow between 4 and 5 per cent annually until the end of this century. In response to favourable demand conditions producers are expanding mine and smelter capacities. Mine capacity outside the centrally planned economies bloc is expected to increase by 45 per cent between 1972 and 1978. 69/

Copper production is much less concentrated than is the case with the other three major metals to be recovered from nodules. Some 56 countries mine more than 1,000 tons of copper (metal content) per year. The industrial countries are the largest producers and consumers, the United States, the Soviet Union and Canada alone accounting for some 3.3 million tons of copper mined in 1972 or 46 per cent of the world's total. The developing countries, accounting for 42 per cent of total mine production (1972), are by far the leading exporters. In 1971, the latest year for which comparable statistics are available, net exports from developing countries in all forms (ores, concentrates, blister and refined copper) amounted to almost 2 million tons or 73 per cent of the world's net copper exports. 70/

Production from nodules is expected to have a very minor impact on copper markets by 1985. If demand for refined copper expands at an average rate of 5 per cent per annum, by 1985 it would amount to about 14.9 million tons. By contrast, production from nodules is expected to reach some 200,000 tons or 1.3 per cent of total consumption. Perhaps the most relevant yardstick for the probable impact of nodule exploitation on copper markets would be the production from nodules as a share of net imports of industrial countries. For example, in 1971 net imports of 2.2 million tons represented approximately 33 per cent 71/ of the total consumption of these countries. 72/ Assuming that net imports of

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68/ Metals Week, 4 February 1974.

69/ International Wrought Copper Council, Survey of Planned Increases in World Copper Mines, Smelter and Refinery Capacities, 1972-1978, London, 1973, pp. 6-7.

70/ Increased scrap recovery, releases from the United States Government stockpile and a faster expansion of mine production in industrial countries resulted in a decrease in the share of developing countries' net exports out of the world total refined consumption: from 31.2 per cent in 1968 to 27.4 per cent in 1971.

71/ This share is likely to increase during the period under consideration. It is known, for instance, that of the increase in mine capacity planned for 1972-1978, 52 per cent of the expansion was to take place in developing countries. International Wrought Copper Council, op. cit., pp. 6-7.

72/ Copper trade statistics for the centrally planned economy block are not sufficiently complete for international comparison. From the figures available, net trade is small, amounting to around 20 to 50 thousand tons of imports or exports, depending on the year.

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advanced market economy countries would still amount to one third of their total copper consumption in 1985, production from nodules would amount to only 5.5 per cent of the required net imports. In other words, production from nodules would be displacing about 200,000 tons of the approximate 3,630,000 tons of net imports that advanced market economy countries are likely to require by 1985. 73/

Table 4. Copper statistics: mine production, refined consumption and net exports of developing and industrial countries, 1968-1972 (thousands of metric tons)

	1968	1969	1970	1971	1972
Mine production	5 473.6	5 949.3	6 372.6	6 460.9	7 022.0
Developing countries	2 399.1	2 534.2	2 582.3	2 652.4	2 939.4
Industrial countries	3 074.5	3 415.1	3 790.3	3 808.5	4 082.6
Refined consumption a/	6 500.2	7 143.2	7 248.5	7 302.7	7 886.1
Developing countries	437.7	519.5	540.3	634.7	680.7
Industrial countries	6 062.5	6 623.7	6 708.3	6 668.0	7 205.4
Net exports b/	2 623.2	2 719.4	2 823.1	2 722.0	inc.
Developing countries	2 027.3	2 199.1	2 175.0	1 999.3	inc.
Industrial countries	595.9	520.3	648.1	722.7	inc.

Source: World Metal Statistics, August 1973 and January 1974.

Notes: a/ Includes scrap and releases from United States government stockpile.

b/ In all forms: ores, concentrates, blister and refined.

(c) Manganese

As stressed before, considerable uncertainties surround the estimates of manganese recovery from nodules. Any assessment of its possible impact on manganese markets must be viewed, therefore, as a precarious first approximation.

About 95 per cent of the world production of manganese ore is used in the steel industry, mainly in the form of ferromanganese. Very large reserves of

73/ By way of comparison, in 1971 net imports reached 723,000 tons in Japan, 472,000 tons in the Federal Republic of Germany, 371,000 tons in the United Kingdom, 308,000 tons in France, 260,000 tons in Italy, 130,000 tons in Belgium and 115,000 tons in the United States. By 1985 these volumes of net imports would probably double.

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manganese exist in many countries, both developing and industrial. The opening up of a number of large modern open pit mines and the utilization of economical bulk ore carriers contributed to a steady fall in prices for the past two decades (events over the past year, however, have led to a sharp increase in manganese prices). Demand for manganese is quite inelastic and thus additional supplies tend to depress prices.

The estimated manganese content in ores mined in 1971 reached 8.3 million tons, of which 46 per cent was produced in developing countries. 74/ Detailed trade statistics available for 1969 indicate that of 3.7 million tons of manganese-in-ore exported in that year, 56 per cent originated from developing countries. 75/ Comparable worldwide statistics on consumption are non-existent, but given the nature of manganese markets, it would be safe to assume that total demand is equivalent to world production. 76/ Assuming that manganese demand will keep expanding at an average annual rate of 5 per cent, by 1985 world demand should be approximately 16.4 million tons of manganese-in-ore.

The tentative estimate of manganese recovery from nodules by 1985 of 920,000 tons would amount to only 5.6 per cent of estimated world demand for that year. Considering, however, that the centrally planned countries as a bloc are net exporters of manganese, production from nodules would be directed at the needs of advanced market economy countries. Production from nodules might supply almost 13 per cent of the import requirements of these countries by 1985. 77/ Given the rather inelastic demand for manganese, 78/ and the ability of traditional suppliers to keep on expanding production for many years with only modest investments, the additional supply from the sea-bed will probably depress market prices. Moreover, if manganese is recovered from 10 million tons of nodules 79/ instead of the 4 million assumed here, production from nodules could account for about one third of the import needs of advanced market economy countries. In that case the market imbalance would be much greater and prices would fall considerably.

74/ United Nations, Statistical Yearbook, 1973 (Preliminary).

75/ UNCTAD, Problems of the World Market for Manganese Ore (document TD/B/C.1/105), July 1971.

76/ In fact, production has been somewhat lower in the past few years due to substantial releases from the United States government stockpile.

77/ If by that time the market share of advanced market economy countries remains the same as in 1969 (57 per cent), this group of countries would consume about 9.3 million tons of manganese. Furthermore, if it is assumed that, as in 1969, about 78 per cent of requirements by advanced market economy countries would be imported, this would amount to some 7.3 million tons of manganese-in-ore.

78/ UNCTAD, "Manganese Ore: Brief review of main problems and possible forms of action" (document TD/B/C.1/131/Add.4), p. 3, and UNCTAD, "The effects of production of manganese from the sea-bed, with particular reference to effects on developing country producers of manganese ore" (TD/B/483), of 23 April 1974.

79/ One operation of 1 million tons/year and 3 operations of 3 million tons/year.

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Developing countries exporting manganese will probably be significantly affected by nodule mining. The extent of this impact is difficult to assess, in view of the existing market structure. Most trade in market economy countries involves transactions from subsidiaries in producing countries to the parent companies - generally large steel producers - in industrial countries. This large "captive market" is not likely to be much affected in terms of volume, though the recorded value of transactions will probably decrease. Some older producers with higher costs due to lower ore grades, long distances from mine to port, and inadequate port facilities, will be the ones most affected.

Three developing countries, Brazil, Gabon and India, each export about $US 30 million annually of manganese ore and ferromanganese. Zaire, Ghana and Morocco export less than $US 10 million each. A few other countries export less than $US 2 million each. Exports of manganese constitute an important foreign exchange earner only in the case of Gabon, where it accounts for some 20 per cent of the total value of exports. For the other major developing country producers, manganese exports represent 2 per cent or less of total exports.

(d) Cobalt

Cobalt is an expensive metal with a relatively small market. It is used in a variety of industrial products, both metallic and non-metallic. The principal characteristic of the metal is probably its resistance to high temperatures, but it also possesses important magnetic and chemical properties, which make it particularly suited to a number of rapidly expanding advanced-technology industries. 80/ At considerably lower prices, cobalt could be substituted for various other non-ferrous metals. 81/ One potential market of particular interest is in electroplating where cobalt was substituted for nickel during the 1969 nickel strike.

Cobalt is produced primarily as a by-product of copper and nickel mining. Zaire is by far the largest producer accounting for two thirds of total mine output. By selective mining of high cobalt content copper ores, Zaire has traditionally adjusted supply to demand conditions. By-product production from other countries has been increasing rapidly, and new mining projects in the Philippines, Australia, New Caledonia, Canada and Zambia are expected to increase supplies by mid-1970s.

80/ The motor vehicle industry could become a major consumer of cobalt in heat-resisting alloys for the manufacture of gas turbines and as a catalyst in exhaust gases after-burners. J. D. Corrick, "Cobalt", in U.S. Bureau of Mines Minerals Yearbook, 1972 preprints.

81/ In this report it was pointed out that the long-term elasticity could not be forecast without further investigation. UNCTAD, Exploitation of the mineral resources of the sea-bed beyond national jurisdiction: issues of international commodity policy. Case study of Cobalt (document TD/B/449/Add.1), June 1973, pp. 2-5.

Statistics of cobalt production and consumption are generally incomplete and often conflicting. This is not surprising due to the by-product nature of cobalt production and its relatively small value in world commodity trade. Recorded mine production averaged 23,000 tons between 1970-1972 of which some 76 per cent was produced by developing countries (see table 5). Estimates of consumption must take into account the actual metal produced from ores, scrap use and releases from

Table 5. Cobalt: world mine production a/

(Co content in metric tons)

Country	1970	1971	1972 b/
Advanced countries	5 350	5 130	5 520
Australia	470	310	740 c/
Canada	2 070	1 960	1 880
Finland	1 270	1 270	1 270
USSR c/	1 540	1 590	1 630
Developing countries	18 500	16 600	17 740
Cuba	1 540	1 540	1 540
Morocco	600	980	1 150
Zaire	13 960	12 000	13 000 c/
Zambia	2 400	2 080	2 050
Total	23 850	21 730	23 260

Source: J. D. Corrick, op. cit., p. 5.

a/ In addition to the countries listed, Bulgaria, Cyprus, Democratic Republic of Germany, New Caledonia, Norway, Poland, United States, Spain and Sweden are known to produce ores (copper, nickel, and/or pyrite) that contain recoverable quantities of cobalt, but available information is inadequate to make reliable estimates of output levels. Other nations may also produce cobalt as a by-product component of ores and concentrates of other metals.

b/ Preliminary.

c/ Estimate.

/...

the United States government stockpile. It is estimated 82/ that during 1969-1971 consumption outside the centrally planned countries averaged 23,800 tons, having grown at an average annual rate of 6.2 per cent over the previous decade.

For the purpose of this exercise, a 6 per cent annual rate is assumed for the period 1972-1980, increasing to 8 per cent during 1981-1985. 83/

World demand by 1985 is projected as 60,000 tons against an estimated production from nodules of 30,000 tons. This would leave another 30,000 tons for traditional suppliers. It can be expected that cobalt prices will start falling when production from nodules reaches the market and by 1985 it is assumed that it should be about two thirds of present levels, or around $US 2.00/lb.

If on the other hand demand fails to expand as fast as this report suggests, or if cobalt production from nodules turns out to be considerably larger than 30,000 tons, the pressure on cobalt prices will be more serious. Prices might fall then to the level of nickel price since cobalt could then be used as a substitute for some uses of nickel. In fact, this situation is likely to develop in the second half of the 1980s.

(e) Summary

The nodule industry is expected to become an important source of minerals by 1985 (see table 6). The impact of sea-bed production on world markets will vary considerably for the four major metals. By that time, nodules will be the most important source of cobalt, supplying at least half of the world market with prices dropping to about two thirds of present levels. Many uncertainties surround the situation of manganese: recovery from nodules might account for 13 per cent of import requirements of advanced market economy countries, resulting in a drop of at least 50 per cent in the price of manganese metal, and some decline in prices of manganese ore and ferromanganese. Nickel markets will be affected by the output from nodules since it will probably account for over one quarter of the import requirement of industrial countries (table 6); considering the elastic nature of demand for nickel, only a gentle decline is expected in its price. The output of copper will only have a minor impact on copper markets; it might amount to 5.5 per cent of the net import requirements of the advanced market economies.

82/ UNCTAD, Case study of cobalt, op. cit., p. 4.

83/ For the period 1972-1980 this is a simple extrapolation of past trends based on a continuation of existing conditions (high prices, i.e., $US 3.10/lb.; relative scarcity; similar end uses). It is obvious, however, that when a substantial output from nodules reaches the market, lower prices will result. The nodule industry will certainly strive to expand the markets for cobalt by assuring continued supply at lower prices. Thus, an 8 per cent annual growth rate for cobalt demand is assumed for the period 1981-1985, which is the period when it is expected that subtantial supplies from nodules would be available.

Table 6. Manganese, nickel, copper and cobalt: probable production from nodules, estimated world demand and estimated net import requirement of industrial countries in 1985 (thousand metric tons)

	Probable production from nodules	Estimated world demand	Production from nodules as a percentage of world demand	Estimated net import requirement of industrial countries b/	Production from nodules as a percentage of net import requirement of industrial countries
Manganese	920	16 400	6	7 300	13
Nickel	220	1 220	18	770	26
Copper	200	14 900	1.3	3 600 a/	5.5
Cobalt	30	60 a/	50	n.a.	n.a.

Source: World Metal Statistics, UN Statistical Yearbook (UNCTAD), Problems of the World Market for Manganese Ore.

a/ Excluding the centrally planned economies.

b/ Assuming that net import requirements would be proportionately the same as in 1972.

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4. The long-term prospect of nodule mining

Sustained long-run development of the nodule industry will depend on its relative competitive position, vis-à-vis other sources of metal supply, namely land mining and recycling. The relative competitive position of these alternative sources of mineral supply will depend in turn on market conditions, technological developments and possible institutional constraints.

The institutional framework for the exploitation of resources of the international area might include regulations for a rational long-term planning of nodule development. This question is examined in the following chapter. It is clear, however, that the controls or regulations which may be adopted, will be designed to orient nodule development along a course somewhat different from that which would emerge from the operation of unregulated market forces. What remains to be seen, however, is what would be the most likely scenario for the long-term development of nodule resources if it were governed exclusively by market forces. On the basis of available information, only some considerations of a general nature can be made about the long-term prospects of nodule mining.

The implications of joint-products and by-products recovery from nodules become apparent when investment in new projects is under consideration. In essence nodule projects would be undertaken, under free market conditions, 84/ as long as the prospective return on investment would be greater than the expected rate of return on alternative investments in traditional land mining. Available information seems to indicate that the first generation of nodule mining will be very profitable indeed (see section III.5). Once the first few ventures become operational and prove to be the financial success that is expected, investment interest will rise. But, as the first miners expand their operations and the second wave of investors make their splash, some market pressures will develop to change the profit picture of the industry.

After the first decade of operation, further expansions of the industry are likely to cause average revenues to decline by more than the possible reductions in operational costs which will probably result from greater productivity and the development of more advanced systems. How soon and by how much the price of each mineral is likely to fall will depend on the relative volume of supply from nodules as compared with their world demand and the comparative cost of land based production. Normally, as a mineral produced from nodule becomes more abundant, its price would tend to fall to the level of its most important substitute.

One of the first casualties is expected to be cobalt. By 1985 approximately half of world demand would probably be supplied by nodule producers. As new nodule projects become operational, the price of cobalt would eventually fall to the level of nickel's.

84/ It seems reasonable to expect that some of the major mineral importing countries might be willing to subsidize nodule miners, if necessary, to attain a minimum of self-sufficiency. In that case the nodule industry might expand beyond the levels that would be warranted by market considerations alone.

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Drastic changes can also be expected in the market for manganese metal. Manganese metal production from just one nodule operation of 1 million tons/year may be almost twice as large as the projected world market in 1980 for manganese in metal form. As a result the price of this metal will fall sharply and eventually it should stabilize at about the present price of ferromanganese, which it would probably replace in the steel industry. This would, of course, mean a fundamental change in the manganese industry, with serious implications for traditional producers of ore and ferromanganese.

The eventual replacement of ferromanganese by manganese metal in the steel industry will be simply a question of competitive cost. The by-product nature of manganese recovery from most systems offers an added incentive for sea-bed miners to develop new metallurgical processes that would reduce the alleged high-cost manganese separation stage. The magnitude of the incentive would be very high indeed; for example, even at $US 200/ton 85/ (instead of the present $US 730/ton for manganese metal) the recovery of manganese metal would increase the gross revenues of nodule ventures by some 50 per cent. It can be expected, therefore, that before the end of the 1980s, the techno-economic problems will probably be overcome and nodules will become the major source of manganese for the world steel industry.

The sharp decline in prices expected for cobalt and manganese, and possibly molybdenum among the trace metals, is not expected to alter substantially the total profitability of the nodule industry. Nickel will remain the most important source of revenue, accounting for about 40 to 55 per cent of gross revenue, depending on whether manganese is recovered or not (see section III.5). The real pressure on the economics of nodule mining will be felt when production expands sufficiently to cause a decline in nickel's price. Even at considerably lower prices for nickel, the advent of second and third generation nodule systems, with their reduced mining, transportation and processing costs, might well retain the economic attractiveness of the industry.

The question, therefore, is what would be the most likely price floor for nickel? The demand for nickel is probably very responsive (elastic) to lower prices sustained over sufficiently long periods of time. Moreover, nickel is a substitute for a number of metals. Though it would be difficult to determine the extent to which nickel can be substituted for some applications of copper, the ultimate floor for nickel might correspond to the price of copper. Since world demand for copper is about 14 times greater than that for nickel (7,886,000 tons versus 574,000 tons in 1972), there would be some scope for absorbing large volumes of additional nickel supply in some special uses of copper. The possibility of interchangeability of nickel and copper in some markets is merely hypothetical and probably would not take place before the 1990s, if at all. If it should occur, however, it would radically change the relative importance of the nodule industry. In that case nodule mining could increase spectacularly and the industry would become a major supplier of copper as well as the largest source of cobalt, manganese, nickel, molybdenum, vanadium and possibly of other metals. This scenario, of course, is only valid if no control over the pace of nodule development is exercised by the Authority.

85/ $US 200/ton is the market price for standard United States ferromanganese containing 78 per cent manganese.

III. PROMOTING THE RATIONAL DEVELOPMENT OF NODULE RESOURCES

A recurrent theme in official and academic statements on nodules is that they should be developed in a rational manner. This convergence of opinions is underscored in paragraph 9 of the Declaration of Principles 86/ which states that "the régime shall, *inter alia*, provide for the orderly and safe development and rational management of the area and its resources and for expanding opportunities in the use thereof". In order to promote the rational development of nodule resources, it will be necessary to identify the major policy objectives, and to examine them to ascertain the extent to which they may be mutually conflicting or complementary.

1. Identification of major policy objectives

Several objectives have been proposed and analysed extensively in academic papers and in the discussions of the Sea-Bed Committee. They have been expressed, with varying degrees of clarity, in the Declaration of Principles and may be summarized as follows:

(a) Encouraging the development of nodule resources

For some time, it has been questioned whether known mineral resources are sufficient for sustained growth in material consumption. More recently, the sharp increase in raw material prices caused major consuming countries to actively seek out alternative sources of supplies. The potential of the nodule industry has prompted industrial countries depending on imported minerals to assign a high priority to its development. These countries, over a period of years, have directed a huge research and development effort to solve problems posed by nodule mining and processing, so that now technology is no longer a limiting factor on the development of this industry.

(b) Minimizing the impact of nodule mining on mineral exports of developing countries

Developing countries have understandably voiced serious concern at the prospect of a new industry which may have a serious impact on their markets. The need for a controlled pace of nodule development is obvious for countries like Chile, Gabon, Ghana, Peru, Philippines, Uganda, Zaire and Zambia which are heavily dependent on the exports of minerals that will also be recovered from nodules. To a large number of other developing countries exports of minerals represent an important contribution to their balance of trade position. For them, a loss of a few million dollars worth of export earnings could also be quite serious, given their

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86/ General Assembly resolution 2749 (XXV).

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perennial balance of payments difficulties. But the argument of balance of payments is not restricted to developing countries: advanced industrial countries which are large exporters of minerals and metals such as Australia, Canada, France and South Africa have also expressed such concern. Alleviation of balance of payments pressures is also an argument used by groups in importing nations requesting unilateral legislation to govern nodule development. 87/ The large measure of support expressed for minimizing adverse effects on developing country mineral exporters is thus explained.

(c) Ensuring the participation of developing countries in the nodule industry

Developing countries contend that the highly sophisticated nature of technology for nodule mining and processing and the heavy capital requirements involved ($US 150 to $US 250 million or more for each nodule venture) will limit the industry to the half-dozen most industrialized countries unless there are measures to the contrary. The smaller industrial nations also recognize their inability to compete with the industrial leaders in this endeavour. 88/ In addition to the potential of the industry itself, considerable spinoff benefits are expected for the shipbuilding, heavy equipment and metal based industries. The pivotal importance of the nodule industry was stressed by the President of the Shipbuilders Council of America:

> "In its maturity, deep ocean mining will undoubtedly contribute to an advancement of technology not only in shipbuilding industry but in the offshore petroleum industry while similarly endowing marine science and other human activities about which we have yet no conception." 89/

(d) Maximizing revenues for the international authority

From the inception of negotiations on an international régime for deep sea-bed mineral resources, it has been assumed that nodule mining would provide a new

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87/ "If S.1134 becomes law, U.S. industry will start immediate efforts to convert manganese nodules, which is now only a mineral curiosity, into material which will flow through the channels of world commerce and aid the United States in reducing its deficit balance of payments". Statement of Mr. T. S. Ary on behalf of the American Mining Congress, before the U.S. Senate Sub-Committee on Minerals, Materials and Fuels on May 17, 1973. Op. cit. p. 136.

88/ Indicative of this concern is the alternative (C) of paragraph 25 of article 34 on participation of developing countries: "For the purpose of this article, States not having attained a level of marine science and technology permitting the exploration of the Area and exploitation of its resources, or not having the financial resources required to carry out such exploration and exploitation, shall be treated on an equal footing with developing countries". Report of the Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor beyond the Limits of National Jurisdiction, vol. II (1973), p. 96.

89/ Hearings before the U.S. Senate Sub-committee on Minerals, Materials and Fuels. 93rd Congress, op. cit., pp. 87-88.

substantial source of revenue for the international community. It is argued that since the most important economic benefits from nodule mining will accrue to the industrial nations developing nodule technology - which are also the major importers of minerals - the maximum possible revenues for the international authority should be exacted from nodule miners. Such revenues would thereafter be shared according to criteria favouring developing countries.

(e) Preservation of the marine environment

In a world increasingly aware of ecological interdependence, it was logical for the Declaration of Principles to include the guideline that activities in the area should be conducted in such ways as to assure "the prevention of pollution and contamination, and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment".

(f) Conservation of nodule resources

In recent years the rapid depletion of traditional sources of raw materials in many countries has brought into focus the need for careful husbanding of the finite resources of our planet. The Declaration of Principles, clearly identifies "the protection and conservation of the natural resources of the area" as a policy objective.

2. Harmonizing conflicts of interests

Some of the above policy objectives can obviously conflict. A systems approach to sea-bed resource management could provide an optimum cost-benefit solution to the harmonization of conflicts if an acceptable list of priorities for the various objectives could be determined. The establishment of priorities is indeed the heart of the matter; and the Sea-Bed Committee has examined these points thoroughly over the past five years. Some basic underlying factors seem to be emerging.

First, the policy objectives of each country or regional group largely reflect their interests as seen in the light of: (1) general market trends, and (2) the special position of their domestic industries vis-à-vis the future sea-bed mining industry. Future events may allay the fears of some countries, aggravate those of others, or change drastically their earlier perspective.

There is a great degree of confidence in the future viability and scope of nodule mining. Industry officials are already contemplating second and third generation systems including such novel concepts as on-board metallurgical processing of nodules. The prospects of a fast changing technology make it all the more difficult for the international community to conceive and determine at this stage all the appropriate methods of managing sea-bed resources. If the likely impact of the first few mining operations can only be visualized in its broad perspective, what can be said of the second and third generation mining systems? This rapid pace of

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technological development underlies the need for giving the international machinery enough flexibility to adapt itself to changing conditions and to adopt new resource management strategies which might be required to handle any new situation.

Given the highly dynamic nature of nodule technology and the uncertainties clouding future market conditions it would be of little use to conceive policy strategies to deal with possible situations beyond a time span of about one decade. In view of these considerations, it should be stressed that in this report: (1) the policy implications examined reflect the framework of interests as perceived in 1974 and should therefore be periodically reviewed; and (2) the time span adopted for analysis of the implications of nodule mining cover the arbitrarily chosen decade 1976-1985.

Another point relating to the harmonization of conflicting interests concerns the nature of trade-offs. The central issue of nodule management is the degree of control, if any, over the pace of resource development. The variation in the approach to this question can be categorized somewhat simplistically as efficiency (free development of nodule resources according to market forces) versus equity (some control over sea-bed resource development). For advocates of free development, market forces would guide the nodule industry to expand as long as it would be profitable to do so, 90/ thus securing the most efficient allocation of resources and benefiting consumers by satisfying their mineral requirements at the least possible cost.

This model of resource allocation favoured by Western economists proceeds from a number of assumptions which are not all met in reality. It is obvious that perfect competition, free resource movement, and general access to technology are not true of the nodule industry. Also it must be recalled that the competitive model of resource allocation presupposes that the existing income distribution is socially and politically acceptable. Therefore all market-oriented developments that might favour consumers in industrial countries at the expense of traditional suppliers in developing countries will need to be closely scrutinized on equity grounds. 91/

3. Balancing nodule development against its impact on mineral exports of developing countries

(a) Basic approaches

The proposals made on ways and means to facilitate nodule development while at

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90/ The theoretical equilibrium under free market conditions would be reached at that point where additional units of investment into nodule mining would be only as profitable as investment in land mining projects or, for that matter, as profitable as alternative investments in other industries not related to mineral production.

91/ It is generally agreed that an additional unit of income is far more important in relative terms for countries at low levels of per capita income than for advanced countries.

the same time minimizing the negative effects on the mineral industries of developing countries may be classified under two general approaches: namely, compensatory and preventive. These two approaches, though not mutually exclusive, are based on different premises. Under the compensatory approach, nodule resources would be developed with few or no controls but with some form of compensation provided to developing countries affected by sea-bed mining. In other words, action would not be taken until some disruption had occurred. The preventive approach would orient the development of nodule mining so as to keep the disruptions from occurring in the first place. There would appear to be no easy solution: the potential production of the major minerals in nodules (cobalt, manganese, nickel and copper) is in proportions quite different from world demand for these minerals. For example, the forecast of metal production from nodules in 1985 would be sufficient to supply 50 per cent of the estimated demand for cobalt, 18 per cent of world demand for nickel, 6 per cent of demand for manganese and only 1.3 per cent of demand for copper.

If the preventive approach were to prevail all across the board and no metal market were to be significantly affected by the future production from nodules, the pace of development of the nodule industry would be very slow indeed. In fact, one single nodule mining venture, of a size considered by industry as the minimum viable (one million tons of dry nodules per year), might be already too large and could affect the market for cobalt. It seems, therefore, that the harmonization of the conflicting interests involved would require that the preventive and compensatory approaches be combined in a politically acceptable strategy for development of the nodule industry.

(b) Long-term planning: the preventive approach

One approach that has been supported by a number of countries is that sea-bed resources should be considered as complementary to traditional sources of supply. The translation of this general precept into practice offers a number of difficulties. For instance, it might be thought that sea-bed resources would have a complementary role if they were developed specifically to supply that part of demand that could not otherwise be supplied by traditional sources. The problem with this interpretation is that demand, supply and prices are all interrelated, and if demand tended to outstrip supply, this imbalance would result in increases in prices to the extent necessary to bring demand and supply to a new equilibrium.

An alternative approach would be to define arbitrarily the concept of complementarity in a dynamic sense, namely, in terms of future increases in demand. On the other hand, if all future demand for the minerals that can be produced from nodules were to be supplied by this new source, this would amount to a policy decision to halt further growth for traditional producers. Existing producers might find it difficult to expand capacity and there would be a virtual impediment to the development of a number of land deposits which have recently been discovered, or may be discovered in the future. The exact extent to which the partition of future production from land and sea-bed sources is politically acceptable is still to be determined. Moreover the views on the specific shares to be allocated to each

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source will likely change with time. The most important factor in this consideration is still unknown, namely the relative efficiency (cost of production) of the nodule industry as compared with land mines.

Assuming that the complementarity approach for sea-bed production might be accepted in terms of a certain share of the increase in demand for the minerals concerned, a number of practical problems would remain to be solved. Since the likely metal production from nodules will be forthcoming in proportions quite different from the demand for these minerals, what would be the basic guideline for the optimum pace of nodule mining? On numerous occasions industry officials and government representatives from countries developing nodule mining systems have indicated that the mainstay of the nodule industry will be nickel. 92/ This position is explained in the following statement by Leigh S. Ratiner, the Director for Ocean Resources of the U.S. Department of the Interior:

> "Our present understanding of marine miners' plans indicates that they will produce either three or four metals concurrently. Future metallurgical developments may enable the extraction on an economic scale of only the more valuable copper and nickel content of nodules. For the present, however, use of these techniques would require marketing of either three or four of the metal components. If one of these metals faces a difficult market situation and is an important source of revenue, the entire production process must be geared to market opportunities for that metal. Since nickel represents such a significant share of the gross value of marine mining production, and since its market opportunities may be restricted during the early phases of deep sea mining development by both the size and nature of nickel markets, it may be concluded that nickel will be the limiting factor on the growth of a marine mining industry for the foreseeable future." 93/

Following this argument to its logical conclusion, Mr. Ratiner, on another occasion, suggested that on the basis of projected growth in demand for nickel between now and the year 2000, some 20 to 90 production units, each producing

92/ As a matter of fact, Summa Corporation refers to nodules as "nickel nodules" instead of using the term manganese or ferromanganese nodules generally employed by the academic community.

93/ Appendix by Leigh S. Ratiner, to a letter of Charles N. Brower to Senator J. William Fulbright dated 1 March 1973, copies of which were made available to members of the Sea Bed Committee.

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approximately 3 million tons of nodule per year could be in operation by the year 2000. 94/

It would seem therefore that the long-term planning of nodule development as a function of the increase in demand for nickel would be politically acceptable to countries developing nodule mining technology. The pace of growth of the nodule industry would, of course, vary depending on the share of the future increase in demand for nickel that the nodule industry would be permitted to supply. Moreover, the exact rate of growth in demand for each mineral produced from nodules will have important implications for future market penetration.

Some actual figures might be helpful in assessing the magnitudes involved in long-term planning of nodule development as a function of the increase in demand for nickel. Assuming that future world demand will increase at an average of 6 per cent a year (for the period 1962-1971 in the market economy countries it was 6.5 per cent), by 1976 the world demand for nickel would amount to 724,000 metric tons. 95/ In that case, the expected 41,000 tons increase in demand for nickel for 1976 could be supplied by approximately 2.7 million tons of nodules yielding an average of 15,000 tons of nickel per million tons of dry nodules. This volume over time can be quite impressive. For instance, during the decade of 1976 to 1985 the increase in demand for nickel at a 6 per cent growth rate would amount to

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94/ See statement of Mr. L. Ratiner at the hearing of the Sub-Committee on Minerals, Materials and Fuels of the United States Senate on 15 June 1973. These figures were apparently derived on the assumption that a production unit of 3,000,000 tons of dry nodules per year would recover on the average 34,000 tons of nickel per year and that demand projections would be as follows:

Estimated world demand for nickel (in metric tons)

	Year	Assuming a 2.4 per cent growth rate	Assuming a 6 per cent growth rate
(a)	1975	779,000	926,000
(b)	2000	1,409,000	3,974,000
(c)	Growth in demand: (b)-(a)	630,000	3,048,000
(d)	Approximate number of mining units: (c) ÷ 34,000	19	90

95/ Demand for newly mined nickel. If direct use of scrap were taken into account, this figure would be considerably larger as in the U.S. projections presented by Mr. Ratiner (see foot-note 1 of previous page).

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540,000 tons. Approximately 36 million tons of high grade nodules 96/ could be authorized in 1985 to supply this increase in demand. Such a volume of nodules could be sufficient to commission six mining operations of the size proposed by Deepsea Ventures (1 million tons/year) and an additional 10 operations of the size which is reported to be planned by Kennecott Copper (3 million tons/year). By contrast, industry officials estimate that by 1985 the capacity of the nodule industry should be around 15 or 16 million tons of nodules, 97/ which coincides with the forecast in this report (15 million tons).

The acceptance of nickel as the pace setter for nodule mining has the very important advantage of guaranteeing the interests of copper producers in developing countries. While the demand for copper was about 14 times larger than the demand for nickel in 1972, the volume of production of nickel from nodules is likely to be some 15 per cent higher than that of copper. Thus, the impact of nodule development on copper markets would be minor for the foreseeable future. 98/ For

96/ Nodules with 1.6 per cent nickel content, assuming a 94 per cent metallurgical efficiency in recovery of the metal giving an output of 15,000 tons of nickel per million tons of dry nodules.

97/ A. Rothstein and R. Kaufman (Deepsea Ventures, Inc.) estimate that by 1985 perhaps six nodule mining units might be in operation. Two of these with a capacity of 1 million tons would recover manganese, while the four others - average rated capacity of 3.5 million tons - would not. If all these units were to reach full capacity by 1985 about 16 million tons of nodule would be mined. See "The Approaching Maturity of Deep Ocean Mining - The Pace Quickens", in 1973 Offshore Technology Conference, V.I., pp. 323 ff. Mr. T. S. Ary, Chairman, AMC Committee on Undersea Mineral Resources, in answer to written questions proposed by Senator Lee Metcalf in relation to hearings on S.1134, suggested that market considerations would probably limit nodule mining to five operations of 3 million tons/year by 1986. op. cit., p. 183.

98/ It is important, however, to keep in mind that the cumulative effect of different compound rates of growth for nickel and copper could change the proportional volumes of demand for these two metals over time. For example, the 14 times greater demand for copper in relation to nickel in 1972 could be considerably reduced by the year 2000 if demand for copper increased at lower rates and for nickel at faster ones.

Ratio of copper/nickel demand by the year 2000 at different annual rates of growth for each metal

Copper / Nickel	5%	4%	3%
6%	11	8	6
8%	6	5	4
10%	4	3	2

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instance, considering the unlikely possibility that by 1985 some 36 million tons of nodules would be mined, production of copper from nodules (468,000 tons) would amount to only 3 per cent of world demand.

The role of manganese is perhaps the most controversial of all metals contained in nodules. Great uncertainty surrounds the likelihood of manganese recovery from nodules, as this mineral has a very low price as compared to copper, nickel and cobalt. Only one company in the United States, Deepsea Ventures, has announced plans for recovering manganese in the form of pure metal. This company has indicated that it might recover 230,000 tons of manganese metal, from its proposed one million ton/year nodule operation, which would be far more than the existing world demand for manganese in metal form. There are some indications that DOMA in Japan plans to produce manganese from nodules, probably in the form of an ore-equivalent.

It can be expected, however, that in time strong pressures 99/ will be generated within the nodule industry to recover the manganese as well. Technical innovation in metallurgical processing will eventually reduce the cost of manganese recovery in the form of either pure metal, ferromanganese or a manganese ore-equivalent.

Though the commercial feasibility of large-scale recovery of manganese from nodules is still to be demonstrated, several developing countries that export this mineral have expressed grave concern for the future of their domestic mines. Since manganese may be recovered from only 4 million tons out of the 15 million tons of nodules which are expected to be mined by 1985 (i.e. 27 per cent), it would seem that a planning guideline for manganese recovery, amounting to 50 per cent of the total volume of nodules mined, might be acceptable to those countries developing nodule systems.

Considering the imponderables of long-term forecasting, it would seem preferable that any planning for nodule mining should be established in a flexible way to respond to market developments. This flexibility would be made more palatable to consumers and exporters alike if the authority's decisions were to be made according to predetermined limits. For example, the maximum level could be set at 100 per cent of the increase in demand for nickel and the minimum level at 50 per cent. On this basis, the nodule industry would know that regardless of prevailing market conditions, they could be assured of at least an annual increase in production equivalent to half of the expected increase in demand for the guideline mineral. The developing countries exporting nickel, manganese and copper,

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99/ Manganese and iron would amount to over one third of the volume of tailings that must be discarded by processing plants. The reduction of waste disposal costs would be another economic incentive for the recovery of this mineral as environmental requirements affecting slag heaps become more strict. Moreover, policy considerations might play an important role in the possibility of inducing some Governments to grant special subsidies for manganese recovery from nodules.

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Table 7. Summary presentation of possible scenarios of controlled nodule development *

(a) Basic guideline: rate of nodule mining as a function of increase in demand for nickel:

minimum authorization rate - 50 per cent of this increase;

maximum authorization rate - 100 per cent of this increase.

(b) Additional limitation - recovery of manganese from nodules:

50 per cent of the nodule mining authorized

(c) Total volume of nodule mining which could be authorized by 1980 and 1985 if nickel demand increases by 6 per cent per annum:

	1980	1985
minimum -	7,700,000 tons	18,000,000 tons
maximum -	15,400,000 tons	36,000,000 tons

(d) Total volume of nodules from which manganese recovery could be authorized by 1980 and 1985 on the assumption of (c) above:

	1980	1985
minimum -	3,850,000 tons	9,000,000 tons
maximum -	7,700,000 tons	18,000,000 tons

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* The figures used in the projected demand for nickel exclude the direct use of nickel in scrap form.

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on the other hand, would be assured that the maximum increase of production forthcoming from nodules would not reduce their present volume of production since the additional production from nodules would be geared, at least theoretically, to the increase in demand.

Time lags in project implementation could serve as an additional factor in softening the impact of sea-bed production on mineral markets. 100/ If the international sea-bed authority were, for instance, to start granting permits in 1976 for nodule mining (licences or joint ventures) 101/ equivalent to the expected increase in world demand for nickel for that year, the volume of nodules involved would be approximately 2.7 million tons. It is obvious, however, that commercial production of metal from those 2.7 million tons of nodules would only reach the market a few years later. The enterprises involved would still have to finalize their investment projects, make the financial arrangements, build the mining system and the processing plant, and run the final tests before starting commercial production. This lead-time would be a minimum of two years in exceptional cases, but more likely of three to five years for most firms. 102/

What would be the likely impact of nodule development along the guidelines described above? A first approximation could be derived on the basis of the following assumptions: (1) the full volume of nodules (and manganese recovery) that would be authorized each year would be in fact contracted for with interested parties; (2) the average lead-time for marketing minerals would be three years from the date of the original contract (if the first contracts for joint ventures or licences are granted in 1976, then production would reach the market in 1979); (3) all ventures would start operation at their full rated capacity and would remain at that level thereafter; (4) average recovery from each million tons of dry nodules would be: 15,000 tons of nickel; 13,000 tons of copper; 2,000 tons of cobalt and 230,000 tons of manganese (if recovered).

100/ On the other hand, it might be decided that time lags in project implementation should be taken into account in the establishment of planning guidelines. The principle of complementarity would be interpreted as the granting of authorization for nodule mining in line with the expected increase in demand for the very year when commercial production would start. In the example of the text, it could mean that in 1976 authorization would be granted to supply the projected increase in demand in 1979, assuming an average three year lead time. In that case, the figure for maximum authorization during the period 1976-1985 would be 43 million tons of nodules.

101/ If on the other hand the Authority were to undertake nodule exploitation directly, the question of control would be obviously greatly simplified.

102/ It is conceivable, on the other hand, that once the rules of the game are clearly defined, the leaders of the industry might schedule the activities of their implementation programme in such a way as to shorten the time between authorization and commercial production.

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Table 8. Hypothetical mineral production from nodules based on full utilization of the planning guidelines *

(in metric tons)

	Nickel	Manganese	Cobalt	Copper
Potential production starting in 1980				
minimum authorization	42,000	320,000	5,500	36,000
maximum authorization	84,000	640,000	11,000	72,000
Potential production by 1985				
minimum authorization	175,000	1,300,000	23,000	150,000
maximum authorization	350,000	2,600,000	46,000	300,000
Estimated world demand: 1980	914,000	12,900,000	44,000	11,650,000
1985	1,220,000	16,400,000	70,000	14,900,000
Share of world market in 1980				
minimum authorization	4.6%	2.5%	12.5%	0.3%
maximum authorization	9.2%	5.0%	25%	0.6%
Share of world market in 1985				
minimum authorization	14.3%	7.9%	33%	1%
maximum authorization	28.6%	15.8%	66%	2%

* See Table 7. Average lead time assumed as 3 years.

As can be seen in Table 8, the potential mineral production from nodules, within the constraints of the planning guidelines, could be quite substantial. It must be understood, however, that these are hypothetical figures. The maximum authorization would represent a potential of some 50 per cent more metal production from nodules than is likely to take place under free market conditions. Under the minimum authorization production of nickel, copper and cobalt would be approximately 25 per cent below the present plans of industry, though the estimated manganese recovery would be unrestricted (see Table 2).

It could be concluded that the planning guidelines exemplified above are fairly in line with the plans of the nodule industry. These guidelines, however, would go a long way toward assuaging the fears repeatedly voiced by mineral exporting developing countries that the nodule industry will doom their domestic mining industry.

The effectiveness of any system to regulate the pace of nodule exploitation will depend, of course, on the extent of the international area. If extensive limits for national jurisdiction are adopted, it is likely that some nodule deposits of commercial interest might fall within national jurisdiction, thus outside the control of the international authority. A number of high grade deposits have already been found in proximity to land areas.

The planning approach exemplified in this report is just one of several possible solutions. Whatever planning strategy is deemed appropriate to harmonize the conflicting interests in sea-bed resource development, it will be necessary to define the regulatory instruments with considerable precision. 103/ On the other hand, it is clear that the international régime under negotiation cannot, even in its detailed rules, standards and procedures, predetermine every administrative procedure to be adopted by the international machinery. If that were so, there would hardly be a need for granting deliberative and executive powers to the authority. Planning, whether in centrally planned or market economies, is a continuous process that requires endless innovations and adjustments not only in methods used but also in goals.

(c) An alternative approach - indirect controls

A certain measure of control over the volume of mineral production from nodules could be obtained with the use of differential levies or royalties for each of the minerals to be recovered from nodules. The minerals which would be most affected by the nodule industry such as cobalt, manganese and molybdenum could be made subject to royalties higher than the average fiscal charge imposed on the recovery of nickel and copper from nodules. This method was already described in

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103/ For example, the optimum size of a nodule operation may be larger than the nodule volume authorized for a given year, i.e., a 3 million tons project versus the 2.7 million tons that could be authorized in 1976. The authority would need to institute procedures for dealing with a number of matters in the administration of a regulated system for nodule exploitation.

previous reports by the Secretary-General 104/ and need not be repeated here. The implementation of such systems, however, would require considerable sophistication in the analysis of market trends and in forecasting the impact that different levels of royalties or levies might have on the operations of the nodule industry.

(d) The compensatory approach

As indicated above, it seems that the most feasible way to minimize the impact of nodule development on developing countries producing cobalt would be by means of compensatory payments. It is difficult to foresee the future behaviour of cobalt markets once large volumes of nodules start being mined because at present the market is highly concentrated in the hands of one single producer in Zaire. In the past, Zaire, acting as a price leader, has tended to reduce output when cobalt prices were falling. 105/ Whether or not Zaire continues its price leadership, the export revenue of cobalt producers is expected to decline sharply once the nodule industry matures. Compensation for these countries might therefore be in order. 106/

It has been argued that such compensation would leave very little revenue left for distribution to the international community. One possible solution to this impasse would be to exact a contribution from those countries that would directly benefit from any drop in cobalt prices. This compensation might be in the form of an internal tax per ton of cobalt consumed in the industrial countries, whether derived from nodules or from traditional land sources, amounting, for instance, to half of the expected drop in price as compared to a base year. 107/ In this way, consumers would still benefit from lower prices, and the interests of developing countries would be protected. A similar compensatory approach might also be envisaged to complement other measures used to minimize the impact on manganese producers.

104/ "Possible impact of sea-bed mineral production in the area beyond national jurisdiction on world markets, with special reference to the problems of developing countries: A preliminary assessment" (document A/AC.138/36) and "Additional note on the possible economic implications of mineral production from the international sea-bed area" (document A/AC.138/73).

105/ UNCTAD "Exploitation of the mineral resources of the sea-bed beyond national jurisdiction: issue of international commodity policy. Case study of cobalt" UNCTAD document TD/B/449/Add.1 of June 1973.

106/ Some analyses have suggested that there might be insufficient revenues for the authority to compensate developing producing countries for actual or potential earnings foregone. See UNCTAD documents TD/B/449/Add.1 and TD/B/483.

107/ See document A/AC.138/36, p. 67.

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(e) Short-term price fluctuation

It has been suggested that the international authority should be empowered to deal with short-term price fluctuations. One possibility would be for the authority to limit or reduce the volume of production from existing nodule mining operations if the prices of some minerals were to fall.108/ It is apparent, however, that the compulsory reduction or suspension of mineral recovery from existing nodule operations would present a number of technical, economic and political difficulties. Moreover, it is doubtful whether an enterprise could subsist financially if it were required to suspend production even if only for a few months. An alternative approach that might be considered is the use of the International Monetary Fund and the World Bank compensatory financing schemes, which were conceived to assist countries that may be faced with shortfalls in export earnings due to unfavourable market developments.

The potential role of commodity agreements for protecting the interests of developing countries exporters should not be over-emphasized. Commodity agreements are generally directed at stabilizing market prices for a given commodity on the basis of the existing market shares of the members. In the case in point, the disequilibrating factor would be the new sea-bed producers who, without any share of the market at present, could not be expected to accept the maintenance of the market status quo. None the less commodity agreements may have a future role to play that would be complementary to other measures designed to minimize the impact on developing countries.

4. Participation of developing countries

Some general considerations are made on indirect and direct means to promote the participation of developing countries in sea-bed mining.

(a) Indirect methods: transfer of knowledge of resources and techniques

It is obvious that little participation is possible in a vacuum of knowledge regarding sea-bed resources and the industrial techniques required for their exploration and exploitation. Given the nature of the industry, only a few entities in a handful of countries possess the necessary data and techniques and they are of course keeping them secret from all potential competitors. Thus, the first step in promoting some measure of participation by developing countries would

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108/ See article 36, paragraph 40, alternative (E) of the texts illustrating area of agreement and disagreement on items one and two of Sub-Committee I's programme of work "to regulate the production, marketing and distribution of raw materials from the Area and, where appropriate, to take, in consultation or in collaboration with the United Nations and its appropriate specialized agencies, measures to facilitate the stabilization of world prices of the raw materials obtained from the Area, through *inter alia* reduction and suspension of production and international commodity agreements, whenever it deems that the production of such raw materials from the Area may have adverse effects on the economies of exporters of similar raw materials from developing countries." Report of the Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor beyond the Limits of National Jurisdiction, Volume II. Document A/9021 of 1973. (Alternative D of the same text contains similar provisions).

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be to institute a system for collecting and disseminating information on nodule resources and mining and processing techniques. As is generally known, industrial and developing countries alike require that all data on resource surveys or prospecting be divulged to the relevant authorities. It might be considered appropriate, therefore, that all information collected by enterprises engaged in the prospecting of international sea-bed resources be shared with the Authority.

It has been suggested that the Authority should organize training programmes for nationals of developing countries on the various subjects related to the exploration and utilization of sea-bed resources. The usefulness of such programmes, however, should not be overestimated. Historically, programmes of transfer of technology, more often than not, have fallen short of their objectives. In an industry just developing a new and sophisticated technology, it can be expected that almost all the experienced specialists will be employed by nodule miners, thus making it unlikely that they would be available to conduct training courses and in the process divulge proprietary information. Moreover, the rapid advance that can be expected in nodule technology would tend to outdate knowledge gained in training programmes before it could be put into practice.

(b) Direct methods - joint ventures

The priority that developing countries have given to their participation in sea-bed mining can be best understood in terms of the experience that some have had with their own natural resources and their ability to exercise control over their exploitation. In a number of instances, these countries were unable to effectively control investment plans, marketing practices, and other managerial decisions of great importance to the local economies. This pattern has been clearly evident in the oil industry where conflicts of interests have become more apparent between the worldwide interests of the major petroleum firms and the national interests of the host State where the venture is located. 109/

Joint ventures are becoming a common feature of the international mining and petroleum industries. It has been suggested that the future of the international petroleum industry will be one in which joint ventures with State companies, or service contracts and production-sharing arrangements, will be the order of the day.110/ Participation of developing countries in the exploitation of sea-bed resources could be fostered in two types of joint ventures. One would be the association of companies from developing countries with enterprises of industrial nations possessing sea-bed technology. It is obvious that in this case participation would be accomplished in a direct manner with business groups from developing countries participating with risk capital and reaping any benefits obtained.

109/ C. W. Friedmann, "Joint Exploration of Ocean Bed Resources: some Organizational Aspects", in Ocean Enterprises, A Special Report on a Preliminary Conference held in preparation for the Pacem in Maribus Convocation, 28 June-3 July, 1970.

110/ L. C. Stevens, "Joint Ventures in the International Oil Industry", in Petroleum Review, October 1973.

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A more indirect way of participation would be through the Enterprise proposed by the 13-Power draft.111/ It is likely that the over-all objective of control over nodule exploitation might be accomplished by the regulatory powers of the international sea-bed authority. Nevertheless, there will still be considerable scope for participation in the decision-making process within the individual nodule mining units to warrant the establishment of joint ventures between interested parties of advanced countries and the Enterprise. A host of questions relating to financial arrangements, location of processing facilities, hiring of personnel, management and marketing 112/ practices, can so drastically affect the profitability of individual mining ventures as to make an active and direct role desirable for the international sea-bed authority in each individual venture. The participation of the Enterprise in joint ventures, moreover, would provide the necessary feedback for the Authority to adjust the rules, standards and regulations of sea-bed mining to the real needs of both the industry and the international community at large.

5. Revenue for the international machinery

It has been suggested 113/ that the "take" of the international authority should neither amount to a hidden subsidy nor to a disincentive as compared to land mining operations. Any differential subsidy or disincentive would encourage inefficient allocation of world resources. It must be said, however, that this principle of "equivalent fiscal charge" is easier to conceptualize than to put into practice.

The tax burden on land mining operations varies dramatically from country to country and even from one mining operation to another, thus leaving open the question of what would be an "equivalent fiscal charge". The adoption of the "average" tax charge in existence in the major mineral producing countries would not necessarily be more desirable than either the lowest or the highest existing fiscal charges. In fact, the fiscal charge of land-based mining ranges from a negative tax (subsidy) to very steep charges equivalent to over half of the market value of the metals produced. 114/

The equivalent fiscal charge principle alone cannot supply an operational method to determine the appropriate share of the international authority in the revenues of

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111/ For example, the granting of discount prices to subsidiaries or associated firms and the use of product distribution through third parties.

112/ "Working paper on the régime for the sea-bed and ocean floor and the subsoil thereof beyond the limits of national jurisdiction", submitted by Chile, Colombia, Ecuador, El Salvador, Guatemala, Guyana, Jamaica, Mexico, Panama, Peru, Trinidad and Tobago, Uruguay, Venezuela, in document A/8421.

113/ D. B. Brooks and F. T. Christy, Jr., "Memorandum on Suggested Operational Guidelines for an International Regulatory Authority for the Sea-bed", in The United Nations and the Bed of the Sea (II), 21st report of the Commission to Study the Organization of Peace, New York, June, 1970.

114/ See "Additional notes on the possible economic implications of mineral production from the international sea-bed area", document A/AC.138/73, pp. 18-19.

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the sea-bed mining industry. A suggestion often made is to establish the highest possible fiscal charge on nodule mining compatible with maintaining the necessary incentives to ensure a steady flow of investments in nodule mining. Though conflicting in the short-run, these two objectives are in fact compatible in the long-run. If enough incentives are given, the nodule industry will develop faster, thus increasing the revenue base of the Authority. The crux of the matter is then the quantification of a prospective level of return on investment that would encourage the large flow of funds necessary for the commissioning of nodule mining systems. A first approximation would be to survey the actual return on comparative investments in manufacturing and mining industries in the countries developing nodule mining technology.

For example, the average return on investment 115/ for the whole manufacturing sector in the United States was 10.8 per cent in 1971 and 12.1 per cent in 1972. What is more relevant for the future nodule industry is that in the United States, the average return in metal mining (23 companies) was 10.5 per cent in 1971 and 10.4 per cent in 1972, while the average return in the non-ferrous metals industry (52 companies) was much lower: 5.0 per cent in 1971 and 7.2 per cent in 1972. 116/ Considering the risks involved in a totally new technology for mining and processing and the novel institutional arrangement to be established for resource exploitation in the international area, it seems reasonable to expect that risk capital from advanced industrial countries would require a minimum prospective return on investment somewhat higher than these average rates of return. Since the rate of 15 per cent has been mentioned by industry officials, in informal discussions, 117/ as their minimum target, this figure is used as a rough rule of thumb in this analysis.

(a) Value of nodules versus value of processed minerals/metals

A prerequisite for any estimate of the profit potential of the nodule industry is the determination of what stages of production should be considered in defining the "international sea-bed mining industry". Should the value of nodules on board the mining ship (ore at the mine site) serve as the base for calculation, or the market value of the processed final products marketed by the industry? The method agreed for this calculation could affect quite dramatically the revenue potential for the international authority. It can be roughly estimated that the nodules on board ship will be worth between 6 and 10 per cent of the value of the final products after the metallurgical processing is completed. 118/

115/ Net worth (investment capital plus non-distributed profits).

116/ First National City Bank, Monthly Economic Letter, April 1973, pp. 6-7.

117/ Marne Dubs, at the 9th Annual Conference of the Marine Technology Society, Washington, D.C., 10-12 September 1973.

118/ Mining costs of $US 6/ton of nodule plus some $3 of profits for an approximate value of $9/ton on board ship. The value of metals extracted from nodules might range from $90 to $170/ton (depending on whether manganese is recovered or not).

On several occasions the representatives of countries developing sea-bed mining systems have indicated that they expect the nodule industry to generate substantial revenues for the international community. Moreover, the concept of the common heritage of mankind would seem to give precedence to the definition that would best benefit the international community as a whole. It could be expected that those countries wishing to set up nodule processing plants in their Territory would be doing so on behalf of the international community. The host country would be trading off its usual share of net revenues or fiscal charge over the metallurgical processing stage for a number of real benefits. For instance, nodule processing will provide local employment and will induce the creation of a number of ancillary activities to supply some of the inputs of the industry and even more important, to process further the metals/minerals produced. Aside from these important economic benefits, the security which comes from having a steady internal supply of mineral might be a sufficient reason for advanced industrial nations to forego their customary tax revenue from activities carried out within their borders. 119/

The following considerations on the revenue potential for the international machinery assume that the base for calculation will be the value of metals produced by the nodule industry. This approach, if generally agreed upon, would need to be considerably refined to take into account a number of specific problems that can be foreseen such as the definition of "final products". Subsequent stages of fabrication such as the production of alloys, plates, sheets, tubes, wires, etc., are not considered here. By the same token, the sale of some by-product chemical reagents such as chlorine 120/ or the use of the tailings for the manufacture of construction materials or other uses will not be considered in the estimates of the revenue potential of the nodule industry.

The determination of metal prices for the purpose of computing the share of the international authority will need to be closely scrutinized. For example, in some countries with domestic price controls, like the United States, copper prices

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119/ The waiver of taxes over certain economic activities is not so unique. Some advanced and developing countries grant tax-free status to manufacturing companies located within some "free port zones", when these activities are geared to the export market. The system of tax credit, however, has a direct parallel with the nodule industry. In most industrial countries, companies operating abroad are permitted to deduct from their tax bill all taxes paid to foreign government. This procedure has been extensively used by the multinational petroleum and mining companies.

120/ Deep-Sea Ventures has indicated that the resulting chlorine from their hydrochlorination process can be a great plus in the financial picture of their metallurgical process. See R. Kaufman and A. J. Rothstein "Recent Developments in Deep-Sea Mining" in Marine Technology Society 6th Annual Preprints, 1970.

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may be considerably lower than in other markets, e.g. the London Metals Exchange. More serious is the possibility that intentional manipulation of prices could have the effect of reducing the take of the Authority. A common practice of multinational corporations to minimize taxes is to sell at a low price the commodity produced in a high tax country to an affiliate in a tax haven, that henceforth would proceed to market the product at prevailing prices. 121/ This procedure could also be applied domestically if the party mining and processing nodules had interests in other industries or activities using the metals produced. Another situation that must be considered is that of countries with currency controls that would make it difficult to remit the share of the Authority abroad; this problem could be very serious if the currency is inconvertible and the country exercises strict control over its foreign trade.

(b) The profit potential of the nodule industry - preliminary estimates of revenues and costs

A preliminary investigation of the gross profit potential of the nodule industry can provide the necessary ground work for determination of the authority's take. The difficulties involved in trying to estimate future revenues and costs of an industry when much of the pertinent information is proprietary cannot be overemphasized. Even in well-established industries a cost benefit analysis for a new project must always be evaluated with care. Thus a prospective cost-benefit analysis for the nodule industry must be viewed as a first approximation to this crucial, if rather obscure, aspect of the future industry. To this end, a number of assumptions must be made to establish the basis for the estimates on costs and revenues.122/ Most of these assumptions have been derived from information made public by the nodule industry.

The estimate of gross revenues or sales is, conceptually, a straight-forward calculation. It can be made by multiplying the expected volume of production of each metal by their expected future prices. The estimated volume of production per million tons of dry nodules is presented in table 1.

Forecasts of future commodity prices are always of a conjectural nature. A considerable degree of uncertainty will be involved if the time span is over five years and a major new source of supply must be taken into account. Thus, some conservative assumptions will be made for metal prices during the first decade of the nodule industry. These prices are below current market prices of early 1974 which with the accelerating process of world-wide inflation will in all probability

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121/ See J. S. Arpan, International Intercorporate Pricing (New York, Praeger, 1971).

122/ See R. Branco, "The Tax Revenue Potential of Manganese Nodules", in Ocean Development and International Law Journal, vol. 1, No. 2, 1973.

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be exceeded in the following years. These price assumptions, conservative as they may be, would serve for a comparison with capital and production costs estimated on present basis, and provide a first approximation to the prospective financial return of the nodule industry. 123/

The assumed prices used in table 9 for calculations of estimated revenue of two possible sizes of nodule mining operations are all below present market prices. The greatest variations were in manganese metal price assumed as under half of current market price and cobalt assumed as 2/3 of current price to allow for the expected drop in prices once these metals are recovered on a commercial scale. 124/ The price of nickel is assumed as about 10 per cent below present levels and the price of copper (US $0.80/lb), substantially below the high levels reached in recent months (up to US $1.10/lb.). Minor metals, including molybdenum (currently US $1.90/lb.), vanadium (US $1.50/lb.), silver and others are assumed to have an average price of US $1.50/lb. This latter price assumption may turn out to be the most conservative of all, particularly in the case of nodules containing platinum, since this metal alone may in fact be worth more than the other metals. 125/

On the basis of these assumptions, the estimated gross revenue for mining operation of one million tons per year producing manganese metal would be approximately US $170 million. Only one firm so far (Deep-Sea Ventures, Inc.) has indicated that it intends to recover manganese in the form of metal. It seems that the other companies in the United States, Europe and Japan are not considering the recovery of manganese. If no manganese is recovered, the estimated revenue for a 3 million ton/year operation would be US $268 million. These are the sizes of mining operations generally mentioned as being planned in the United States. 126/

Several attempts have been made in recent years to estimate capital requirements and mining and processing costs for different sizes of nodule

123/ These assumptions on prices must not be construed as projections or forecasts of metal prices in the 1980s but just as working assumptions for comparison with present cost estimates.

124/ See section II, on the probable impact of nodule mining.

125/ ECAFE/CCOP, *op. cit.*, p. 42.

126/ L. S. Ratiner, *locus cit.* and A. J. Rothstein and R. Kaufman *op. cit.*

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Table 9. Estimated revenue of two possible sizes of nodule mining operations

	1 million ton/year		3 million tons/year	
	Metal Production (thousand tons)	Value of Production (US $ million)	Metal Production (thousand tons)	Value of Production (US $ million)
Manganese[a/]	230.0	80.5	-	-
Nickel[b/]	15.0	49.5	45.0	148.5
Copper[c/]	13.0	22.9	39.0	68.6
Cobalt[d/]	2.0	8.8	6.0	26.4
Minor metals[e/]	2.5	8.2	7.5	24.7
TOTAL	262.5	$169.9	127.5	$268.2

Notes:

a/ Long term price of manganese metal assumed as US $350/ton (as against $.33/lb. or US $730/ton in December 1973) to take into account the impact on the rather small market for manganese metal.

b/ Price of US $1.50/lb. or US $3,300/ton (US $1.62 in January 1974).

c/ Price of US $0.80/lb. or US $1,760/ton (US $1.05 in December 1973).

d/ Price assumed as US $2.00/lb. or US $4,400/ton (as against US $3.10/lb. in December 1973).

e/ Varying quantities of molybdenum (US $1.90/lb. in December 1973), vanadium (US $1.50/lb. in December 1973), zinc (US $0.80/lb. in December 1973), silver (US $45/lb. in December 1973) and others, all assumed at an average price of US $1.50/lb or US $3,300/ton. This assumption would be meaningless for nodules containing platinum.

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ventures.127/ Many of the earlier estimates tended to be rather high. Uncertainties and unknowns were generally allowed for with large upward margins against errors. This caution is understandable given the novelty and complexity of nodule systems. For instance, nodule density, the topography of the ocean floor and the efficiency of the gathering apparatus (mining head) will influence mining costs. And so will the water depth and the efficiency of the system to lift the nodules from the ocean floor to the mine ship. The size of ore carriers and the round-trip distance between mine site and processing plant will determine the transportation cost.

But it is the processing cost that has probably caused the widest variation in total cost estimates. It is obvious that the metal content in nodules, plant capacity (daily throughout) and the specific circumstances of plant location (distance from port, environmental constraints, labour costs, cost of reagents and other inputs) will all influence the cost of processing. It seems, however, that the assumptions on the specific metallurgical processing system used for the estimates are the single most important reason for the high cost figures generally suggested. Estimates of processing cost based on pyrometallurgical treatment

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127/ John Mero, The Mineral Resources of the Sea, (Elsevier Publishing, N.Y., 1965), pp. 313 ff.

P. E. Sorensen and W. 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. 1611-1620.

A. Kaufman, "A survey of the Economics of Ocean Mining", paper prepared for the U.S.-Japan Marine Mining Panel Joint Meeting, Tokyo, 13 March-3 April 1970.

F. L. La Que, "Deep-Ocean Mining: Prospects and Anticipated Short-Term Benefits", in Ocean Enterprises, an occasional paper published by the Center for the Study of Democratic Institutions, June 1970, pp. 17-27.

G. L. Hubred, "New slant on the economy of manganese nodules", Ocean Industry, August 1970, pp. 26-27.

G. E. Bollow, "Economic Effects of Deep Ocean Mineral Exploitation", Master Thesis for the Naval Post-graduate School, 1971.

H. J. Meiser and E. Muller, "Manganese nodules - a further resource to cover the mineral requirements?", in Meerestechnik, No. 5, October 1973, pp. 145-150.

John Mero, "Potential Economic Value of Ocean-Floor Manganese Nodule Deposits", in Ferromanganese Deposits of the Ocean Floor, (ed.) D. R. Horn, (National Science Foundation, Washington, D.C., 1972).

G. Claus, "Theoretical and Experimental Investigations of Deep Ocean Mining Systems and Their Economic Evaluation", 2nd International Ocean Development Conference, Tokyo, 5-7 October 1972: pp. 1925-1955.

are around US $50 per ton of dry nodule, 128/ and those on hydrochlorination at around US $30. 129/

The actual costs of mining, transporting and processing the nodules and marketing the metals produced will only be known after the first production unit starts operation. Even then, costs are likely to decrease as efficiency of operation improves and also as the industry develops more advanced systems. At the present time, any estimate of costs must be viewed with care. The task has been made somewhat easier by the recent disclosures of two American companies. Officials from Deep-Sea Ventures Inc. published 130/ a range of estimates of capital costs and total operating costs for several sizes of production units, which is reproduced in figure 7. They indicated that for their own organization an economic model was used that permitted them to estimate the cost of investment and operations with considerable assurance. For other sizes, however, the range of estimates provided in figure 7 was based mostly on the estimates of others adjusted within 50 per cent to 400 per cent depending on their evaluation of the reliability of the third party's figures. It can be inferred, therefore, that the actual estimates of costs for the type and size of operation planned by Deepsea Ventures would fall within the range shown in figure 7 for a one million ton/year production unit. The range of estimates for other sizes are crude approximations of doubtful reliability.

The information provided by an official of Kennecott Copper, Inc. 131/ revealing. He suggested that the nodules could be gathered at the ocean floor and lifted on board ship for about US $6 per ton.132/ The transportation costs to shore would run between $3 and $6 per ton.133/ Metallurgical processing could be done for between $10 to $15 or between $12 to $18, depending on whether or not strict environmental regulations were enforced. He summarized that the average cost could be about $9 per ton of nodule delivered at the shore plant plus $13 for processing for a total of $22 per ton. He suggested that to be on the safe side a range of $20 to $30 per ton could be used.134/ Dubs also indicated that total investments to

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128/ Meiser and Muller, op. cit.

129/ Rothstein and Kaufman (1970), op. cit.

130/ A. J. Rothstein and R. Kaufman, "The approaching maturity of deep ocean mining - The pace quickens", in 1973 Offshore Technology Conference Preprints, pp. 323-344.

131/ Mr. Marne Dubs, Director of the Ocean Resources Department, gave these figures during the question and answer period, following the presentation of his paper "Metal markets, economics and ocean mining", at the 9th Annual Conference of the Marine Technology Society, held in Washington, D.C. during 10-12 September 1973.

132/ This estimate of mining cost is in line with the estimates of G. Clauss, op. cit. ($6.20 to $6.56/ton) for different hydraulic lift systems.

133/ Other estimates of transportation costs are: $4/ton (Mero), $4.80/ton (Clauss) and $6.30/ton (Sorensen and Mead).

134/ These figures are noticeably lower than the range of $35 and $55 derived from figure 7 for an annual production of 3 million tons of nodule.

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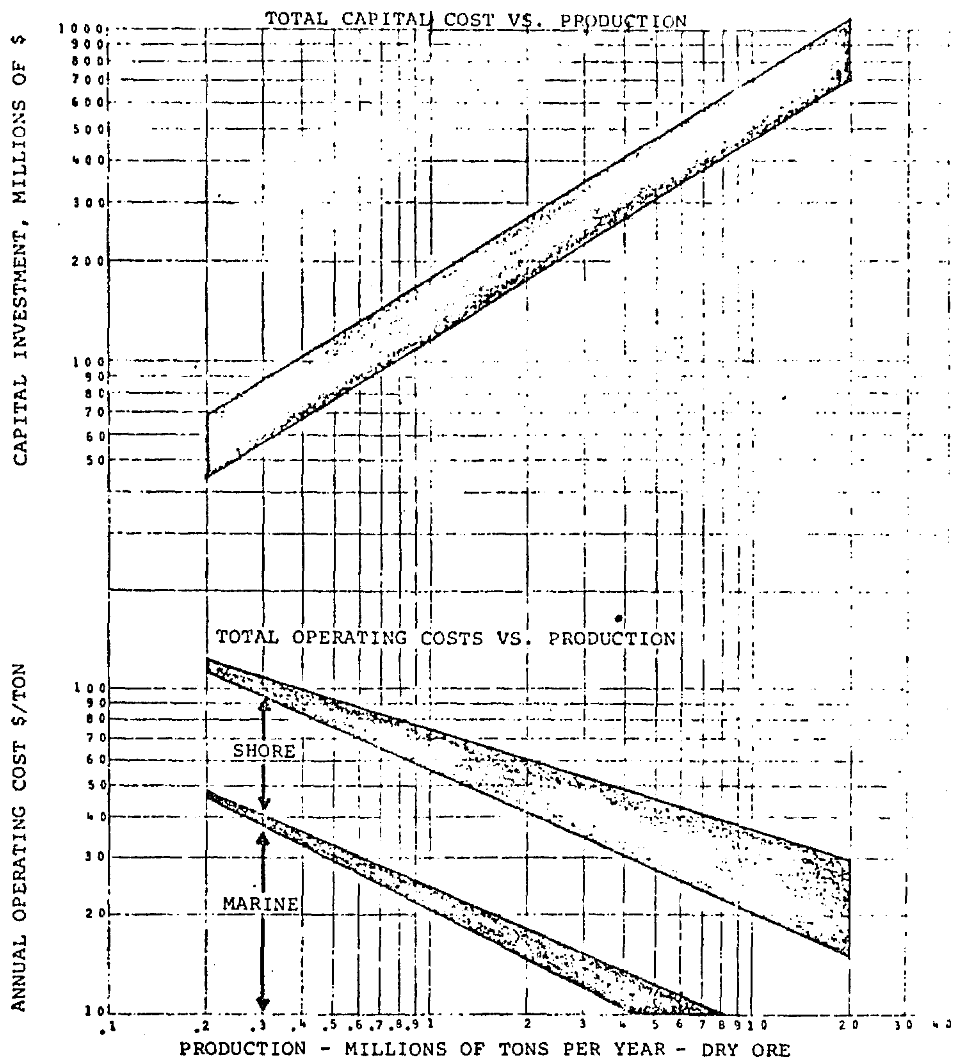
Figure 7. Capital and operating costs vs. production (costs based on full stream production at outset)



Source: A. J. Rothstein and R. Kaufman, "The approaching maturity of deep ocean mining - The pace quickens", in 1973 Offshore Technology Conference Preprints, p. 340

bring such a 3 million ton operation on stream would be between 250 to 280 million dollars. Since Dubs' figures apparently reflect the actual estimates of his company's proposed nodule system they could be used for cost-benefit estimates of a 3,000,000 tons mining operation.

A first approximation to the gross "profit" potential of nodule mining, before the "take" of the authority (operational net revenues) is indicated in table 10 which summarizes the estimates of gross revenues, operational costs and total investment. It is not very likely that the low estimate of return on total investment - as well as the high estimate - will actually be realized because its computation assumes the most pessimistic assumptions in every case: low gross revenue, high total operational costs and high total investment. This low estimate of return (43 per cent and 54 per cent respectively for 1 and 3 million tons operations), however, has the merit of sounding a cautious note for future policy making. 135/

In the future, after the best nodule deposits are exhausted, ore bodies with lower grades will probably be mined. By the same token, prices of some metals, in particular cobalt, manganese and nickel, might also fall as the volume of nodule recovery mounts. The impact of these developments on the profitability of the nodule industry will probably be less serious than it might be thought. The reason is that investment and operational costs are also likely to fall. 136/

(c) The share of revenues of the international authority

The estimates of operational results computed above for the nodule industry provide the necessary basis for a consideration of the possible share of revenue for the Authority. The exact extent and form of this share will depend on the nature of the régime and the manner in which the exploitation takes place.

The share of the Authority, whether in the form of profit participation or taxation, should be effective in generating maximum revenues for the Authority. It should also induce the most efficient allocation of sea-bed resources among potential sea-bed miners. It is well known in economic geology that the best grade ore body of a region is several times more valuable than the "average" ore grade. The distribution and grade of nodule resources of the ocean floor, as on land, are

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135/ These figures on the estimated return on total investment assume that depreciation allowances according to standard practice were included in the cost estimates given by the industry representatives mentioned. But even if that were not the case, and an additional allowance of, say, 10 per cent over total investment were made, the operational results would still be very attractive. For the one million ton operation they would range from a low of 33 per cent to a high of 99 per cent with a medium estimate of 53 per cent return. The 3 million ton operation would also fare very well with returns ranging from a low of 44 per cent to a high of 84 per cent with a medium estimated return of 65 per cent.

136/ It has been the experience of every major new industry that costs of production tend to fall sharply once the industry matures (i.e. plastics, colour TV, mini-computers, etc.).

Table 10. Estimated operational results of two possible sizes of nodule mining units (millions of $US)

	1 million tons/year			3 million tons/year		
	High	Medium	Low	High	Medium	Low
(a) Estimated gross revenue[a/]	188	170	154	296	268	242
(b) Estimated total costs[b/]	76	66	56	90	75	60
(c) Estimated net revenue[c/]	132[c/]	104	78[c/]	236[c/]	193	152[c/]
(d) Estimated total investment[b/]	180	150	120	280	265	250
(e) Return on total investment[d/]	109%[d/]	69%	43%[d/]	94%[d/]	73%	54%[d/]

a/ Using the figures of table 9 as medium, the high and low estimates were computed as 10 per cent greater and 10 per cent lower than the medium.

b/ High and low from Rothstein-Kaufman (1 million tons) and Dubs (3 million tons); medium is the arithmetic average.

c/ High estimated net revenue (c) calculated as high (a) minus low (b); low (c) as: low (a) minus high (b).

d/ High return on total investment (e) is: high (c) divided by low (d); low (e) is: low (c) divided by high (d).

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very uneven. Some areas with high nodule concentration, high metal content, ideal ocean floor topographic conditions and proximity to processing plants would be considerably more attractive than the "average" nodule deposit. If allocation of mine sites is made by some arbitrary means (first-in, first-served basis; random distribution of ocean floor blocks to interested nations, etc.) some of the best mine sites might be allocated to parties that may not even have the capability to mine the nodules. Moreover, the authority would not receive any extra revenue with the allocation of the choice mine sites, even if they were to go to the most efficient producers.

Though the "most efficient producer" is only a theoretical concept, it serves, in fact, as a guideline in most schemes for allocation of mineral resources. The method used is to auction the right of exclusive exploitation to interested parties. 137/ Under an auction system the exploitation rights for a given site would

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137/ The advantages of the auction system for nodule resources were described by two authorities in mineral economics:

> "The auction mechanism provides several advantages over a system that awards rights to the first claimant or over a system that awards rights on the basis of non-economic criteria. First, it helps to ensure that the most efficient producers will get the exploitation rights. This is because the exploiters with the lowest costs will be able to bid the greatest amount. Under a "first-come, first-served" arrangement, there is no assurance that exploiters will be efficient. And under a system where non-economic criteria are used to allocate rights, this, by definition, would award rights to the less efficient. It would also tend to distribute wealth by awarding rights rather than by providing shares in royalties and auction revenues.
>
> Second, the auction mechanism provides the least arbitrary means for choosing among competing claimants. Competition among claimants may not be great for the manganese nodules of the deep sea-bed for many years to come. But eventually, as the demand increases for such resources, the competition will become important.
>
> Third, the auction mechanism approximates a fair value for the exploitation right much more effectively than any other system. The exploiter bids no more than he feels he can afford. This permits him to take into consideration the degree of risk attached to the operation, the value of the market, and other economic variables. It also builds in a large degree of flexibility and provides for an automatic response to the changes in conditions of risk, market, etc. It can, and should be combined with royalty payments so that the world community can share in production values."

David B. Brooks and Francis T. Christy, Jr., "Memorandum on Suggested Operational Guidelines for an International Regulatory Authority for the Sea-Bed", in The United Nations and the Bed of the Sea (II), 21st Report of the Commission to Study the Organization of Peace, New York, June 1970, pp. 29-30.

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be awarded to the highest bidder. Refusal prices and other conditions to protect the public interest could also be imposed.

In summary, the determination of the take of the Authority should meet several objectives: (1) maximize revenues for the Authority; (2) assure the necessary financial incentives to attract capital and technology into the nodule industry; and (3) promote the allocation of choice mine sites to the most efficient producers. These objectives could be met by establishing the share of the authority as made up of two component parts. The first component would be equal for all nodule mining ventures and would be established at a level that would assure the necessary financial incentives for the industry. The second component would be different for each venture and would be designed to derive that extra revenue that interested parties would be willing to pay for the right to exploit the choice mine sites.

(i) The basic component of the Authority's share of revenues

The basic component, common to all operations, could be determined in several ways. It could be based on the right of exclusive access to the resource, as, for instance, the payment of rental fees per square kilometre of area leased. 138/ It could be based on production, such as a royalty over the value of output, a levy per ton of mineral recovered, or in a more crude form a fee per ton of nodule mined. It could also be based on net revenues (profits) such as a tax over profits or a direct sharing of profits in the case of joint-ventures with the Authority. These three approaches are not mutually exclusive. On the contrary, they are often combined in national legislations to reinforce each other in securing a fair share of revenue for the government.

A take based on net revenues may assume quite distinct legal forms. In financial terms, however, a 50 per cent tax on profits is essentially the same as a partnership with equal sharing in the profits of the venture. This general approach has been traditionally favoured by fiscal experts and business groups because of its intrinsic flexibility. It permits the government and the business entity to benefit equally in cases of exceptionally favourable market conditions resulting in high profits.

The shortcomings of a tax on, or participation in, the profits (operational results) of a business venture are mostly of an administrative nature. Computation of "taxable" profits can easily become a highly contentious affair often resulting

138/ Concession taxes related to land area can be applied both to the exploration and to the exploitation stages. They can include deposits providing a minimum "guarantee" to the government if the concession is not explored or exploited. These taxes seldom amount to an important share of the total take of the government. They are generally designed to compensate the owner of the property that will be disturbed by the mining activities. They serve, however, the important function of discouraging speculation by concessionaries who are not interested in carrying out the exploration or commercial mining of the area. See J. N. Behrman, "Taxation of extractive industries in Latin America and the impact on foreign investors", in R. F. Mikesell (ed.) Foreign Investment in the Petroleum and Mineral Industries (Baltimore, the Johns Hopkins Press, 1971), pp. 56 ff.

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in disputes between the fiscal authorities and the firm concerned. Despite the extensive experience of advanced industrial countries in tax enforcement, it is known that a number of procedures can be and often are used to reduce the magnitude of taxable profits. The use of such procedures is particularly common where multinational corporations are involved and when some buying or selling takes place in more than one country. 139/ These practices have been extensively described in the literature and much attention has been given in recent years to their control. 140/

If the share of the Authority is established as a tax on profits, exhaustive regulations will be required on methods to compute taxable profits. The novelty of an international machinery with fiscal powers would need to be studied closely. It is obvious that most of the potential points of discord in the computation of net revenues could be avoided if the Authority itself were a partner in the sea-bed mining venture and had an active role in management.

Taxes on production or sales have the opposite characteristics of those levied on profits. They are much simpler to administer as the tax guidelines are easier to determine, i.e., volume of production or value of sales. On the other hand, these taxes are not very flexible to changes in operational conditions. When prices reach very high levels the enterprise is able to reap much higher net

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139/ The United Nations report, Multinational Corporations in World Development (ST/ECA/190 - New York, 1973), summarizes in a section on profit management (pp. 34-35):

> "Dividends and royalty payments are not the only means whereby multinational corporations withdraw profits from a foreign subsidiary. Profits can be recorded in other units of a global system, including holding companies located in tax havens, through control of the transfer prices for goods and services supplied by the parent company or exports to other affiliates.
>
> "The importance of these controls in influencing the net profit before local taxes depends largely on the proportion of total purchases and sales tied to other affiliates. Prices charged for tied imports have been shown in some instances to be far above prevailing "world" prices, and conversely those for exports have been below world prices. As already noted, overpricing, particularly for wholly-owned affiliates, has been used as an alternative to royalty payments. Considerable variation exists, however, in the amount of overpricing or underpricing and its over-all frequency is not known."

140/ For an indepth analysis of multinational practices to reduce tax liability in host countries, the reader is referred to: J. S. Arpan, International Intercorporate Pricing (New York, Praeger, 1971); United Nations, "Establishing transfer prices in allocation of taxable income among countries" (ST/SG/AC.8/L.3 - New York, 1973); and J. Schulman, "Transfer pricing in multinational business", D. B. A. thesis, Harvard University, 1967.

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profits than it would be possible with a tax on profits. When operational conditions are unfavourable due to fall in sales revenues or sharp increases in costs of production actual profits are sharply reduced or even wiped out: in such cases, the payment of royalties might constitute an excessive burden to the enterprise. For this reason royalties are generally set conservatively at levels compatible with the likely financial position of firms during unfavourable years.

But the question still remains: what could be the actual share of revenues of the authority that would meet the requirement of providing the necessary incentive for the industry, namely guaranteeing at least a 15 per cent return on investment for nodule ventures? The determination of such shares - whether based on gross revenues or on net revenues - generally requires detailed studies on the likely operational results of the industry. The data available for the estimates of revenues and costs of the future nodule industry used in this report are clearly of a preliminary nature. Therefore, the figures presented must be understood as first approximations requiring further refinement.

From the figures in table 11 it could be tentatively concluded that a possible share of the Authority at 30 per cent of gross revenues (sales) 141/ or 50 per cent of net revenues (profits) would still make nodule mining a rather attractive commercial proposition even considering the risks inherent in a new industry. The medium estimate of return on investment after payment of the Authority's share is quite similar for both methods: for the 1 million tons operation 35 per cent and for the 3 million tons size 43 per cent and 36 per cent. As expected, the range between high and low estimates of operational results is much wider for the 30 per cent share over gross revenues than for the 50 per cent share over net revenues, regardless of the size of operation. The limiting point is the low estimate of return (18 per cent) for the 1 million ton size with the share of the Authority set at 30 per cent of gross revenues. The 3 million ton operation would seem to fare considerably better: the low estimated return would be 28 per cent with payment of a 30 per cent share on gross revenues, and 27 per cent with a share of 50 per cent on net revenues.

The method of financing total investment will also affect the operational results of the equity capital invested in the nodule venture. Industrial and mining companies generally borrow a substantial proportion of their total capital requirements for a new venture. This proportion may be as high as 90 per cent in exceptional cases. It would seem reasonable to assume that firms from advanced countries would probably borrow at least 50 per cent of the total capital

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141/ A share of 30 per cent of gross revenues may seem rather high at first sight. In many countries royalties of up to 20 per cent (Mexico and the United States) are payable over the value of mineral output. In the United States draft Convention on the International Sea-Bed Area it is proposed that miners should pay the Authority the equivalent of 5 to 40 per cent of the gross value at the site of oil and gas, and 2 to 20 per cent of the gross value at the site of other minerals (appendix A, No. 10.2). It must be recalled, however, that the "take" is made up of royalties plus concession fees, income taxes, and other charges.

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Table 11. Estimated operational results of two possible sizes of nodule mining operations after payment of two alternative shares of revenues to the Authority

(in millions US dollars)

	1 million ton/year			3 million ton/year		
	High	Medium	Low	High	Medium	Low
Estimated net revenue before payment of Authority's share:	132	104	78	236	193	152
Possible shares of the Authority:						
30% share over gross revenue (royalty)	56	51	46	89	80	72
50% share of net revenue (profit split)	66	52	39	118	96	76
Estimated net revenue after payment of Authority's share:						
with 30% share over gross revenue	75	53	33	146	113	79
with 50% share of net revenue	66	52	39	118	96	76
Estimated return on total investment after payment of Authority's share:						
with 30% share over gross revenue	63%	35%	18%	58%	43%	28%
with 50% share of net revenue	55%	35%	22%	47%	36%	27%

Source: table 10.

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requirements for a nodule mining venture. 142/ Borrowing will improve the return on equity as long as the rate of interest payable is less than the rate of return on total investment. 143/

The calculations of return on equity investment shown in table 12 are based on the assumption that the liability over borrowed capital would rest with the original investor. These computations show that the return on equity investment, even in the case of the low estimate, would seem quite attractive with either method of determining the Authority's share. Return on equity appears to be most attractive (over 44 per cent) for the larger size of operations (3 million tons of nodules per year). 144/

142/ The practice of multinationals is quite interesting:

> "The capital structure of a newly established subsidiary generally has a large proportion of locally raised debt if it is a joint venture, much less if it is wholly-owned. Studies of United States investment in Australia and Japan have shown that contributions of technology are likely to be capitalized in joint ventures, but not in wholly-owned subsidiaries. This difference may partly explain why wholly-owned subsidiaries have generally reported a higher return on book equity than joint ventures. Further differences in financial policy are evident, especially in the early years of existence: wholly-owned subsidiaries are provided with special support services at low or zero cost; royalty payments are temporarily forgiven; dividends are postponed. On the other hand, in later years, parent companies expect to be able to move funds between subsidiaries on demand."

United Nations report (ST/ECA/190), op. cit, p. 35.

143/ The liability for interest payment is also important if the share of the Authority is based on net revenues. The interest payment can be treated either as a liability of the nodule venture or of the parent company providing the equity capital and technology. In the former case, the Authority would effectively be subsidizing half of the cost of borrowing if the share of the Authority amounted to 50 per cent of net revenues. Conversely, it might be interpreted that in joint ventures the Authority would enter the partnership with the resources of the international community while the associated enterprise would provide all the capital and technology required. In that case, the liability for payment of interest and principal would lie with the original investor and not with the joint venture itself. This problem would not occur if the share of the Authority were based on gross revenues.

144/ It is assumed in these calculations that the nodule mining companies would not be subject to additional national corporate taxes on their profits. Since industrial countries provide for tax credits in their fiscal codes, the domestic tax liability of these companies might in fact be negative. The companies might be able to claim some deduction on their domestic taxes from other operations, equivalent to the difference between their payments to the Authority and the tax they would have paid if the nodule industry were entirely of a local nature. As is well known, mining companies in industrial countries generally benefit from special tax advantages (depletion allowance, accelerated depreciation, etc.), that tend to reduce their tax liability.

Table 1[illegible]. Estimated return on equity investment (50% of total investment) of two possible sizes of nodule mining operations (assumed interest rate on borrowed funds = 10%)

(in millions of US dollars)

	1 million tons			3 million tons		
	High	Medium	Low	High	Medium	Low
Net revenue after payment of Authority's share:						
- as 30% of gross revenue	75	53	33	146	113	79
- as 50% of net revenue	66	52	39	118	96	76
Interest payment = 10% over half of total investment	6	8	9	12	13	14
Net revenue after interest payment						
- with 30% share of gross revenue	69	45	24	134	100	65
- with 50% share of net revenue	60	44	30	106	83	62
Estimated return over equity (half of total investment)						
- with 30% share of gross revenue	115%	60%	27%	107%	75%	46%
- with 50% share of net revenue	100%	59%	33%	85%	63%	44%

Source: tables 10 and 11.

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(ii) Auction of mine sites

A second component of the Authority's share of revenues in nodule mining could be derived from auctioning the mine sites. An auction system to be effective would have to take into account the rather small number of enterprises actively engaged in developing nodule systems. The numerous precedents in auctioning offshore blocks in the oil industry might be helpful in designing appropriate procedures for the nodule industry.

The first issue in a possible auction system would be the choice of sites which would be opened for bids. In the oil industry the appropriate agency of the government determines the specific blocks of its continental shelf to be offered in auction. It decides on the delimitation of the blocks and their exact location. This procedure might have serious disadvantages in the nodule industry, particularly in the initial years, since the international authority would have limited knowledge of nodule distribution. Moreover, such procedure would unduly penalize the companies that have spent large sums prospecting the ocean floor for the most desirable potential mine sites. Instead, it might be preferable to permit the interested parties to indicate the specific locations on which they wish to bid. In that case, the Authority could set a deadline to receive notifications of one possible mine site from each interested party. On the predetermined date, the Authority would publicize the specific locations of the ocean floor for which it would entertain bids a few months later. 145/

The obvious question, however, is whether there would be any real competition for mine sites. It might be argued that, since only a few (6 to 8) enterprises or groups seem to be actively engaged in developing nodule systems, these groups might arrange among themselves not to bid on each other's sites. Two factors would minimize this danger. First, the number of companies or groups potentially interested in nodule mining is quite large. In fact, it might be said that the

145/ The question of whether to establish a world-wide grid for potential sea-bed mining blocks is discussed below in section III.7 on conservation of nodule resources.

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majority of large oil and mining companies in the world are potentially interested in sea-bed mining. 146/ It seems reasonable to expect that once nodule mining is proven to be commercially viable many other firms will enter the industry.

The second factor that would enhance the chances of competitive bidding is the possibility that some form of control over the pace of nodule development might be adopted. If the Authority adopts a system of control similar to the one discussed above (III.3.4), a certain volume of nodule mining would be authorized each year. Using the figures presented in table 7 as an example, by 1976 the Authority might authorize projects to mine approximately 2.7 million tons of nodules. Assuming that 1976 would be the first year of provisional entry into force of the international régime, at that time it is likely that all the 7 or 8 most active groups would try to obtain authorization to go ahead with their programmes and at the same time assure the exclusive exploitation rights over their desired sites. Considering the likely sizes of operation, these groups might request authorization to mine an annual volume of 19 to 22 million tons of nodules, or approximately 6 to 7 times as much tonnage as may be granted that year. The companies in that case would have to include in their bids - particularly in the first few years - a factor for priority over time 147/ as well as priority over a specific mine site.

146/ This interest can be seen in the participation of 32 firms from 6 countries (United States of America, Canada, France, Federal Republic of Germany, Australia and Japan) in the CLB system tests of 1972. These firms paid a minimum fee of $US 50,000 to participate in these tests. It seems likely that a number of other firms might enter the nodule industry by means of "purchased technology". The multinational groups established so far are primarily aimed at a co-operative development of technology. It can be expected that once a nodule system becomes operational, one or more members of that group might be tempted to operate alone. One additional factor in the possible future expansion of the industry is the programme of Howard Hughes. His nodule mining system, presently undergoing tests in the Pacific Ocean, may be available to other interested parties. In fact Summa Corporation has not yet finalized its plans for the commercial stage of nodule exploitation. A number of alternatives are under consideration: (a) to mine and process the nodules alone; (b) to set up a joint venture with a firm, or firms, experienced in metallurgy and marketing; (c) to mine nodules for sale to other parties; and (d) to build and sell complete nodule mining systems to interested parties.

147/ It might be countered that these 7 or 8 groups would attempt to arrange among themselves a time schedule as well as an agreement not to bid on each other's claims. The likelihood of such arrangements is not very great because of the importance of the time element in business and the difficulty to enforce such an agreement in the face of so many unknowns. For instance, company X that would be accorded priority by the other firms for the first year might disclose a mine site with such ideal conditions that one or more parties to the "gentlemen's agreement" would be tempted to repudiate the arrangement and try to obtain control of that site with a high bid. Moreover, the other several dozen potential nodule miners would also have a role to play in assuring the competitiveness of an auction system for sites. These latecomers could take a short-cut and instead of spending several million dollars over several years in exploration programmes, might simply spend equivalent sums as their bid prices for the choice sites that would be disclosed by the leaders in the industry.

The nature of bids would need to be determined if an auction system is adopted. Two basic possibilities could be contemplated, namely the full payment of a certain sum which would constitute the bid price (as in the oil industry) or the offer to make payments larger than those statutorily determined, over gross or net revenue, once production commences. 148/ Each method has advantages and disadvantages. A cash price for a site has the advantage of simplicity; the site would simply go to the highest bidder. The cash price has also the advantage of discouraging speculators from sitting on choice sites, though speculators can also be discouraged by the establishment of minimum work requirements (a schedule of minimum annual expenditures) and by surface rental fees. The disadvantage of the cash price is that it increases the financial burden of getting started in the nodule industry. As a result, the miner will attempt to raise the cut-off grade of the ore body and to speed up production schedules. 148/ These procedures do not lead to good resources conservation practices.

Bids offering additional participation in gross or net revenues by the Authority would avoid some of the disadvantages of cash prices. On the other hand, they would be quite complex to evaluate. Decisions on "the best bid" for the Authority could lead to contention depending on the method of evaluation of bids. For instance a bid offering 4 per cent additional royalty might in fact be more attractive for the Authority than a bid offering 5 per cent depending on the prospective schedule of cash flow for both projects and the rate of discount used for the purpose of project evaluation. 149/ Still another alternative is the combination of royalty and bonus in the auction system. 150/

In conclusion, it could be said that the revenue potential for the Authority from nodule exploitation is quite attractive. A prerequisite for the determination of the take of the Authority is an agreement on the type of régime to govern the exploitation of nodules. The formulation of an ideal, or a desirable, take would only be possible after a decision is made on "who may exploit the area" and "in what form the exploitation may take place". Once this decision is made, further studies on the economics of nodule mining would be necessary to determine the most appropriate levels for each component of the take of the Authority.

148/ See A. P. H. Van Meurs, Petroleum Economics and Offshore Mining Legislation (Amsterdam, Elsevier Publishing Co., 1971) pp. 87 ff.

149/ See United Nations, Manual on Economic Development Projects, (58.II.G.5) New York, 1958; and O.E.C.D., Manual of Industrial Project Analysis in Developing Countries, Paris, 1969.

150/ "It may be that because of the high levels of risk and uncertainty in much of the public domain land, the optimum leasing system might include a combination of royalty and bonus bidding", J. W. Sprague and B. Julian, "An analysis of the impact of an all-competitive leasing system on onshore oil and gas leasing revenue", Natural Resources Journal, July 1970, pp. 515-531.

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6. Preservation of the marine environment

Despite the universal agreement on the need for measures to preserve the marine environment in all activities of exploration of the international area and exploitation of its resources, the translation of this principle into practice offers a number of difficulties. The problem centres on the definition of what constitutes an interference with the ecological balance of the marine environment. It is on the basis of such definition that operational standards for activities in the area could be established.

The amount of research on the deep sea environment is almost negligible compared to the multitude of programmes concerned with the ecological processes of the shallow coastal environment. But even in the latter case, scientists are far from unanimous in their opinions as to whether certain specific activities interfere significantly with the ecological balance of the marine environment. It is obvious, therefore, that at the moment there is a serious gap of knowledge on the ecology of the deep oceans. Though some research on the environmental impact of nodule mining has been carried out in the United States, 151/ and the United Nations has commissioned a study of this subject, the data existing at present would not be sufficient to establish detailed environmental standards.

Most of the environmental observations made so far were based on the intermittent operation of prototype lifting systems in relatively shallow waters - under 1,000 metres depth. The ecological impact of the operation of a large mining system in 4,000 to 5,000 metres water depth, and in some cases 800 miles from the nearest land, will probably only be assessed in its entirety when commercial operations have been under way for some time. Moreover, the nature of bottom sediments and benthic life is likely to vary from site to site. Ocean currents throughout the water column and water characteristics (temperature, salinity, etc.) might also be different depending on the location. Last but not least, the particular methods of mining and separation of sediments will have different impact on the benthic and pelagic environments. For instance, the continuous line bucket (CLB) system is designed to bring only the nodules to the surface. The hydraulic and airlift pumping systems, on the other hand, will transport large quantities of cold bottom water (rich in nutrients) as well as sediments to the warmer waters at the surface. 152/

151/ See: T. C. Malone, C. Garside and D. S. Roels, "Potential Environmental Impact of Manganese-Nodule Mining in the Deep Sea", in 1973 Offshore Technology Conference Preprints, vol. I, pp. 129-135; C. G. Welling, "Some Environmental Factors Associated with Deep Ocean Mining", 8th Annual Marine Technology Society Meeting, 1972; A. F. Amos, C. Garside, K. C. Haines and O. A. Roels, "Effects of Surface-Discharged Deep Sea Mining Effluent", Journal of Marine Technology Society (1972) 6, No. 4, pp. 40-45.

152/ T. C. Malone, C. Garside and D. S. Roels, op. cit., p. 129.

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Given these circumstances, it might be desirable to determine the appropriate standards for protecting the ecological balance in three stages. First, to incorporate in the régime general principles for the preservation of this environment and the competence to establish and enforce standards. As a second line of defence, environmental impact statements could be required from all companies and groups requesting contracts or licences to mine nodules. Finally, the Authority could progressively develop detailed rules, standards and regulations, based on its accumulated experience. 153/

The above considerations refer primarily to deep-sea-bed mining. It must be borne in mind, however, that at present approximately 95 per cent of the ocean pollution originates from vessels. 154/ Pollutants are primarily introduced into the marine environment by collisions and other maritime casualties, loading and bunkering operations, and operational discharges. The matter of standards and regulations for these activities will be considered by the Third United Nations Law of the Sea Conference, with particular reference to the work done by the Inter-Governmental Maritime Consultative Organization.

7. Conservation of nodule resources

The concern for conservation of sea-bed resources expressed in the Declaration of Principles reflects the fact that nodule deposits are among the last mineral frontiers in our resource-hungry world. The concept of resource conservation, however, is not always clearly understood. In a nutshell, "the conservation of non-renewable resources is effected by rational, efficient use and long-term exploitation plans, and by the prevention of waste through inefficient production and treatment techniques or otherwise". 155/

The basic approach to resource conservation is to maximize the long-term utilization of a resource. To this end the individual operator may have to be discouraged from undertaking certain methods of resource exploitation that might be commercially attractive in the short-run. Conservation methods with respect to nodule resources would fall into two broad categories: (1) over-all management of the international area and (2) regulation of mining operations. The issues of resource conservation, with some alternative approaches for each case, are presented in summary form in figure 8.

153/ For effective protection of the marine environment, as for other policy objectives, the Authority should be invested with sufficiently broad powers and flexibility to adjust its standards and regulations to its accumulated knowledge of the marine environment and to new circumstances with which it may be confronted in the future.

154/ Competence to establish standards for the control of vessel source pollution, working paper presented by the United States of America, document A/AC.138/SC.III/L.36 (1973).

155/ United Nations, Natural Resources of Developing Countries: Investigation, Development and Rational Utilization (New York, 1970, document E.70.II.B.2), p. 39.

Figure 8. Summary presentation of issues and alternatives relating to sea-bed resource conservation

A. Management of the international area

1. Decisions relating to space (surface boundaries)

(a) Over-all subdivision of the international area

(i) On an ad hoc basis as requested by sea-bed miners

(ii) According to master grid

(b) Size of individual blocks

(i) As requested by miners

(ii) Equal size for all blocks

(iii) Variable sizes pre-determined by grid
- blocks of one degree square as defined by meridians
- size determined by geological, morphological and other considerations

2. Decisions relating to time

(a) Reservation of areas for future uses

(i) Area returned to Authority (3/4 of initial area authorized for exploitation)

(ii) Alternative bands with width of 2 degrees of longitude running from pole to pole

(iii) Discretionary decision by the Authority

(b) Annual authorization of surface area, or nodule tonnage, for exploitation

(i) No limits - as requested by interested parties

(ii) Controlled nodule development based on principle of complementarity with land-based production

(c) Duration of exploration and exploitation permits - work requirements

B. Regulation of mining operations

1. No minimum recovery efficiency required

2. Control aimed at avoiding wasteful mining methods

(a) Unmined areas of blocks

(i) Unminable zones - topographic barriers

(ii) Areas with nodules below "cut-off" grade

(b) "Sweep" efficiency

(i) Limited manoeuvreability

- Continuous Line Bucket (CLB) system

- "Vacuum cleaning" (hydraulic) and airlift systems

(ii) Extensive manoeuvreability - bottom crawling devices

(c) Dredge efficiency

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It should be stressed that these issues are to a considerable extent interdependent. Thus, a given strategy of resource conservation would take account of each one of these areas. For example, a master grid for the international area with blocks of 50 km x 50 km (2,500 km^2) could be established; every two adjacent rows of blocks (100 km wide) would be available for exploitation and the adjoining two reserved for future use; each enterprise would be allocated one block for a certain number of years, subject to the metal production plan approved by the Authority. This hypothetical approach would resolve the over-all subdivision requirement for the international area and the size of individual blocks, while automatically reserving half of the best mine sites for future use. It would facilitate the control of nodule development so as to minimize the possible impact on developing countries exporters of minerals. It would prevent the speculative holding of large areas of top grade nodule deposits by a few operators, while at the same time, minimizing the need for detailed work requirements (the usual means of discouraging speculative holdings). Finally, it would provide an intrinsic regulation of minimum recovery efficiency. 156/

Management of the international area, from a resource conservation point of view, will require decisions with regard to space and to time. The spatial or geographical question has many similarities with the offshore oil industry. The two basic elements in the equation are the subdivision of the international area into "blocks", or potential mine sites, and the size of these blocks. Two alternatives are possible with respect to the subdivision of the area. The first is simply to leave it to the interested parties (the nodule miners) to indicate the shape and specific location of desired blocks. This approach makes over-all resource management more difficult and may lead to some waste since the area left between the chosen blocks may be of such odd shapes and small size as to make its exploitation unattractive. This situation can be visualized in the hypothetical case A in figure 9, where a substantial buffer area might be left unused.

The other approach is to subdivide the international area in a rather homogeneous fashion as is generally done for the offshore oil industry. This would mean the establishment of a grid with parallel blocks of the same shape. The grid could be either of a global character with all blocks similarly defined by geographic co-ordinates, or of a more regional character, where the size of blocks would vary according to the geomorphic characteristics of the sea-floor, latitude, nodule density and grade, etc. In the hypothetical example of figure 9 B, the grid would be based on meridians of latitude and longitude. This rather simple and straightforward case would result in progressively smaller blocks with distance from the equator, as can be seen in table 13. The desirability of such a master grid would depend on considerations about the most appropriate block size.

156/ For example, an enterprise wishing to mine 3 million tons of nodules per year could be notified that only after five years of mining activities would it be granted another block; if the nodule density at that site were known to be about 4 lb. per square foot, or a total of about 50 million tons for the whole block, it means that after five years of exploitation some 15 million tons of nodules would be recovered, representing an implicit recovery efficiency of 30 per cent.

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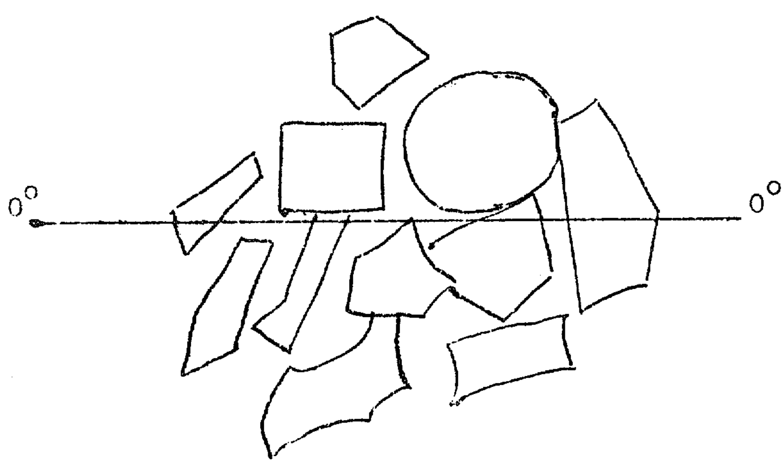
Figure 9. Two hypothetical cases of subdivision of the International Area

A. International Area subdivided on an ad hoc basis with blocks shaped as requested by nodule miners



B. International Area subdivided with a global grid based on meridians of latitude and longitude

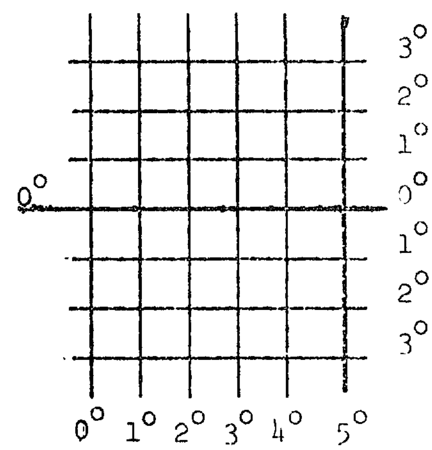


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Table 13. Area of one-degree square blocks (in square kilometers)

Latitude	Area in km^2	Latitude	Area in km^2	Latitude	Area in km^2
0°- 1°	12,309	30°- 31°	10,643	60°- 61°	6,124
1°- 2°	12,305	31°- 32°	10,534	61°- 62°	5,935
2°- 3°	12,298	32°- 33°	10,422	62°- 63°	5,745
3°- 4°	12,287	33°- 34°	10,307	63°- 64°	5,552
4°- 5°	12,273	34°- 35°	10,189	64°- 65°	5,358
5°- 6°	12,254	35°- 36°	10,067	65°- 66°	5,162
6°- 7°	12,233	36°- 37°	9,942	66°- 67°	4,964
7°- 8°	12,207	37°- 38°	9,815	67°- 68°	4,765
8°- 9°	12,178	38°- 39°	9,684	68°- 69°	4,564
9°- 10°	12,145	39°- 40°	9,550	69°- 70°	4,362
10°- 11°	12,109	40°- 41°	9,414	70°- 71°	4,159
11°- 12°	12,069	41°- 42°	9,274	71°- 72°	3,954
12°- 13°	12,025	42°- 43°	9,132	72°- 73°	3,747
13°- 14°	11,978	43°- 44°	8,986	73°- 74°	3,540
14°- 15°	11,926	44°- 45°	8,838	74°- 75°	3,331
15°- 16°	11,873	45°- 46°	8,687	75°- 76°	3,121
16°- 17°	11,815	46°- 47°	8,534	76°- 77°	2,910
17°- 18°	11,754	47°- 48°	8,377	77°- 78°	2,699
18°- 19°	11,689	48°- 49°	8,218	78°- 79°	2,486
19°- 20°	11,621	49°- 50°	8,057	79°- 80°	2,273
20°- 21°	11,549	50°- 51°	7,893	80°- 81°	2,058
21°- 22°	11,474	51°- 52°	7,726	81°- 82°	1,844
22°- 23°	11,395	52°- 53°	7,557	82°- 83°	1,628
23°- 24°	11,313	53°- 54°	7,386	83°- 84°	1,412
24°- 25°	11,227	54°- 55°	7,212	84°- 85°	1,196
25°- 26°	11,138	55°- 56°	7,036	85°- 86°	979
26°- 27°	11,046	56°- 57°	6,858	86°- 87°	762
27°- 28°	10,950	57°- 58°	6,678	87°- 88°	544
28°- 29°	10,851	58°- 59°	6,495	88°- 89°	327
29°- 30°	10,749	59°- 60°	6,310	89°- 90°	109

Source: *Geographical Conversion Tables* (Zurich, Amiran and Schick, 1961), pp. 219-221.

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A number of factors have to be taken into account in the determination of mine-site size for the nodule industry. The consideration that is generally advanced is that the mine size must be sufficient to provide the necessary nodule tonnage for the normal operation of the mining equipment and processing plant during their expected lifetime. It is reasonable to expect that in most industrial countries, these facilities would be depreciated in less than 10 years. Since nodule mining is a new industry at the beginning of its development, it can be expected that its rate of technological progress will make for a rapid obsolescence of plant and equipment. If the size of the mining blocks is to be determined so as to provide the necessary feedstock throughout the lifetime of the project, it seems that this period could be arbitrarily defined within the span of 10 to 20 years. The need of sufficiently large mine sites for this purpose is strongly questioned by one company developing nodule systems. International Nickel Co. 157/ has proposed that each licensee be granted exclusive rights of access over an area of 2,500 km^2, with a buffer zone of at least 5 km left between blocks to prevent encroachment. These smaller mine sites would prevent a speculative "land grab" by a few companies. Once the nodule deposits of one site have been depleted the miner would be granted another block, which could conceivably be one adjoining to the first one.

The problem of determining an "appropriate" block size is compounded by the fact that nodule density and grade change from site to site. Moreover, recovery efficiency of the different mining systems under development may vary considerably. Given these factors, three alternative approaches regarding mine size are possible: (a) variable sizes as requested by the sea-bed miner; (b) a standard size for all blocks regardless of locality or proposed production capacity; and (c) variable sizes predetermined by master grid.

An indication of what might be the claims of future miners as to the size required for their projects was given in a paper prepared by officials of two United States companies. 158/ Using a comprehensive formula, the authors estimated that within the range of assumptions suggested for the variables in their formula, the tract area with an average density of 1.5 lb. per square foot, required for an annual production of 3 million tons of dry nodules over 20 years could range from 32,668 km^2 to 127,043 km^2. While the proposed formula seems most useful, the assumptions used for the calculations would have to be critically examined as to

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157/ INCO, "An Approach to International Regulation of the Recovery of Deep Sea Ferro Manganese Nodules", mimeograph, January 1973.

158/ J. E. Flipse, M. A. Dubs and R. J. Greenwald, "Preproduction Manganese Nodule Mining Activities and Requirements", in Mineral Resources of the Deep Sea-Bed, op. cit., 15 March 1973.

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their applicability to the real situation of nodule mining. 159/ It seems reasonable to assume that nodule miners would want to obtain control over as large an area as possible of top grade sites.

The other aspect of management of the international area for resource conservation relates to the time element. The issues involved are: (a) reservation of areas for future use; (b) annual authorization of surface area, or nodule volume, for exploitation and (c) the duration of exploration and exploitation permits. This last point is a common feature of all mining legislation and is generally associated with work requirements for the periods in question so as to prevent speculative holding of sites. The possibility of setting up a programme of controlled nodule development with maximum annual authorization of a certain tonnage of nodules for exploitation would depend on the nature of the régime and future decisions of the Authority. This question is discussed at greater length in section III.3 above.

The reservation of areas for future use is a question having to do as much with equity as with resource conservation. It is generally agreed that in the absence of rules to the contrary a handful of firms from the most advanced countries could, in a few years, acquire rights over the best mine sites throughout the world's oceans. Later comers - developing countries as well as the small industrial countries - would have a very limited role to play, if any. This, of course, would apply if resource exploitation is carried out directly by the interested parties through licences. It has been suggested, therefore, that it would be in the interest of the world community at large to reserve part of the best nodule sites for future use.

This objective could be achieved in three different ways as illustrated in figure 10. One possibility would be to reserve three quarters of the initial area granted for exploration for future use; the nodule miner might then be requested to return this part to the Authority upon commencement of the exploitation stage. This approach is likely to guarantee quite attractive sites for future generations of miners since the quality of nodule deposits is not likely to vary greatly from that of the adjoining sites retained by the initial miner.

If the Authority establishes a master grid based on meridians, another possibility would be to hold for future use alternative bands with a width of 2° of longitude running from pole to pole. This method would automatically divide the ocean floor into adjoining areas which could be exploited in the first years and those that would be reserved for later use. For example, it is known that the most extensive and interesting deposits of nodules are in the North Pacific lying

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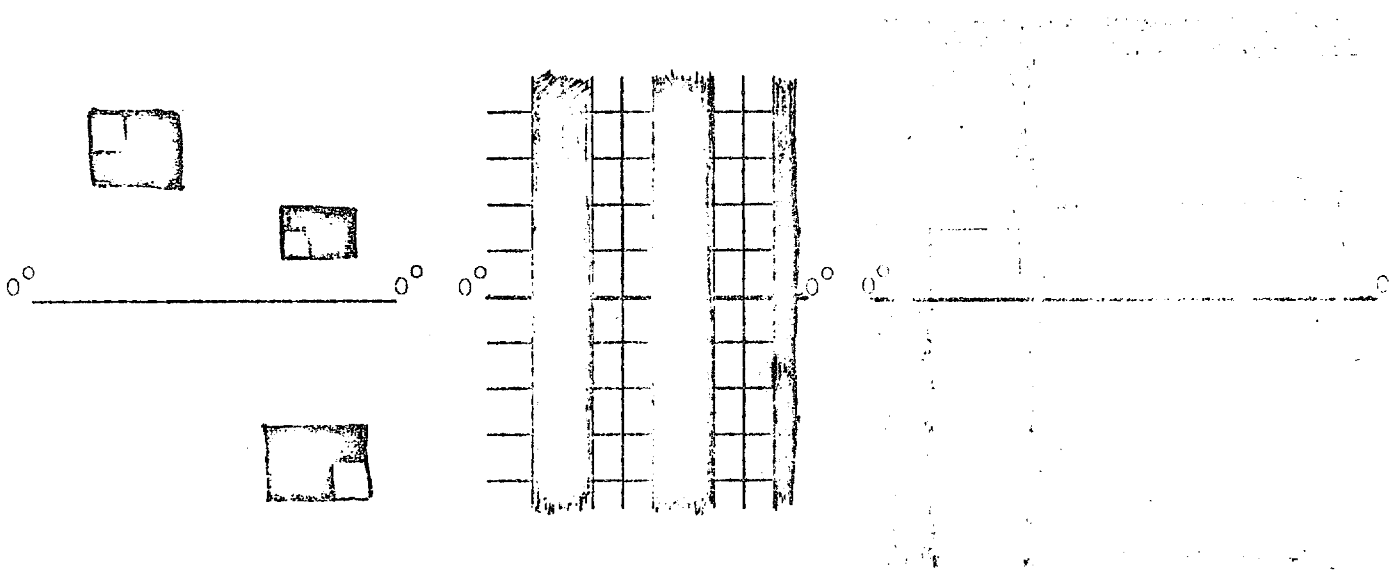
159/ It is interesting to note that the bill prepared by the American Mining Congress proposing interim legislation for deep sea-bed resources and which is presently under consideration by the United States Congress indicates that exclusive exploration rights should be granted over an area of 40,000 km^2. A provision is made that once exploitation starts, the miner would retain 1/4 of the area (10,000 km^2) returning the remainder 3/4 to the "international registry clearinghouse".

Figure 10 <u>Three possible approaches to the reservation of areas for future use</u>
<u>(The area shaded would be reserved for the future)</u>

A. Reserve the area returned to the Authority after the exploration stage

B. Reserve two alternative rows running from N to S in the master grid

C. Open up for exploitation only some specific areas of the ocean floor



in an east-west band between 6°N and 20°N and extending from 110°W to 180°W. 160/ If alternate bands of 2° longitude were drawn over this general area, it can be said that, half of the best mine sites, in principle, would be available for exploitation while the other half would be held in abeyance for future use.

A third method would be a discretionary decision of the Authority regarding general areas which might be made available for exploitation, therefore holding the remainder of the international sea-bed area for future use. This approach is the one generally adopted by coastal countries for offshore hydrocarbon resources. The difficulty in applying this approach to the management of deep sea-bed resources is that knowledge about the precise location of high grade nodule deposits is limited to the few companies that are actively engaged in nodule exploration programmes.

In a more strict sense, resource conservation is aimed at the actual regulation of mining operations. The objective is to avoid wasteful mining methods which tend to be adopted when a company holds the mineral right over a very large property. In these cases, the company attempts to maximize short-run profits by mining only the highest grade ores leaving behind ore which would be normally considered of commercial recovery grade. But existing knowledge of nodule mining technology is insufficient for the establishment of detailed regulations. The Authority, however, could set up minimum targets for nodule recovery below which no exploitation activity would be permitted.

The desirability of setting up these minimum recovery targets is illustrated by the examples in the paper "Pre-production manganese nodule mining activities and requirements". 161/ In this paper it is estimated that with existing technology, nodule recovery might be as low as 9 per cent to a maximum of 35 per cent of the total volume of nodules in place. The Authority might wish to consider whether it would be in the long-run interest of the international community to permit nodule mining operations which might leave behind 91 per cent of these important mineral resources. Recovery efficiency is a function of several factors, the most important of which are the percentage of total area that would remain unmined, the dredge efficiency and the sweep efficiency of the system.

The unmined area of a block depends on topographical barriers on the one hand and on nodule grade on the other. It is possible that part of an exploitation block might contain nodules below the cut-off grade in which case this area would not be worked over by the mining company. The paper suggests that 10 per cent of a mine site is likely to contain nodules below the cut-off grade. 162/ It seems, however, that if the block size is not excessively large only a negligible proportion of the total area might contain nodules below the "cut-off" grade. The

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160/ D. R. Horn, B. M. Horn and M. M. Delach; Ocean Manganese Nodules Metal Values and Mining Sites, NSF Technical Report No. 4, Washington, D.C. 1973.

161/ Flipse, Dubs and Greenwald, op. cit.

162/ Ibid.

/...

cut-off grade, of course, remains to be defined. As for the unmineable zones, which in the quoted industry paper are suggested to range between 15 - 25 per cent of the total area, the applicability of these figures would again depend on the size of the mine site. The larger the mine site - the paper considered mine sites as large as 750,000 square kilometres - the greater the likelihood of a significant proportion of the total area being covered with topographic barriers.

Dredge efficiency is the capability to collect the nodules lying within the "sweep" of the minehead. The industry paper uses 3 assumptions: 30 per cent, 50 per cent and 70 per cent. These assumptions probably reflect the capabilities of the mining systems under development by Deepsea Ventures and Kennecott. In their own words: "At the present stage of development of the technology, it is unlikely that ocean miners will be able to approach a pick up efficiency of 100 per cent". 163/

The same could be said of the sweep efficiency. The industry paper works with assumptions of 45 per cent and 65 per cent of the total mine site. It can be visualized how difficult it will be to control the movement of a towed dredgehead. This system will work like a giant vacuum cleaner with a suction head perhaps 15 metres wide (50 feet) dangling from the mine ship by about 5,000 metres of semi-flexible pipe. Given the currents throughout the water column, even with precise steering of the mine ship to a course exactly 15 metres parallel to the previous run, the mine head at the bottom could be sweeping a new row anywhere within a 150 metres path. One mining company, after several computer simulation exercises, was forced to conclude that the best procedure would be to simply sweep the mine site at random.

Given the stage of existing technology both dredge efficiency and sweep efficiency must be rather low. But regulation of mining operations cannot be logically based on a level of technology which is some 5 to 10 years prior to actual commercial operations. It is obvious that considerable progress can be expected from the leaders of the industry, such as TV monitoring of the mining operations, sophisticated guidance systems for the dredge head and other devices. It is also possible that mining systems with bottom crawling devices will become operational, thus increasing both pick up efficiency and sweep efficiency.

163/ *Op. cit.*, p. 655.

UNITED NATIONS

THIRD CONFERENCE ON THE LAW OF THE SEA

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REPORTS SUBMITTED BY THE UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

Note by the Secretary-General of the Third United Nations Conference on the Law of the Sea

The Secretary-General has the honour to communicate the attached note of the Secretary-General of UNCTAD, dated 21 May 1974, referring to the reports prepared by the UNCTAD secretariat. These reports will be available, in limited quantities, in Caracas.

74-15619

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Third United Nations Conference on the Law of the Sea: Note by the Secretary-General of UNCTAD

1. The secretariat of UNCTAD has prepared a number of reports, within its field of competence, on issues relevant to the business of the Third United Nations Conference on the Law of the Sea. The Trade and Development Board has requested that they be transmitted to that Conference, for consideration, and this note is submitted accordingly.

2. It should be recalled that the question of mineral production from the sea-bed first arose within UNCTAD as a result of General Assembly resolution 2750 (XXV) of 17 December 1970, which requested the Secretary-General of the United Nations to co-operate with the United Nations Conference on Trade and Development (and other bodies) in order to:

> "(a) Identify the problems arising from the production of certain minerals from the area beyond the limits of national jurisdiction and examine the impact they will have on the economic well-being of the developing countries, in particular on prices of mineral exports on the world market;
>
> "(b) Study these problems in the light of the scale of possible exploitation of the sea-bed, taking into account the world demand for raw materials and the evolution of costs and prices;
>
> "(c) Propose effective solutions for dealing with these problems."

3. In accordance with that resolution, the UNCTAD secretariat co-operated with the Department of Economic and Social Affairs of the United Nations secretariat in the preparation of relevant studies, and reported on this co-operation to the Committee on Commodities at its sixth session. In the discussion of this subject at the Committee's sixth session, representatives of developing countries stated that they attached great importance to the subject-matter of General Assembly resolution 2750 A (XXV); that the co-operation envisaged in the resolution should be regarded as referring to UNCTAD at the intergovernmental as well as the secretariat level; that provision should be made for the Committee on Commodities to be informed of, and to discuss, developments in this field on a continuing basis; and that an opportunity should be provided for an examination of the matter at the third session of the Conference. Similar views were expressed at the eleventh session of the Trade and Development Board.

4. The UNCTAD secretariat initially carried out a preliminary over-all review of the main issues of international commodity policy arising from the potential production of minerals from the area of the sea-bed beyond the limits of national jurisdiction. The results of this review were incorporated in certain reports by the Secretary-General of the United Nations to the Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor beyond the Limits of National Jurisdiction (documents A/AC.138/36 and A/AC.138/73) and were presented to the United Nations Conference on Trade and Development at its third session as document TD/113/Supp.4.

/...

5. The United Nations Conference on Trade and Development, in resolution 51 (III), adopted at its third session, decided that

> "the question of the economic consequences and implications for the economies of the developing countries resulting from the exploitation of mineral resources shall be kept constantly under review by the Conference and its subsidiary organs, in particular the Trade and Development Board"

and it invited the Secretary-General of UNCTAD

> "to continue to study the measures necessary to avoid the adverse economic effects which the exploitation of the sea-bed ... beyond the limits of national jurisdiction may have on the prices of minerals exported primarily by developing countries, and to propose specific and detailed measures in that connexion".

6. Accordingly, the UNCTAD secretariat continued its examination of these matters, with the initial objective of assessing, through case studies of individual minerals, the possible quantitative impact of the production of minerals from the sea-bed on world markets and the export earnings of the developing producing countries. The results of the first case study to be completed - relating to cobalt - were summarized and commented upon in document TD/B.449 and Add.1, presented to the Board at its thirteenth session. In response to a request made by the Conference in another part of resolution 51 (III), the Board, at its thirteenth session, also had before it a report by the FAO secretariat on "Possible adverse effects of the exploitation of the sea-bed beyond national jurisdiction on fishery resources" (TD/B/447).

7. At its thirteenth session, the Trade and Development Board noted the reports contained in documents TD/B/447, TD/B/449 and Add.1 and requested that these studies, together with a summary of the views expressed thereon at that session, be transmitted to the Third United Nations Conference on the Law of the Sea for consideration.

8. Since the thirteenth session of the Trade and Development Board, the UNCTAD secretariat has completed a further case study, relating to manganese ore, which, in the spirit of the Board's decision, should also be brought to the attention of the Third United Nations Conference on the Law of the Sea.

9. Accordingly, in pursuance of the aforementioned request of the Board, the following reports are transmitted for presentation to the Third United Nations Conference on the Law of the Sea. (The list takes into account the desirability of document TD/B/449 being read in conjunction with an earlier report by the UNCTAD secretariat (TD/113/Supp.4); the possible interest of Governments in the econometric study on which the report on cobalt is largely based; and the availability of a further case study, relating to manganese ore (TD/B/483 and Add.1).)

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Title	Symbol	Date
Commodity problems and policies: mineral production from the area of the sea-bed beyond national jurisdiction: issues of international commodity policy: report by the UNCTAD secretariat	TD/113/Supp.4	March 1972
Possible adverse effects of the exploitation of the sea-bed beyond national jurisdiction on fishery resources: report by the FAO secretariat	TD/B/447	June 1973
Exploitation of the mineral resources of the sea-bed beyond national jurisdiction: issues of international commodity policy	TD/B/449	June 1973
Exploitation of the mineral resources of the sea-bed beyond national jurisdiction; issues of international commodity policy: case study of cobalt	TD/B/449/Add.1	June 1973
The impact of cobalt production from the sea-bed: a review of present empirical knowledge and preliminary appraisal (by Professor F. Gerard Adams, consultant)	TD/B/(XIII)/Misc.3 (available in English only)	July 1973
The effects of production of manganese from the sea-bed, with particular reference to effects on developing country producers of manganese ore: report by the UNCTAD secretariat	TD/B/483	April 1974
An econometric model of the manganese ore industry	TD/B/483/Add.1	April 1974

10. The text of that part of the Report of the Trade and Development Board on its thirteenth session which contains a summary of the views expressed on documents TD/B/447, TD/B/449 and Add.1 at that session (paras. 45 to 58 of document TD/B/474) is reproduced as an annex to this note.

11. Studies by the UNCTAD secretariat of the possible impact on world markets, and on the export earnings of developing countries, of the production of copper and nickel from the international area of the sea-bed are currently in progress for presentation when completed to the Trade and Development Board or/and the Committee on Commodities. Copies of these reports will be transmitted, when available, to the Third United Nations Conference on the Law of the Sea; the report on copper is expected to become available in the course of June 1974.

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Annex

Extract from Report of the Trade and Development Board on its thirteenth session, held at the Palais des Nations, Geneva, from 21 August to 11 September 1973 1/

E. The exploitation, for commercial purposes, of the resources of the sea-bed and the ocean floor, and the subsoil thereof, beyond the limits of national jurisdiction (Conference resolution 51 (III))

45. The representative of the Secretary-General of UNCTAD introduced the secretariat's progress report prepared in conformity with Conference resolution 51 (III) (TD/B/449) and the summary of a case study of the possible effects of the production of cobalt from the sea-bed on the world market for this mineral (TD/B/449/Add.1). He stated that studies of the potential consequences of the production of manganese ore and nickel from the sea-bed were being undertaken. In the secretariat's opinion there were two possible methods of protecting existing producers of minerals against possible adverse effects of the mining of these minerals from the sea-bed: the preventive method and the compensatory method. For the reasons given in the study relating to cobalt it considered that the compensatory method would probably be ineffective and that for this reason alternative methods might have to be considered.

46. The representative of the FAO introduced the study prepared by the FAO secretariat in response to the invitation of the Secretary-General of UNCTAD regarding the possible adverse effects of the exploitation of the sea-bed beyond the national jurisdiction on fishery resources (TD/B/447). He emphasized that the study was a preliminary one inasmuch as the limits of national jurisdiction were as yet undefined and as the existing state of knowledge regarding the subject did not permit the drawing of definitive conclusions. He drew specific attention to the passages in the document which concerned the harmful effects on fisheries of the discharge of toxic substances into the sea. He pointed out that research was needed to determine the potential effects of the exploitation of the sea-bed on the biological resources of the sea.

47. The representatives of several developing countries emphasized the competence of UNCTAD, in accordance with General Assembly resolution 2750 A (XXV) and Conference resolution 51 (III), and in keeping with the discussions that had already taken place in the Board and the Committee on Commodities, to study the question of the economic implications of the commercial exploitation of mineral production from the sea-bed and ocean floor beyond national jurisdiction, to propose measures for dealing with possible adverse effects of such exploitation and to keep under constant review both in the Board and through its subsidiary organs, especially the Committee on Commodities, the complex problems arising from mineral production from the sea-bed. One such representative stated that these studies showed that UNCTAD's analysis of the economic consequences of such exploitation could be carried out without trespassing on the competence of other forums.

1/ Document TD/B/474: to be reproduced as part of document A/9015 in Official Records of the General [illegible] Twenty-eighth Session, Supplement No. 15.

48. They attached importance to measures taht should be evolved and adopted to avoid any possible adverse impact on world markets for the minerals concerned. The representatives of several developing countries urged that such measures should be adopted before the commencement of commercial exploitation in order to ensure that exploitation could be regulated so as to preclude developing producing countries from being adversely affected. Such preventive arrangements could be effective only if the sea-bed authority was empowered to undertake direct exploration of the area by itself or by means of joint ventures or service contracts, thus ensuring direct control by the sea-bed authority. An economic and development planning unit within the authority itself, which could monitor on a continuing basis the effects of exploitation of sea-bed minerals on land-based production in developing countries, should form an integral part of any system of control. These representatives were of the view that in this regard all States ought to observe the moratorium on the exploitation of the sea-bed beyond national jurisdiction recommended by General Assembly resolution 2574 (XXIV) and Conference resolution 52 (III).

49. The representative of a developing socialist country of Asia stated that the international seas beyond the limits of national jurisdiction and the resources thereof should in principle belong to the peoples of all countries. He reiterated the competence of UNCTAD to propose measures necessary to avoid adverse economic effects which exploitation of the sea-bed might have on the prices of minerals exported primarily by the developing countries and he called on all States engaged in activities in the sea-bed area beyond the limits of national jurisdiction to cease such activities before the establishment of an international régime.

50. The representative of a developed market economy country noted that his country had supported a proposal made in the United Nations Committee on the Sea-Bed to establish, within a proposed international sea-bed authority, a commodity board aimed at regulating mineral production from the international area of the sea-bed. It was the hope of this delegation that such an international board would benefit both developed and developing countries.

51. The representatives of several developed market economy countries were of the view that, since the conclusions which might be drawn from the studies were still tentative and since many economic aspects of sea-bed production were as yet uncertain, no firm conclusion or recommendation regarding measures or approaches to avoid market disruption could be reached at this stage. Moreover, they considered that these questions were the primary responsibility of the United Nations Committee dealing with the sea-bed and would be discussed subsequently at the Conference on the Law of the Sea. They also wished to avoid any action which might prejudice the conclusions, or duplicate the work, of the forthcoming Conference on the Law of the Sea.

52. The representative of one developed market economy country observed that the UNCTAD secretariat's views on possible consequences of the exploitation of sea-bed resources on the export earnings of developing countires were interesting, but that these consequences could not be the only criteria relevant to this matter.

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53. The representative of a developed market economy country said there was a need to consider the orderly exploitation of sea-bed resources and that the question of the conservation of such resources should be taken into account.

54. Several of the representatives participating in the debate stated that in conformity with General Assembly resolution 2750 A (XXV) and Conference resolution 51 (III), UNCTAD should continue to study the problems arising from the commercial exploitation of the sea-bed and strengthen and supplement the present studies. They urged that close liaison should be maintained by the UNCTAD secretariat in its future work with the secretariats of other United Nations bodies concerned with these questions.

55. The representatives of some developed market economy countries emphasized that care should be taken to avoid duplication of work. The representatives of several developing countries emphasized that in view of the competence of UNCTAD in the field of international commodity policy, it should study the possible adverse implications of sea-bed production and propose remedial measures.

56. The representatives of a developing country said that the use for military purposes of the sea-bed and ocean floor might prejudice the future constructive use of the resources in question. He suggested that the organizations within the United Nations system, among them UNCTAD, should keep this aspect of the subject under review.

Action by the Board

57. At its 380th meeting on 8 September 1973, the Board noted the reports contained in documents TD/B/447, TD/B/449 and Add.1 on this matter.

58. Bearing in mind that the exploitation of the sea-bed was still in a preliminary stage and that more knowledge had to be gained regarding exploitation processes and their possible effects on the conservation and utilization of living resources, and noting further that this matter was under consideration by the Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor beyond the Limits of National Jurisdiction acting as a preparatory committee for the Third United Nations Conference on the Law of the Sea, the Board requested that the studies mentioned above, 1/ together with a summary of the views expressed thereon at its present session, be transmitted to the Third United Nations Conference on the Law of the Sea for consideration, and noted that the secretariat intended to carry out case studies on manganese and nickel. The Board noted with interest the FAO study on fisheries resources of the seas and oceans.

1/ For the further views of delegations and a statement by the Secretary-General of UNCTAD on this matter, see the summary record of the 380th meeting (TD/B/SR.380).

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United Nations Conference on Trade and Development

TRADE AND DEVELOPMENT BOARD
Fourteenth session
Geneva, 20 August 1974
Item 4 of the provisional agenda

THE EFFECTS OF PRODUCTION OF MANGANESE FROM THE SEA-BED, WITH PARTICULAR REFERENCE TO EFFECTS ON DEVELOPING COUNTRY PRODUCERS OF MANGANESE ORE

Report by the UNCTAD secretariat

1. The attached report presents a quantitative assessment of the impact of the production of manganese from the ocean floor upon the land-based manganese ore industry and, in particular, upon developing country producers of manganese ore. It is the latest in a series of reports which deal, in a quantitative manner, with the question of the effects of commercial development of the mineral resources of the sea-bed beyond the limits of national jurisdiction.

2. In accordance with resolution 2750A (XXV) of the United Nations General Assembly and with resolution 51 (III) of the third session of the United Nations Conference on Trade and Development, the UNCTAD secretariat has been investigating the economic consequences for the developing countries of such utilization of sea-bed mineral resources. After discussions of this subject at the sixth session of the Committee on Commodities and at the eleventh session of the Trade and Development Board, the secretariat submitted to the third session of the Conference the results of its preliminary over-all review of the entire question. 1/ Subsequently, the secretariat embarked upon a detailed quantitative assessment of the effects of commercial development of sea-bed mineral resources. Thus far, the quantitative assessment has focused upon the derivation of numerical estimates of the impact upon the markets for each of four metals and, in particular, upon developing country producers of these commodities. The metals concerned - cobalt, manganese, nickel, and copper - are the most valuable constituents of the manganese nodules found in such profusion on the

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1/ "Mineral production from the area of the sea-bed beyond national jurisdiction: issues of international commodity policy: report by the UNCTAD secretariat" (TD/113/Supp.4). Subsequently, the text of this report was incorporated in the relevant report by the Secretary-General of the United Nations to the July/August 1972 session of the Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor beyond the Limits of National Jurisdiction, under the title "Additional notes on the possible economic implications of mineral production from the international sea-bed area" (A/AC.138/73).

ocean floor. The vehicle for the derivation of these estimates has, in each case, been an econometric model of the market in question. Results pertaining to cobalt were presented to the thirteenth session of the Trade and Development Board 2/ and figures for copper are being made available to the fourteenth session of the Board. 3/ As noted above, the present paper provides numerical estimates of the effects of sea-bed production of manganese, with particular reference to effects on developing country producers of manganese ore. The econometric model on which the present analysis is based is described in an addendum to this paper "An econometric model of the manganese ore industry" (TD/B/483/Add.1).

3. The next logical step in the over-all quantitative assessment is to integrate the four models computationally and to simulate the interaction between the levels of sea-bed and land production of the four metals. The development of such an integrated structure of relationships would enhance the capability of the secretariat systematically to utilize new knowledge of sea-bed production technology and costs as such knowledge becomes available. It would then facilitate the implementation by the secretariat of the decision, taken at the third session of the United Nations Conference on Trade and Development, that "the question of the economic consequences and implications for the economies of the developing countries resulting from the exploitation of mineral resources shall be kept constantly under review". 4/

2/ "Exploitation of the mineral resources of the sea-bed beyond national jurisdiction: issues of international commodity policy. Note by the UNCTAD secretariat" (TD/B/449) and "Case study of cobalt" (TD/B/449/Add.1)

3/ "The effects of production of copper from the sea-bed, with particular reference to effects on developing country producers of copper" (TD/B/484). A report on consequences for the nickel market is being prepared by an UNCTAD consultant.

4/ Proceedings of the United Nations Conference on Trade and Development, Third Session, vol.I, Report and annexes (United Nations publication, Sales No: E.73.II.D.4), pp.78-9.

Contents

I. SUMMARY AND CONCLUSIONS

4. This paper presents the results of an analysis of the effects of the mining of manganese nodules from the ocean floor on the land-based manganese ore industry and, in particular, on the developing country producers of such ore. These results are based on an econometric model of the manganese ore industry - summarized on page 17 - and fully described in TD/B/483/Add.1.

5. The analysis is related to a base case set of premises, which can be summarized as follows.

(a) The range of sea-bed production levels which can realistically be anticipated over the projection period (1974-80), is taken to run from a low of about 442,000 metric tons of manganese ore in 1980 to a high of about 4,420,000 metric tons of ore in the same year.

(b) Production of manganese ore from the sea bed is assumed to be planned, broadly, on principles similar to those relating to land-based production. This will lead to a partial, though not pound-for-pound, displacement of land-source supplies by ocean-source supplies.

(c) The share of the developing countries in aggregate land-based production will remain approximately constant at its current level over the period.

(d) Real gross national product in the industrialized countries which are the principal consumers of manganese ore is assumed to grow during the projection period at recently observed rates. Further details of these assumptions and information about other assumptions made are provided in chapter II. The base case premises just summarized should be regarded as merely a reasonable reference case for study. Alternatives to certain key assumptions and the effects of these alternatives on the analytical results are considered in chapter V.

6. The principal results which flow from the base case premises and which pertain to the manganese ore industry as a whole are as follows (see Chapter III for details).

7. Aggregate consumption of manganese ore in the developed market economies and in the developing countries is expected to increase at an average annual rate of about 5.8 per cent between 1974 and 1980. 5/ This is a somewhat higher rate of increase than the average over, say, the last two decades. It reflects the anticipated

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5/ All physical quantitites and values are aggregates of the developed market economies and developing countries. Published data on the manganese economies of the socialist countries were insufficient to permit representation of these countries in the econometric model on which the analysis is based. All quantities and values refer to manganese ore of metallurgical grade. Data limitations prevented inclusion of chemical-grade, battery-grade, or ferruginous manganese ore within the model. Consumption of metallurgical-grade ore, however, represents about 90 per cent of total consumption of all types of manganese ore.

relatively high rate of growth of steel production in the developing countries and an increase in the share of production by such countries in the total. Sea-bed output of manganese ore will affect the price of such ore. However, since consumption of manganese ore is very price-inelastic, consumption is unlikely to vary with sea-bed production.

8. Production of manganese ore from land sources will, of course, be affected by ocean mining operations. In the absence of sea-bed production, land-based output is anticipated to grow at an annual average rate of 4.2 per cent. Given a moderate level of sea-bed production, 6/ this rate will probably drop to about 1.5 per cent per year. In the last year of the forecast period (1980), the reduction in land volume will be from 12.6 million metric tons to 10.4 million metric tons, a reduction of about 18 per cent. 7/

9. The price of manganese ore is expected to be fairly insensitive to the level of sea-bed production. Without production from the ocean floor, price is expected to decline by about 1.1 per cent per year under the influence of continuing high production capacity, United States Government stockpile deliveries, and imports from the socialist countries. This rate of decline will accelerate to only about 1.6 per cent per annum under the assumption of a medium level of sea-bed output. The difference in prices between the two situations in 1980 is the difference between $17.3 per metric ton and $16.8 per metric ton. 8/ The effect of ocean mining development on the price of manganese ore is moderated by the fact that sea-bed production will to some extent supplant land-based production. Hence the effect of the former on total supplies will be mitigated.

10. The base set of assumptions also has implications for the export earnings of developing country producers of manganese ore. 9/ In the absence of an ocean mining development, the export earnings of the developing countries from the sale of manganese ore are expected to rise at an annual rate of about 3.1 per cent over the forecast period. This gain reflects the conflicting effects of an anticipated slight decline in price, offset by a moderate rise in export volume. With a medium level of sea-bed production of manganese ore, export earnings would probably decline by about 2.0 per cent per year between 1974 and 1980. These differential rates of change imply a very substantial difference in export earnings in 1980 as between the no sea-bed production case and the medium sea-bed production case, the difference between $93.7 million in the first case and $65.6 million in the second, a reduction of approximately 30 per cent (see chapter IV for further details).

6/ This is the "medium 2" sea-bed production case shown in table 1 below.

7/ All quantities are gross weight of ore. An analysis in terms of weight of metal content would also have been of interest but was precluded by data limitations.

8/ This is a world average f.o.b. price per ton of metallurgical-grade ore, gross weight.

9/ Figures on another indicator of the impact on developing country producers, namely value of annual production, are given in table 7 below.

11. As noted, the results given above rest upon a particular set of assumptions, the base set. It is of interest to determine how the figures of developing country export earnings might change in response to plausible variations in certain key assumptions. (see chapter V).

12. It could, for example, be assumed that the developing countries' share of aggregate land-based production would decline because they would feel the full effect of the displacement of land supplies of manganese ore by sea-bed production. This would be the probable result, for example, if sea-bed production were to be utilized mainly in the United States which is a distinct possibility, at least over the first few years of the forecast period. Under these circumstances, and with a medium level of sea-bed output, the export revenues of developing countries from the sale of manganese ore would decline at an annual average rate of 6.3 per cent falling to $48.5 million by 1980. In that year, such earnings would be about 21 per cent lower than if the impact of sea-bed production had been shared equally with the developed market economies and 48 per cent lower than if there were no ocean mining.

13. Similarly, it might be assumed that the average growth rate of the industrial countries, which are at present the principal consumers of manganese ore, would be less than historically experienced. Under the influence of a temporary (two-year) reduction of growth in these countries, and given a medium level of sea-bed production, export earnings of developing countries from the sale of manganese ore would be relatively lightly affected. Under a sustained reduction of growth (one-half the recent historical rate) - once again with a medium sea-bed output - such earnings would suffer quite drastically, however, falling to $54.2 million in 1980, a decline of 4.5 per cent per year between 1974 and 1980. In the latter year, earnings would be approximately 17 per cent less than if growth had been sustained at its historical rate. Such earnings would be 42 per cent less than if growth had been sustained and the sea-bed development had not occurred.

14. All the above results obtain under an assumption of a fairly moderate scale of ocean mining operations. Under an assumption of a high - but not impossibly high - scale of operations, the effects would be even more severe.

15. The table below draws together the main analytical results relating to the effects of sea-be production on export e rnings of developi g country producers of manganese ore.

Export earnings of developing countries from manganese ore in 1980

Under the base set of assumptions		Under alternative assumptions regarding:			
		Developing countries share of land production		Reduced growth in the industrialized countries a/	
No sea-bed production	Moderate sea-bed production	Developed countries' production displaced	Developing countries' production displaced	Temporary reduction	Sustained reduction
		($US million)			
93.7	65.6	86.5	48.5	62.8	54.2

a/ Taken here as the 11 major consumers of manganese ore.

16. The figures presented in the table above suggest that some sort of sea-bed regulatory regime will probably be required in order to protect the export earnings of developing country producers of manganese ore. Regulations could pertain to offering prices, production, or offers to sell the output from mining operations, or some combination of these. On the other hand, a compensatory approach to protecting the export earnings of developing countries would probably not be successful. Under any sea-bed case considered, losses in export earnings of the developing countries amount to about 50 per cent of the value of sea-bed production. Since the latter represents gross revenues, without deduction for operating costs, depreciation and amortization, and return on capital, the prospects for compensating the developing countries for loss of export earnings solely from the sale of sea-bed production of manganese ore do not appear bright. Thus, a system of regulation in which losses are prevented, rather than compensated after the fact, would seem to be indicated. Definitive statements on these matters, however, must await a joint analysis of all four principal sea-bed metals, an analysis in which interactions among the various metals and between land and ocean operations can be systematically examined.

II. MAJOR PREMISES AND SCOPE OF THE ANALYSIS

17. This chapter describes the base set of assumptions on which the bulk of the results presented in the remainder of the paper depend. It also summarizes the causal relationships embodied in the econometric model utilized to derive conclusions from these assumptions. Finally, some limitations of the analysis are also discussed.

18. The first set of assumptions adopted relates to the levels of sea-bed production of manganese ore. The levels of sea-bed production considered in this report - in common with the other reports in this series - are based upon premises which appear in the United Nations Sea-Bed Committee document. 10/ These premises are as follows. Each sea-bed mining operation yields an annual production of manganese nodules of 1,500,000 metric tons, equivalent to 1,000,000 metric tons dry weight. These contain, on the average, 30 per cent manganese, 1.5 per cent nickel, 1.5 per cent copper, and 0.3 per cent cobalt by weight. Recovery factors are 93 per cent, 96 per cent, 94 per cent and 96 per cent, respectively. On these assumptions, the Sea-Bed Committee report proceeds to derive the implied quantities of metals for various numbers of mining operations in a single year. The patterns of expansion of mining operations treated in the present report appear in table 1. These five patterns, in conjunction with the other assumptions stated in this paragraph, yield the five cases of sea-bed output of manganese ore shown in table 1. The production figure for a given number of mining operations shown in table 1 differs from that for the same number of operations shown in the Sea-Bed Committee report. The latter assumes that all of the manganese in a given quantity of nodules will be produced as pure metal; in this report, it is assumed that all such manganese will be produced as manganese dioxide, one of the intermediate products in the separation processes currently under study. Given the incremental costs associated with the isolation of manganese beyond the dioxide stage, and given the fact that relatively little manganese is consumed as pure metal, it has seemed more realistic to assume that processing ceases at the manganese dioxide stage. The latter is a common manganese mineral and completely suited to the production of ferroalloys, the form in which most manganese is consumed.

19. Another apparently important assumption relates to the extent to which sea-bed production is viewed as displacing land-based production of manganese ore. As mentioned in the preceding paragraph, the manganese content of sea-bed nodules is much higher than that of any other metal. About 30 per cent of a unit of nodules (by weight) is manganese. When compared with projected consumption of manganese ore, the future output of such material from the sea-bed - while not overwhelming in magnitude - is still fairly significant. 11/ A key question then in assessing the impact of ocean mining on the developing countries is how this new source of supply will impinge upon the traditional land-based industry, or more specifically, how the production levels of land-based producers will be affected by the ocean mining phenomenon. There are two extreme assumptions in this regard. One assumption might be that sea-bed production will simply constitute a net addition to land source output, the latter continuing to grow at some predetermined rate. Alternatively, another assumption might be that sea-bed production will displace an equal amount of land-based output. Neither of these assumptions seems very realistic, however.

10/ "Possible impact of sea-bed mineral production in the area beyond national jurisdiction on world markets, with special reference to the problems of developing countries: a preliminary assessment." (A/AC.138/36).

11/ In the most extreme case - the 1980, high, sea-bed production case - output from the ocean floor would represent about 29 per cent of total projected consumption.

Table 1

Sea-bed production: alternative cases

	Low sea-bed production		Medium 1 sea-bed production		Medium 2 sea-bed production		High sea-bed production	
	No. of mining operations a/	Sea-bed production b/	No. of mining operations a/	Sea-bed production b/	No. of mining operations a/	Sea-bed production b/	No. of mining operations a/	Sea-bed production b/
1974	0.0	0.0	0.0	0.0	1.0	0.442	1.0	0.442
1975	0.5	0.221	0.5	0.221	2.0	0.883	2.0	0.883
1976	1.0	0.442	1.0	0.442	3.0	1.330	3.0	1.330
1977	1.0	0.442	1.5	0.662	4.0	1.770	5.0	2.210
1978	1.0	0.442	2.0	0.883	5.0	2.210	7.0	3.090
1979	1.0	0.442	2.5	1.100	6.0	2.650	9.0	3.970
1980	1.0	0.442	3.0	1.330	7.0	3.090	10.0	4.420

a/ Cumulative number in operation during a given year.

b/ Millions of metric tons, gross weight, of ore.

The levels of sea-bed production considered here are too great not to supplant some land-based production; on the other hand, there does not seem to be any reason to suppose that ocean production will be completely substituted, pound-for-pound, for land-derived ore. 12/ A reasonable intermediate case flows from the idea that the production of manganese ore from both sources will be planned on more or less the same principles. 13/ As a consequence, sea-bed production will be substituted for land-based production to some extent, but not to the extent of a pound-for-pound displacement of the latter. The notion that production from both supply sources will be planned similarly seems particularly plausible in the light of existing ties between the parent firms of manganese ore companies and the member firms of the several consortia engaged in sea-bed mining research. Although this approach seems reasonable, it is not inevitable. Accordingly, the sensitivity of the principal results to the assumption on the extent of displacement of land-based by sea-based production is also examined (see chapter V).

12/ Obviously, the extent of displacement of land-based production by ocean-based production depends on the relative asking prices of the two supply sources. This, in turn, translates into a question of relative costs of production. It is sometimes said that sea-bed manganese production will be "justified" by revenues derived from the sale of nickel, copper, and cobalt. The argument is that the four metals will be produced under conditions of joint costs ∇ which will be more than covered by revenues from the sale of copper, cobalt, and nickel ∇ and that therefore the manganese produced can be virtually given away. This argument overlooks the nature of the production processes currently under consideration, however. Certainly, the four metals will be mined jointly. Nevertheless, they will be separated sequentially, at least, in the processes currently being considered. In all these processes, manganese is extracted last and with attendant of costs which are truly incremental to this particular metal. At the appropriate point of the production process, a decision will be forced upon the operators of the processing facility. The alternatives will be: either bear the costs of disposal of the leach liquor after extraction of cobalt, nickel, and copper only, or, bear the net cost (possibly negative since marginal revenues may exceed marginal costs) of extracting manganese by further processing and then disposing of the waste liquor. The choice will be made on the usual basis of comparing net benefits (or losses) associated with the alternative courses of action. Although the marginal costs associated with extraction of manganese are not definitely known as yet, indications are that they will be a sizeable portion of the current price of manganese. Hence, there is no reason to anticipate a wholesale displacement of land-based production by sea-bed production.

13/ To implement this notion within the context of the model developed in the addendum to this document (TD/B/483/Add.1), it is necessary to modify the production equation proposed for the model, which is: $[O/LND - K/LND] = \lambda [C/AGG - K/LND] + U(4)$, where O/LND and K/LND are output and capacity, respectively of land-based manganese ore production facilities, C/AGG is aggregate consumption of manganese ore, and U(4) is a random element in the relationship. However, given sea-bed production and assuming both supply sources are planned similarly, the equation becomes: $[(O/LND + O/SEA) - (K/LND + K/SEA)] = \lambda [C/AGG - (K/LND + K/SEA)] + U(4)$, where O/SEA and K/SEA are output and capacity, respectively of sea-based production facilities. The hypothesis is that the variation of total output from total productive capacity is proportional to the variation of consumption from total productive capacity. Given the likely rigidity of sea-bed production levels over the fairly short time horizon under consideration, it is probably safe to take sea-bed actual output as, in fact, identical to sea-bed capacity output. This makes it possible to simplify the equation above to:
$(O/LND - K/LND) = \lambda [C/AGG - (K/LND + O/SEA)] + U(4)$.

20. For the operation of the model, it was also necessary to make certain assumptions about the future time paths of variables exogenous to the model. Ferroalloy production and crude steel production in the 11 leading consuming countries outside the socialist countries are assumed to grow during the period 1974-80 at average annual rates of 4.5 per cent and 4.4 per cent, respectively. 14/ Alternative assumptions in this respect are considered in chapter V. United States Government stockpile releases are assumed to be in the order of 400,000 metric tons per year over the period. 15/ Net imports into the developed market economies and developing countries from the socialist countries are projected to grow at a somewhat higher rate than that historically observed, reaching a level of 1.7 million metric tons in the last forecast year. This acceleration reflects factors influencing both imports from and exports to the socialist countries. Imports from the socialist countries are expected to grow faster than in the past. Such imports should be spurred by a somewhat higher future rate of steel production in the developed and developing countries as a whole. In addition, imports from the socialist countries into Western Europe have significant transport cost advantages over imports from sources in Africa, and an improved political climate should permit such imports to occur. On the other hand, it may be difficult for exports from market economy countries to socialist countries in Eastern Europe to maintain a constant market share, given the inherently large transport cost advantage of USSR exports to other socialist countries of Eastern Europe. The combined effects of the trends will probably be an increase in the rate of growth of net imports of manganese ore into developed and developing countries from the socialist countries. 16/

21. These various assumptions are used in the econometric model to derive the analytical results presented in the following sections. Before presenting these results, it would seem useful to give a brief summary of some of the principal causal relationships found in the manganese ore industry and embodied in the econometric model. 17/ These relations can be summarized as follows. Annual consumption of manganese ore in the 11 major consuming countries can be closely related to ferroalloy production and steel production in these countries. Annual consumption in the remaining developed market economies and in the developing countries, although also ultimately dependent on ferroalloy production and steel production, can be simply, and successfully, specified as a time trend. Production of manganese ore, in an analytical period as short as one year, depends on production capacity in the manganese ore

14/ Whereas consumption of manganese ore in these countries depends explicitly on ferroalloy production and steel production in the econometric model, consumption in the remainder of the area is specified as a time trend. The latter trend is consistent with the observed growth of steel production in the same area of about 10 per cent per year.

15/ These releases have been quite volatile and 400,000 metric tons should be taken as simply an average annual figure over the forecast period.

16/ These projections are essentially arbitary. However, in the context of the model used the effect of sea-bed production on the export earnings of developing country producers of manganese ore is not affected by the assumption made regarding the magnitude of the net trade in manganese ore of the socialist countries of Eastern Europe.

17/ For a detailed description of the model, see TD/B/483/Add.1.

industry, with fluctuations from capacity levels being determined by consumption during the year. Finally, the annual price of manganese ore is influenced by the level of commercial stocks and by United States Government stockpile releases. These relationships (specified as to mathematical form and numerical constants), with a few logical identities, comprise the econometric model.

22. The assumptions outlined in paragraphs 18 to 21, and the econometric model briefly described above, imply certain conclusions. The conclusions which pertain to the land-based manganese ore industry as a whole are discussed in chapter III, while those which pertain to the developing countries specifically are dealt with in chapter IV. Although the assumptions adopted constitute a reasonable context in which to deduce the effects of sea-bed production of manganese ore, they are not the only premises which could have been adopted. It is of interest, then, to investigate how the results of the analysis vary as certain key assumptions are varied, and, with this in mind, the sensitivity of the analytical results to the assumptions made is considered in chapter V.

23. Finally, certain limitations of the analysis should be noted. For example, it deals with high-grade metallurigcal ore only and does not consider chemical-grade, battery-grade, or ferruginous ores. As a practical matter, for the industry as a whole this restriction is less serious than it may appear, since consumption of high-grade metallurgical ore represents at least 90 per cent of total consumption of all types. Moreover, because of data limitations, the manganese ore industry within the socialist countries has been excluded from the analysis. Since, however, the primary interest is in the manganese ore industries of the developing countries, this limitation is also not too serious. Production in the socialist countries is mostly consumed within the group, and consumption in the socialist countries is mostly satisfied by internal production. Finally, the level of sea-bed production is not made dependent on the price of manganese ore. In the prevailing uncertainty regarding sea-bed production technology and costs, this limitation seems unavoidable. However, at each level of sea-bed output of manganese ore considered, the projected price of such ore is assumed to be sufficient to make revenues exceed costs of production of private producers.

III. EFFECTS OF SEA-BED PRODUCTION ON THE LAND-BASED MANGANESE ORE INDUSTRY

24. Table 2 presents projections of manganese ore consumption by the eleven leading consuming nations, by other consumers, and the total of both. In each case, only one projection is presented, since manganese ore consumption will not presumably vary with the source (sea-bed or land) of the ore utilized. The relatively high rate of growth of consumption in the 'other consumers' category is, in large measure, a reflection of anticipated high growth rates of steel and ferroalloy production in the developing countries.

25. Table 3 depicts the levels of land-based manganese ore production under alternative levels of sea-bed production of such ore. In addition, a projection of land-based output in the absence of sea-bed exploitation is provided for comparison purposes. In the absence of sea-bed production, output of ore from land sources is projected to grow at an average (compound) rate of 4.2 per cent per year. This is about the rate of change experienced in recent years. However, as ocean-floor production rises, land production is partly displaced until in the presence of a high level of sea-bed production, land-based production actually declines slightly over the projection period. The absolute declines in land-based production shown in the high sea-bed production case in 1977-79 are due to the magnitude of the increases in sea-bed production relative to those in aggregate consumption in those particular years. Total production of manganese ore from both the sea-bed and land sources is given in table 4.

26. Estimates of the future price of manganese ore are provided in table 5. It will be observed that, even in the absence of sea-bed production, the price of manganese ore is expected to decline slightly. Consumption will continue to grow, of course, but United States Government stockpile releases, imports from the socialist countries, and levels of production capacity (relative to levels of steel production) will continue to exert pressure on prices. The increasing pace of sea-bed mining - from the low to the high cases - has had what is, at first glance, a surprisingly moderate effect on prices. The explanation is that to some extent ocean-source supplies will supplant land-source supplies and, consequently, the effect on total supplies will be mitigated. 18/

27. The values of sea-bed production implied in tables 1 and 5 are shown in table 6.

18/ If, however, there is no displacement of land-based production, the effects of even the medium 2 level of sea-bed production are considerably more severe (see table 9).

Table 2

Consumption of manganese ore: actual 1969, and projections for 1974-1980

(millions of metric tons)

	11 principal consumers a/	Other consumers b/	Total
Actual 1969	6.73	1.56	8.29
1974	7.88	2.57	10.4
1975	8.20	2.83	11.0
1976	8.53	3.11	11.6
1977	8.88	3.42	12.3
1978	9.24	3.77	13.0
1979	9.61	4.14	13.8
1980	10.00	4.55	14.6
Average annual percentage change, 1974-80	4.1	10.0	5.8

a/ Belgium, Canada, Federal Republic of Germany, Italy, Luxembourg, Netherlands, Sweden, United States of America.

b/ Others.

Source: See annex I, 'A note on data employed', in the addendum to the present document (TD/B/483/Add.1).

Table 3

Aggregate production of manganese ore from land sources

(Millions of metric tons)

	No sea-bed production	Low sea-bed production	Medium 1 sea-bed production	Medium 2 sea-bed production	High sea-bed production
Actual 1969	8.88	-	-	-	-
1974	9.85	9.85	9.85	9.53	9.53
1975	10.30	10.10	10.10	9.67	9.67
1976	10.70	10.40	10.40	9.76	9.76
1977	11.10	10.80	10.60	9.82	9.49
1978	11.50	11.20	10.90	9.90	9.26
1979	12.00	11.70	11.20	10.10	9.13
1980	12.60	12.30	11.70	10.40	9.41
Average annual percentage change 1974-80	4.2	3.8	2.9	1.5 a/	-0.2 a/

a/ If sea-bed production in 1974 is ignored, these figures fall to 0.9 and -0.8 for the medium 2 and high sea-bed cases respectively.

Table 4

Aggregate production of manganese ore from both sea-bed and land sources

(Millions of metric tons)

	No sea-bed production	Low sea-bed production	Medium 1 sea-bed production	Medium 2 sea-bed production	High sea-bed production
Actual 1969	8.8	-	-	-	-
1974	9.85	9.85	9.85	9.97	9.97
1975	10.30	10.30	10.30	10.60	10.60
1976	10.70	10.80	10.80	11.10	11.10
1977	11.10	11.20	11.30	11.60	11.70
1978	11.50	11.60	11.80	12.10	12.40
1979	12.00	12.10	12.30	12.70	13.10
1980	12.60	12.70	13.00	13.50	13.80
Average annual percentage change 1974-80	4.2	4.3	4.7	5.2 a/	5.6 a/

a/ If sea-bed production in 1974 is ignored, these figures rise to 5.4 and 5.8 for the medium 2 and high sea-bed cases respectively.

Table 5

Price of manganese ore a/

($US/metric ton)

	No sea-bed production	Low sea-bed production	Medium 1 sea-bed production	Medium 2 sea-bed production	High sea-bed production
Actual 1969	18.0	-	-	-	-
1974	18.5	18.5	18.5	18.5	18.5
1975	18.2	18.2	18.2	18.2	18.2
1976	18.0	18.0	18.0	17.9	17.9
1977	17.7	17.7	17.7	17.6	17.6
1978	17.5	17.5	17.5	17.3	17.2
1979	17.4	17.3	17.3	17.0	16.9
1980	17.3	17.2	17.1	16.8	16.6
Average annual percentage change 1974-80	-1.1	-1.2	-1.3	-1.6	-1.8

a/ Metallurgical grade ore of average purity, world average f.o.b. price, gross weight.

Table 6

Value of sea-bed production of manganese ore

(Millions of $US)

	Low sea-bed production	Medium 1 sea-bed production	Medium 2 sea-bed production	High sea-bed production
1974	0.00	0.00	8.17	8.17
1975	4.02	4.02	16.10	16.10
1976	7.95	7.95	23.70	23.70
1977	7.82	11.70	31.80	38.90
1978	7.73	15.50	38.20	53.20
1979	7.64	19.10	45.00	67.20
1980	7.59	22.70	51.90	73.30

IV. EFFECTS OF SEA-BED PRODUCTION ON DEVELOPING COUNTRY PRODUCERS OF MANGANESE ORE

28. In this section, two measurements are presented of the impact of the sea-bed mining phenomenon on the developing country producers of manganese ore. Estimates of the value of developing countries' output of manganese ore are shown in table 7, and estimates of these countries' export revenues from the sale of such ore are given in table 8.

29. In making the transition from an analysis of the effects of sea-bed exploitation on the whole industry to an analysis of its effects on developing countries specifically, the following identity has been employed:

$$X/DC = O/DC - C/DC + M/DC - \Delta I/DC$$

Where X represents exports; O, output; C, consumption; M, imports; and, ΔI, inventory change; the suffix DC indicating the developing countries. Given the production of developing countries O/DC, the value of such production can be estimated. Given the production, consumption, imports, and stock change of developing countries, their exports can then be derived using the above equation. In turn, given exports, export revenues can be estimated.

30. Since future levels of aggregate land-source production of manganese ore have already been estimated (table 3), the production of the developing countries (O/DC) can be derived by applying these countries' share of the market to that total. A key element then in deducing the effects of sea-bed mining of manganese ore on the developing country producers of such ore is the determination of the share of the developing countries in future land-source production. The share of the developing countries in total production has been declining since the mid-1960s. There have been two principal reasons for this decline. First, certain leading developing country producers of manganese ore - Ghana, Morocco, India - have suffered from depletion of their deposits of metallurgical grade ore (in the case of India, this has been accompanied by a desire to reserve such ore for an expanding domestic steel industry.) Secondly, another developed market economy - Australia - has become a major producer with the opening of new efficient mines. These two developments have been to a considerable extent offset by the continued expansion of the industry in certain other traditional developing country producers, especially in Brazil, and by the emergence of Gabon in the mid-1960s as a leading producer. In view of such individual country trends, and in the light of present knowledge of new mining projects, it is estimated that the share of developing countries in total land-based production will remain approximately constant at its current level until 1980. The projection of market shares is always precarious, of course, and this pattern should be regarded as merely a reasonable base estimate. The sensitivity of the results given below to variations in this assumption is examined in Chapter V.

31. The other elements in the equation determining developing countries' exports of manganese ore are more tractable. Imports by the developing countries of such ore can be taken as virtually zero, since the principal developing consumers (the principal developing steel-makers) have substantial deposits of metallurgical grade ore. Stock level changes in the developing countries are taken as the same proportion of aggregate stock level changes as they have been in recent years.

Finally, consumption of manganese ore in the developing countries has been estimated on the basis of projections of steel production in each of the principal developing producing countries.

32. The effects of sea-bed manganese ore production on the value of such ore produced by the developing countries is shown in table 7. In the medium 2 and high sea-bed output cases, actual declines in the value of developing countries' production are indicated. Even in the medium 1 case, the rate of growth of these countries' production is seriously affected. The effects of ocean-floor production are, perhaps, more dramatically revealed in a direct comparison of the value of developing countries production, in the case of no sea-bed production, with the values of production in the various sea-bed cases. Such a comparison shows that sea-bed mining will reduce the value of production of manganese ore by developing countries in 1980 by between 3 and 29 per cent, depending on the particular case considered.

33. Even more drastic are the effects of sea-bed production on developing countries' export revenues from manganese ore. As table 8 shows, in both the medium 2 sea-bed case and the high sea-bed case, declines occur in export revenues. Furthermore, revenues in 1980 fall by between 5 to 42 per cent in the absence of sea-bed production. It will be remembered that sea-bed production will apparently cause only moderate declines in the price of manganese ore (see table 5). These declines will be limited, however, precisely because of fairly substantial inroads by ocean floor production into land production, thereby moderating the growth of total supplies. This same displacement of land-based output, combined with a moderate decline in price, will result in serious declines in the value of production and export revenues from manganese ore for developing countries. Indeed, under any sea-bed case considered, losses in export earnings of the developing countries amount to about 50 per cent of the total value of sea-bed production.

Table 7

Value of production of manganese ore by developing countries

(Millions of $ US)

	No sea-bed production	Low sea-bed production	Medium 1 sea-bed production	Medium 2 sea-bed production	High sea-bed production
Actual 1969	96.1	-	-	-	-
1974	100.0	100.0	100.0	97.1	97.1
1975	103.0	102.0	102.0	96.8	96.8
1976	106.0	103.0	103.0	96.0	96.0
1977	108.0	105.0	103.0	94.8	91.7
1978	111.0	108.0	104.0	94.1	87.8
1979	115.0	112.0	107.0	94.5	85.0
1980	121.0	117.0	110.0	95.7	86.0
Average annual percentage change 1974-80	3.3	2.7	1.6	-0.2	-2.0

Table 8

Export Earnings of Developing Countries from the sale of manganese ore

(Millions of $ US)

	No sea-bed production	Low sea-bed production	Medium 1 sea-bed production	Medium 2 sea-bed production	High sea-bed production
Actual 1969	66.1	-	-	-	-
1974	78.0	78.0	78.0	74.1	74.1
1975	80.3	78.4	78.4	72.4	72.4
1976	82.5	76.6	78.6	70.7	70.7
1977	84.5	80.6	78.7	68.8	65.1
1978	87.0	82.9	79.1	67.2	59.8
1979	90.1	85.9	80.2	66.2	55.1
1980	93.7	89.4	81.6	65.6	54.3
Average annual percentage change 1974-80	3.1	2.3	0.8	-2.0	-5.0

V. SENSITIVITY OF RESULTS TO ASSUMPTIONS

34. This section considers the sensitivity of the estimates of export earnings of developing country procedures of manganese ore to changes in certain key assumptions. Variations in three assumptions are considered: the amount of displacement of land-based production of manganese ore by sea-bed production; the share of the market of developing countries in land-based output; and the rate of growth in total real product in the industrialized countries. To avoid a plethora of results, the effects of variation in a given assumption are shown only in the context of the medium 2 sea-bed case.

35. Consider, first, the variation in the degree of displacement of aggregate land-based production by sea-bed production. As noted earlier (para. 19), the assumption that sea-bed production will be planned analogously to land-based production led to only partial displacement of supplies from the latter source. The effects on export earnings of the two extreme situations - one in which there is no displacement, the other in which there is pound-for-pound displacement - are presented in table 9. The results vary surprisingly little from the central case of partial displacement of land supplies. Although export volume rises when there is no displacement and falls when there is pound-for-pound displacement, price falls more rapidly in the former case than in the latter. The net effect is that the entire range of variation in 1980, from one extreme case to the other, is only of the order of 6 per cent.

36. Variation of the assumption about the market share of developing country producers would, however, result in substantial variation in the estimated effects on the export revenue of developing countries. Variation in the market position of these countries is implied by alternative assumptions regarding the delivery location of sea-bed production. If, for example, it is assumed that all sea-bed production over the period arises from Japanese owned mining facilities and is utilized in Japan, then land-based production in developed market economies (Australia and South Africa) will be principally affected, and developing countries will gain in market share. If, on the other hand, all sea-bed production is conducted by United States firms and is allocated to the United States market, then developing country producers (Gabon, Brazil) will be principally affected, and lose market share. Since both the United States and Japan are leading developers of ocean-mining systems, and since several other nations are actively engaged in research too, either assumption is extreme. Nevertheless, they are interesting assumptions in that together they delimit the possibilities. The effects of both on the manganese ore export earnings of developing countries are presented in table 10. As the table reveals, in both cases the export earnings of the developing countries differ considerably from the central case in which the burden of displacement of supplies from traditional sources is shared equally by the developed market economies and by the developing countries. The difference in results solely depends on which group bears the burden of displacement; prices are the same in either case. In 1980, the reduction in the export earnings of the developing countries is in the order of 17 per cent relative to the base case, if these countries bear the full burden of displacement. In the same year, the increase in their earnings is about 21 per cent relative to the base case if the developed market economies bear the full burden. Even in the latter case, of course, there is a reduction of about 8 per cent in the developing countries' export earnings, in comparison with the situation in which there is no sea-bed output at all, because of the fall in price which [illegible] no matter whose production is supplanted.

37. Similarly, the export earnings of developing country producers of manganese ore are seriously affected by variations in real growth rates in the economies of the principal consumers of such ore. 19/ Two alternative situations are considered: one in which growth is reduced over the whole period to one-half of the historical growth rate; and a second in which no growth occurs from 1973 to 1974, one-half the historical rate from 1974 to 1975, and the full historical rate from 1975 to 1980. Results appear in table 11. The temporary reduction in growth would cause only a moderate decline in export earnings below the base case - about 4 per cent in 1980. The sustained reduction in growth, however, would result in a drop in export earnings of about 17 per cent in that year.

19/ In this analysis, changes in real growth rates of such consumers are represented by changes in growth rates of ferroalloy and steel production by those countries.

Table 9

Export earnings of developing countries from the sale of manganese ore under alternative assumptions regarding displacement of land-based production a/

	No displacement			Partial displacement b/			Ton-for-ton displacement		
	Export earnings (millions of $ US)	Export price ($ US/ metric ton)	Export volume (millions of metric tons)	Export earnings (millions of $ US)	Export price ($ US/ metric ton)	Export volume (millions of metric tons)	Export earnings (millions of $ US)	Export price ($ US/ metric ton)	Export volume (millions of metric tons)
1974	75.60	18.50	4.08	74.10	18.50	4.00	73.50	18.50	3.97
1975	75.10	18.10	4.14	72.40	18.20	3.98	71.50	18.20	3.92
1976	74.10	17.70	4.20	70.70	17.90	3.95	69.40	18.00	3.86
1977	72.60	17.10	4.24	68.80	17.60	3.92	67.30	17.70	3.80
1978	71.00	16.50	4.30	67.20	17.30	3.89	65.70	17.50	3.74
1979	69.60	15.90	4.38	66.20	17.00	3.89	64.70	17.40	3.72
1980	68.10	15.20	4.48	65.60	16.80	3.91	64.20	17.30	3.70
Average annual percentage change 1974-80	-1.8	-3.3	1.5	-2.0	-1.6	-0.4	-2.3	-1.1	-1.2

a/ Medium 2 sea-bed case

b/ Base case assumption

Note: In the absence of sea-bed production, export earnings of developing country producers in 1980 would be approximately $ US 93.7 million.

Table 10

Export earnings of developing countries from the sale of manganese ore under alternative assumptions regarding developing countries' share of land-based production *a/

	Sea-bed impact borne by developed market economies			Sea-bed impact shared b/			Sea-bed impact borne by developing countries		
	Export earnings (millions of $US)	Export price ($US/ metric ton)	Export volume (millions of metric tons)	Export earnings (millions of $US)	Export price ($US/ metric ton)	Export volume (millions of metric tons)	Export earnings (millions of $US)	Export price ($US/ metric ton)	Export volume (millions of metric tons)
1974	77.4	18.5	4.18	74.1	18.5	4.00	71.4	18.5	3.86
1975	79.0	18.2	4.34	72.4	18.2	3.98	67.2	18.2	3.69
1976	80.3	17.9	4.49	70.7	17.9	3.95	62.8	17.9	3.51
1977	81.2	17.6	4.63	68.8	17.6	3.92	58.6	17.6	3.34
1978	82.6	17.3	4.78	67.2	17.3	3.89	54.7	17.3	3.17
1979	87.3	17.0	4.95	66.2	17.0	3.89	51.4	17.0	3.02
1980	86.5	16.8	5.16	65.6	16.8	3.91	48.5	16.8	2.89
Average annual percentage change 1974-80	1.9	-1.6	3.6	-2.0	-1.6	-0.4	-6.3	-1.6	-4.7

a/ Medium 2 sea-bed case.

b/ Base case assumption

Note: In the absence of sea-bed production, export earnings of the developing country producers in 1980 would be approximately $US 93.7 million.

Table 11

Export earnings of developing countries from the sale of manganese ore under alternative assumptions regarding growth rates* a/

	Impulse reduction of growth			Continuation of historical growth b/			Sustained reduction of growth		
	Export earnings (millions of $US)	Export price ($US/ metric ton)	Export volume (millions of metric tons)	Export earnings (millions of $US)	Export price ($US/ metric ton)	Export volume (millions of metric tons)	Export earnings (millions of $US)	Export price ($US/ metric ton)	Export volume (millions of metric tons)
1974	71.3	18.5	3.85	74.1	18.5	4.00	71.3	18.5	3.85
1975	68.4	18.2	3.76	72.4	18.2	3.98	68.4	18.2	3.76
1976	66.8	17.8	3.75	70.7	17.9	3.95	65.3	17.8	3.66
1977	65.2	17.5	3.73	68.8	17.6	3.92	62.0	17.5	3.55
1978	63.9	17.2	3.72	67.2	17.3	3.89	59.0	17.1	3.44
1979	63.1	16.9	3.74	66.2	17.0	3.89	56.4	16.8	3.35
1980	62.8	16.6	3.78	65.6	16.8	3.91	54.2	16.5	3.28
Average annual per cent change 1974-80	-2.1	-1.8	-0.3	-2.0	-1.6	-0.4	-4.5	-1.9	-2.6

a/ Medium 2 sea-bed case.

b/ Base case assumption. Changes in growth rates in the major developed countries are represented by changes in ferroalloy and steel production.

Note: In the absence of sea-bed production, export earnings of developing country producers in 1980 would be approximately $93.7 million.

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AN ECONOMETRIC MODEL OF THE MANGANESE ORE INDUSTRY*/

Contents

*/ This model forms the basis for the analysis given in document TD/B/483, entitled "The effects of production of manganese from the sea-bed, with particular reference to effects on developing country producers of manganese ore".

INTRODUCTION

1. This paper describes an econometric model of the manganese ore industry. The model was developed in order to explore the implications of the exploitation of sea-bed manganese nodules for developing country producers of manganese ore. An attempt has also been made to keep the mathematical system as simple and flexible as possible - consistent with the needs of realism - in order to make the meaning of the model intuitively clear, and in order to facilitate the application of the model to other problems confronting the manganese ore industry.

2. The model consists of seven equations in seven jointly dependent variables - consumption in the eleven leading developed market economy consumers, consumption in the remaining developed market economies and in the developing countries, aggregate consumption, production, price, commercial stock change and commercial stock level. 1/ All variables in the model are annual rates. All quantities are aggregates over the developed market economies and developing countries. The quantities refer to gross weight of ore. Although a model containing quantity variables defined in terms of weight of metal content would also have been of interest, it was not possible to develop such a model owing to data limitations. Coefficients in all equations were estimated by ordinary least squares (OLS) over the 18-year sample period 1953-1970.

3. Certain limitations of the model should be noted. For example, the model deals with metallurgical-grade ore only and does not cover chemical-grade, battery-grade, or ferruginous ores. However, this restriction is less serious than it may appear, since consumption of metallurgical-grade ore represents at least 90 per cent of total consumption of all types. Also, because of data limitations, the production and consumption of manganese ore within the socialist countries have been excluded from the present analysis. Since, however, the primary interest is in the manganese ore industries of developing countries, this limitation is also not too serious. Account has, however, been taken of the flow of (net) exports from the East European socialist countries to Western Europe, which is the point at which manganese activities within the socialist countries impinge upon those in the developing countries.

4. For each equation, the following statistics are provided: R^2, and t values (the latter appear under the appropriate coefficient estimates). All R^2 are statistically significant and, in fact, very high. All coefficient estimates are statistically significant at the ten per cent level, except the coefficient for United States Government stock change in the price equation.

1/ The figures for commercial stock levels used in this addendum have been calculated on the basis of the (algebraic) sum of commercial stock changes since the end of 1950 (see para. 35).

I. CONSUMPTION

5. It is estimated that approximately 90 per cent of total world consumption of manganese ore is in various metallurgical uses. The remaining quantity is consumed in the manufacture of chemicals (hydroquinine, potassium permanganate, etc.) or dry-cell batteries. In the same way that metallurgical use dominates over-all consumption of manganese ore, iron and steel industry use dominates metallurgical consumption. Roughly 90 per cent of the combined total usage of the European Economic Community and Japan occurs in iron and steel production alone, and about 93 per cent of United States consumption stems from that industry. Counteracting the effects of sulphur by increasing the malleability of crude steel is the single most important application of manganese. This is an essential function in crude steel production and no other metal can compete with manganese on a cost basis in this application. As a consequence, all crude steel contains manganese as a result of standard steel production procedures. Moreover, in addition to its desulphurizing properties, manganese has useful cleansing and deoxidizing characteristics in raw steel. Most manganese consumed for this purpose is used in the form of one of the ferroalloys - ferromanganese, silicomanganese and spiegeleisen. Of these, ferromanganese is by far the most important, comprising about 90 per cent of the total in the United States in 1970 and similar proportions in other major steel producing countries. In addition to its use as a desulphurizing additive in crude steel, manganese is also utilized as an alloying element in a number of special purpose steels.

6. Econometric investigation of aggregate annual consumption of manganese ore is subject to the availability of national statistics on consumption. Such statistics are available for the 11 leading steel producers in the developed market economies, which are estimated to account for between 85 and 90 per cent of annual manganese ore consumption outside the socialist countries in recent years.

7. Consumption patterns in each of the major consumers were examined separately. On the basis of these investigations, certain general conclusions can be drawn:

(a) The price of manganese ore has no perceptible effect on the consumption of manganese. For a few countries, however, price rises in ore may induce some small substitution of ferroalloy imports for ore imports; 2/

(b) In spite of the fact that virtually all ferroalloy production is used in making steel, both ferroalloy production and steel production are independently significant in explaining manganese ore consumption. This is explained by the fact that in most countries significant quantities of ore are introduced directly into the production of pig iron, without passing through the ferroalloy stage; 3/

2/ The price elasticities were insignificant in most cases, Germany and the United Kingdom being exceptions. Although, even in these cases, consumption is inelastic with respect to price, the magnitude of the elasticities were surprisingly high. Both countries are importers of ferruginous manganese ore and ferroalloys, and it is possible that there has been substition of these for manganese ore when the price of ore has been particularly high.

3/ Elasticities of consumption with respect to ferroalloy production were uniformly significant, with a range roughly between 0.5 and 1.5. Elasticities with respect to steel production showed greater variability with the statistically significant values ranging between about 0.2 and about 1.0.

(c) It cannot be maintained on the basis of the available data that the newer steel-making processes (electric-furnace and oxygen processes) differ from the open-hearth process in terms of manganese ore consumption per unit of steel produced. This does not mean, of course, that the newer processes do not diminish in some degree the demand for ore; it means rather that the effect attributable to the particular steel-making process used is so small as to be obliterated (in the data) by the effects of the total volume of steel and ferroalloy produced.

8. Subsequent to the individual country studies, an aggregate consumption function for the 11 major consumers 4/ was generated. The best specification, with estimated coefficients, is the following:

$$C/MAJ = -375.66 + \underset{6.24}{1.5052}\ OF/MAJ + \underset{2.53}{0.00576}\ OS/MAJ + U(1) \qquad (1)$$

$$R^2 = 0.99$$

where C/MAJ is consumption of manganese ore by major consumers, and OF/MAJ and OS/MAJ are output of ferroalloys and output of crude steel, respectively, by the same countries. The variable U(1) represents a random element in the equation.

9. Determination of the level of consumption of manganese ore by the leading consumers then is quite a simple process, owing to the fact that the overwhelming share of such ore is used in a single application without significant alternative uses over a wide range of prices. Further, since the cost of the manganese ore consumed is such a small fraction of the total cost of producing a given quantity of steel, and since there are no good substitutes for such ore at comparable prices, the price-elasticity of demand for manganese ore is virtually zero. 5/

10. Residual consumption outside the major consuming areas is specified as a time trend:

$$C/OTH = (314.00)\underset{22.59}{(1.10023)}^{t}U(2) \qquad (2)$$

$$R^2 = 0.98$$

where C/OTH is consumption of manganese ore in other countries, t is the time trend variable, and U(2) is a random element. Actual data on ferroalloy production outside the 11 major consuming nations were not available, and this precluded the use of the specification employed in equation (1). The exponential trend adopted implies a

4/ Belgium, Canada, Federal Republic of Germany, Italy, Luxembourg, Netherlands, Sweden, United States of America.

5/ This fact has policy implications since it suggests the possibility of controlling price by a policy of supply restraint.

constant percentage change over time. This type of trend fits the data for C/OTH better than alternative trend formulations which were tested. Considering the brevity of the projection period (1974-1980), the extrapolation of this trend over the period does not seem unrealistic. Furthermore, the estimated rate of change over time of the consumption of manganese ore is virtually equal to the forecast rate of growth of steel production outside the 11 major consumers. The fact that there is very little variation in the ratio of manganese ore consumed to steel produced provides an argument for the extrapolation of the estimated trend in consumption over the projection period.

11. Aggregate consumption in all the developed market economies and the developing countries is as follows:

$$C/AGG = C/MAJ + C/OTH \tag{3}$$

where C/AGG is the aggregate consumption of the whole area.

II. PRODUCTION

12. For the purpose of offering an explanation of the determination of the level of annual production of manganese ore, annual production can conveniently be subdivided into two components. These are a basic level of production, which is taken as the productive capacity of the industry, K/LND, 6/ and a variation of actual production about that basic level, O/LND-K/LND. The following identity holds:

$$O/LND \equiv K/LND + (O/LND - K/LND)^{7/}$$

13. Examination of data on annual production of manganese ore and on annual price of such ore suggests a systematic relationship between annual output and annual price lagged several periods. Such a relationship can be rationalized in terms of the effect of past prices on current productive capacity and the presence of the latter as an element in current output. The idea that current productive capacity in an industry depends on past prices for the goods of that industry is a familiar one and seems to need no particular justification. The following relation is therefore assumed:

$$K/LND = \beta_o + \beta_1 P/AVR.$$

That is, current annual productive capacity in the manganese ore industry is taken as depending on a weighted average of several lagged annual prices: P/AVR. 8/

14. The variation of actual production from capacity production depends both on cost factors and on demand factors. For the purposes of this analysis, however, the cost aspect is ignored since published cost data do not exist. Moreover, in a period as short as one year, changes in the prices of individual inputs or in productivity do not seem very important as determinants of changes in production, at least, not in comparison with changes in the relatively volatile aspect of demand, which is so sensitive to the business cycle.

6/ The term "productive capacity" is not used in the sense of the maximum output which it is physically possible to produce. For a particular firm (given the production function and prices of inputs), a given capital stock implies an output level which minimizes short-run average cost. This output is defined as the productive capacity of the individual firm and the sum of the firms' capacities as the productive capacity of the industry.

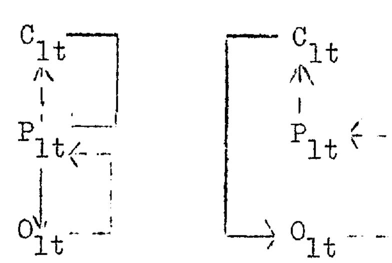
7/ The choice of notation, O/LND and K/LND, is to draw attention to the distinction between land-based industry (LND suffix) and ocean mining operations. This distinction is important in the application of the model to the sea-bed question (see addendum, TD/B/483/Add.1).

8/ It seems that current profitability is a significant factor in shaping a firm's expectations as to future profitability, and hence in determining its investment policy and future levels of productive capacity. But, if future capacity depends on current profitability, then it depends on cost variables as well as revenue variables (such as product price). Although this is clear in theory, the inclusion of cost variables in the equation determining productive capacity in the manganese ore industry is impossible because of a lack of data on the prices of inputs and absence of information about the production function for this commodity.

15. In conventional theories of how to determine the level of production of an economic good (or alternatively, the variation of current production from a given capacity), considerable emphasis is accorded to contemporaneous prices as a determining factor. This is true of standard oligopoly theories, as well as of the classical competitive theory of the firm. The data on annual production of manganese ore and on the contemporaneous annual price of such ore, however, fail to reveal any systematic relationship between these two variables. 9/ On reflection, the absence of such a relationship does not seem particularly surprising. The intuitive notion that current output depends on current price is based upon the premise that firms maximize profits over a given period. Yet, the idea that firms in this industry plan their year's production primarily having regard to considerations of profit maximization during that particular year seems dubious. The planning horizons of large firms probably extend over several years, and a given year's production is made to conform to that longer run plan. The output in a given year, which, in conjunction with the planned outputs for the other years of the planning period, maximizes profits over that longer run, may or may not maximize profits in any given year. Consequently, the problem is to find an explanation of the annual variation of production around capacity which does not rely on contemporaneous annual price.

16. The approach adopted here is that annual variations of actual production from capacity production can be related directly to annual consumption. The relationship between consumption and production as usually envisaged is depicted in diagram 1,a below, which indicates that current demand, i.e. current consumption, influences current production only through the intermediary of price (solid lines below). 10/ The view adopted here is that the situation in the industry is as illustrated in diagram 1,b, namely that consumption influences production directly, without price intervening. This is not to dispute the idea that in the long run production depends on consumption <u>through</u> price. It is simply a recognition of the fact that, in a period as short as a year, price has but little influence on production.

Diagram 1



1, a 1, b

17. It is possible to conceive of at least two mechanisms whereby, in this particular industry, production varies directly with consumption over the short run: an extra-market mechanism and an intra-market mechanism.

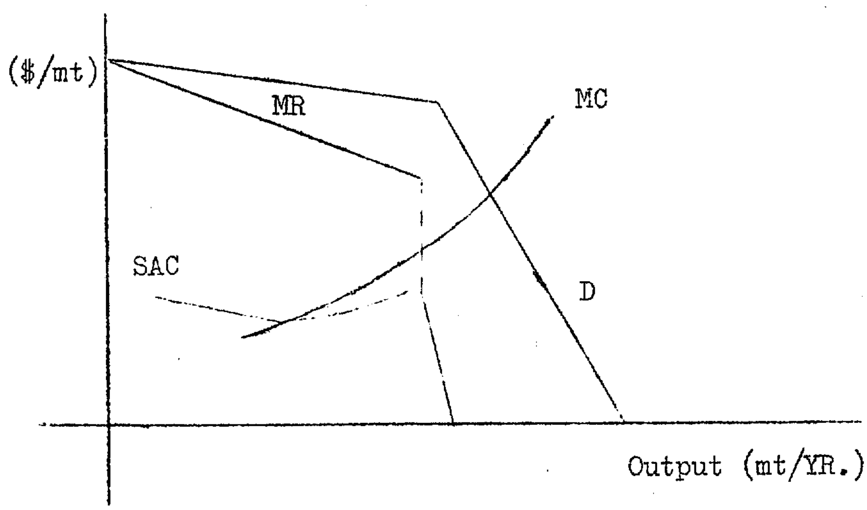
9/ A number of specific hypotheses, with and without other possible explanatory variables, were examined. Formulations included averages of prices, finite sums (polynomial lags and Almon lags), distributed lags, changes in output related to contemporaneous changes in price, etc. Both linear and non-linear forms were tried but none produced a workable relationship between annual production and contemporaneous annual price.

10/ As noted in Section I, the link between P_1 and C_1 is virtually non-existent.

18. The extra-market mechanism reflects the institutional context of the manganese ore industry. Much of the annual output of manganese ore is produced under long-term contracts or under subsidiary-parent company relationships. Under these circumstances, changes in consumption do not necessarily result in changes in market demand and market price, at least at some ranges of consumption levels. Deliveries under existing contracts are simply expanded or contracted under a contractual price which is not necessarily precisely equal to the current market price; or alternatively transfers from subsidiary to parent are entered at a bookkeeping price which also does not necessarily coincide with the current market price. This being so, the effect of annual consumption on contemporaneous annual market price is weak, and output varies directly in tune with consumption, rather than through the intervention of market prices.

19. The intra-market mechanism reflects the oligopolistic character of the manganese ore industry. Given the price interdependency which exists among major firms in this industry, it seems likely that a typical firm envisages the demand curve which it faces as being more elastic above the currently existing price than below that price. In other words, it probably believes that, if it raised its price substantially above the existing level, its competitors would not follow suit and it would lose some of its share of the market; or conversely, that if it lowered its price below the existing level, its competitors would match the reduction and it would not improve its share of the market. It probably believes that the demand curve which it faces is kinked at the current price, and is more elastic above the current price than below it. This view of the individual firm's demand curve is illustrated in diagram 2 below. The demand curve facing the firm (as perceived by the oligopolist) is the kinked curve D and the corresponding marginal revenue curve is MR. The short-run average cost curve is SAC and the marginal cost curve is MC.

Diagram 2



20. If consumption changes, and with it market demand, then, after a period of demand shifts, price will not change but current production will expand or contract as a direct response to the demand shift. As long as the consumption shift produces intersections of the MR and MC curves within the broken section of the former (as perceived by the firm), price will not change but production will. Both of these mechanisms show a direct link between consumption and production, and neither involves an intermediate link with price.

21. There are various ways in which it is possible to show empirically that variations around capacity depend directly on consumption. Here, it is assumed that the amount by which actual production exceeds or falls short of capacity production depends on the amount by which consumption exceeds or falls short of capacity. More specifically:

$$[O/LND - K/LND] = \gamma\, [C/AGG - K/LND] + U(4)$$

That is, the variation of actual production from capacity is proportional to the amount by which consumption exceeds (falls short of) capacity (plus a random factor, U(4)).

22. The hypotheses on productive capacity and on the variation of actual production from capacity can now be amalgamated into a single hypothesis on the determination of actual production of manganese ore. The equations,

$$K/LND = \beta_0 + \beta_1\, P/AVR$$

$$[O/LND - K/LND] = \gamma\, [C/AGG - K/LND] + U(4)$$

when combined, and after estimation of coefficients, yield:

$$O/LND = 982.79 + \underset{2.30}{54.111}\, P/AVR + \underset{11.75}{0.73075}\, C/AGG + U(4) \qquad (4)$$

$$R^2 = 0.96$$

where P/AVR is to be interpreted as a simple three-year average of prices beginning at price lagged eight years. 11/ Equation (4) represents the production sector of the model.

11/ All three-year weighted averages of lagged prices from a (centred) lag of two years to a (centred) lag of ten years were investigated. The lag chosen was picked on a basis of sign appropriateness, R^2, t value, etc ..

III. PRICE

23. The general structure of the market for manganese ore is one of bilateral oligopoly, with about eight large producers trading with a handful of large steel companies and minerals trading firms. There are second tiers of considerably smaller firms on both the supply and the demand sides, but the market is dominated by, and prices determined by, the interaction of the large firms. The United States Government has been a participant in the manganese ore market as it has accumulated, and more recently partially liquidated, a strategic reserve of manganese ore. In addition, the socialist countries, and particularly the USSR, play a role in the market. There is a flow of net exports, mainly from the USSR to Western Europe and the influence of this flow on prices was investigated.

24. Since, for the most part, manganese ore is mined outside the main consuming countries, a large portion of trade in such ore is international in character. In 1970, nearly 50 per cent of all ore produced entered international trade. The broad pattern of trade is composed of a main flow from developing countries to developed market economies, and of lesser flows from surplus developed market-economy countries (South Africa and Australia) and the USSR to deficit developed market-economy countries.

25. As noted above, the structure of the market for manganese ore is one of bilateral oligopoly. Nevertheless, the standard oligopoly models are of little use as explanations of the annual price of manganese ore. A basic obstacle to the utilization of these theories in the present context is that they all posit market clearing over the period of analysis. 12/ It would be necessary to assume that annual quantity data represented observations on equilibrium quantities, that is, that the market was in equilibrium, year after year. However, it would be unrealistic to assume that the market for manganese ore clears within the same year that a change in some exogenous variable occurs. Given an initial equilibrium and a perturbation of some variable in the system, a number of years would be required to bring price, quantity demanded and quantity supplied to new equilibrium values, even in the absence of further disturbances. In the interim, the quantity exchanged data would be observations on disequilibrium quantities in contradiction to the requirements of the models. As in the case of the production sector, the difficulty lies in the brevity of the analytical period - one year - relative to the natural inertia of the industry. 13/ For these reasons, the usual oligopoly models of price determination cannot be used in the present analysis.

12/ An additional difficulty is that these models explain output in terms of contemporaneous price. As noted in para. 15 above, however, annual production of manganese ore does not seem to be related to contemporaneous annual price.

13/ Such considerations are reinforced by the fact that price, as statistically calculated, reflects the existence of tied sales and long-term contracts and could be expected to be relatively slow-moving.

26. Instead, the determination of manganese ore price in a period as short as one year is taken as essentially an inventory phenomenon, relating price to the level of commercial inventories and to United States Government stock level changes. (A dummy variable is also included to account for disruption of the market in 1957 f llowing the initial closure of the Suez Canal.) The estimated result is:

$$P = 27.747 + \underset{0.92}{0.00184 \, \Delta \, I/USG} - \underset{-2.04}{0.00023 \, I/COM \, (t-1)} + \underset{6.34}{10.735 \, DDI} + U \, (5). \qquad (5)$$

$$R^2 = 0.88$$

where P is the price of manganese ore, Δ I/USG is United States Government stock change, I/COM(t-1) is commercial inventories at the end of preceding year, DDI is the dummy variable, and U(5) is a random variable. No significant role in price determination was found for (net) imports from the socialist countries.

IV. THE COMPLETE MODEL

27. The model is closed with two identities relating to inventories, viz:

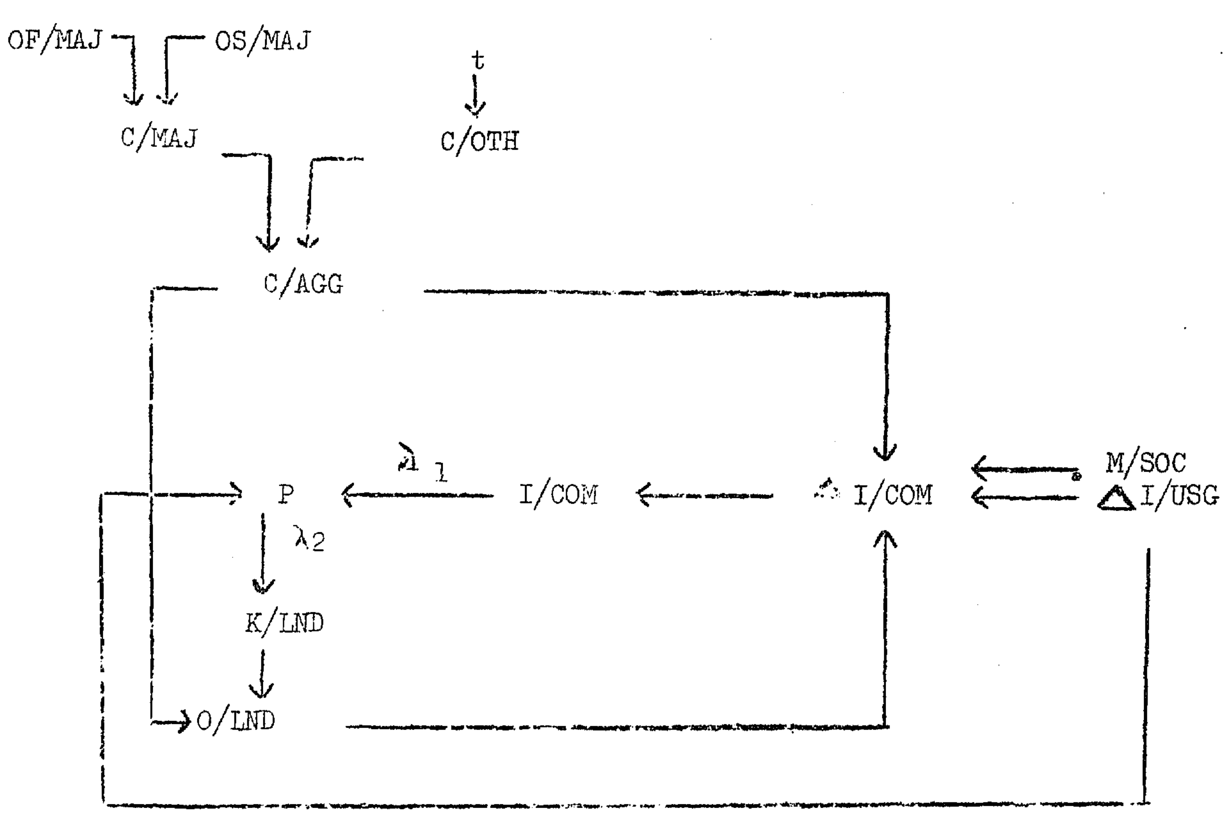
$$\Delta I/COM \equiv O/LND - C/AGG + M/SOC - \Delta I/USG \tag{6}$$

$$I/COM \equiv I/COM(t-1) + \Delta I/COM \tag{7}$$

where Δ I/COM is change in commercial stocks, and M/SOC is net imports from the socialist countries.

28. The causation embodied in the model can be summarized in the following terms (see diagram 3 below). Aggregate consumption is determined, through its components, by steel production and ferroalloy production in the major industrial countries and by a trend element. Aggregate production is determined by aggregate consumption and (through productive capacity) by an average of lagged prices. The change in commercial stocks is determined by aggregate production, aggregate consumption, net imports from the socialist countries, and United States Government stock change. Price is determined by lagged commercial inventory levels and by United States Government stock change.

Diagram 3



V. VERIFICATION OF THE ESTIMATED STRUCTURE

29. The estimated structure consisting of equations (1) to (7), was used as a unit to calculate values for the seven jointly dependent variables, year-by-year over the period 1953-70. Since actual data for each variable for each year are available, the errors of the calculated figures can be determined, as well as the estimated capacity of the structure to reproduce the values of the variables over the past. This will provide a basis for forming a tentative judgment of the model's power to predict future values of the variables. The mean absolute per cent errors (MAPE) over the period for the calculated values of the variables are as follows:

Variable	MAPE
C/MAJ	1.98
C/OTH	7.57
C/AGG	1.73
O/LND	2.19
P	7.04
Δ I/COM	8.99
I/COM	0.67

These values are very low and provide some assurance of the model's predictive capacity, barring drastic structural changes in the manganese ore industry.

30. Further confirmation of the estimated structure can be obtained by considering its testable implications. The following equation is implied by the structure of the production hypothesis:

$$K/LND = 3650.1 + 201.15\ P/AV$$

Although no statistics on productive capacity outside the socialist countries exist for this industry, some indirect corroboration of the above equation can be found. If the figures produced by the equation are realistic, they should mirror the major events known to have affected capacity in the industry. It is known, for example, that the productive capacity of the manganese ore industry rose sharply with the opening up of the mines in Gabon and the efficient new mines in Australia; and it is also known that capacity has been diminished by the closure of mines in several of the traditional manganese ore producers in recent years. The figures implied by the equation should reflect these developments. Table 1 below gives the capacity figures implied by this equation. The expansion of capacity owing to the opening of the Gabonese mines in the early 1960s can be seen in the sharp rise in the capacity figures for 1961 and 1962. The opening of new mines in Australia shows up in the higher capacity figures for 1965 and 1966. The absence of developments of the order of magnitude of the Gabonese and Australian ventures, coupled with some shutdowns of mines in traditional producers, are reflected in the levelling off and slight reduction of productive capacity in the last few years shown. While this does not constitute a direct verification of the capacity figures, it does reveal that the figures seem to reflect the major developments affecting capacity. The relationship of capacity to actual output implied in table 1 is consistent, too, with the course of prices during the 1960s.

31. Another equation is implied by this production hypothesis, namely,

$$[O/LND - K/LND] = 0.73075\ [C/AGG - K/LND]$$

First, it can be noted that the estimate of the constant of proportionality is positive as the hypothesis demands. Further, in every year of the sample period in which capacity exceeds consumption, capacity also exceeds actual output. This too is in line with the hypothesis.

Table 1

Consumption, output, and implied productive capacity in the manganese ore industry

(Thousands of metric tons, gross weight)

	Consumption	Output	Implied productive capacity
1960	5140	6070	8020
1961	5220	6200	8740
1962	5480	6590	9070
1963	5390	6200	9000
1964	6410	6960	8950
1965	7320	7820	9660
1966	6980	8320	10700
1967	7360	8000	10900
1968	7900	8410	10100
1969	8290	8880	9410
1970	9430	9290	9210

Annex I

A NOTE ON DATA EMPLOYED

Most of the numerical data employed in estimating the coefficients of equations and in verifying the estimated structure were extracted from published sources. For four variables, however, it was necessary to synthesize data since published data were not available at all or a sufficiently long homogenous series was not available. These variables are: P, C/OTH, I/COM and $\triangle$I/USG. This note outlines the process employed to generate figures for each of these.

There is only one time series of data on market prices of manganese ore which is of considerable duration and ready availability. This is the series for 48-50 per cent manganese content ore published in the Metal Bulletin. Unfortunately, the series is for ore c.i.f. New York. Since, however, shipping costs represent perhaps as much as one-third of this price on the average, it is very difficult to differentiate between fluctuations in the series attributable to changes in freight rates and those that are attributable to changes in market prices f.o.b. Further, attempts to adjust the series for changes in freight rates were not successful. Clearly, however, since the ultimate interest is in the export earnings of developing country producers of manganese ore, the price concept required is that of an f.o.b. price. As an alternative to the published price, a unit export value may be used. Since total export values reflect the inclusion of values of exports of ore sold under long-term contracts or under parent company-subsidiary arrangements, the derived unit export value for a period will not exactly equal the average open market spot price for the same ore during the same period. However, this is an advantage rather than a disadvantage. Since long-term contracts and parent company-subsidiary relationships will continue to exist in the future, an average unit export value - which reflects these factors - should provide a better indicator of the unit value of ore accruing to developing country producers than an open market spot price. There is, however, a conceptual difficulty in using an average unit export value as an operational definition of price. The problem is that exports of metallurgical-grade, chemical-grade, battery-grade and ferruginous ore are included in the statistics of manganese ore exports, while the focus of interest in the present report is on the unit export value of metallurgical-grade ore. As a practical matter, however, this is not a serious problem, because the quantities of metallurgical-grade ore produced and exported are overwhelmingly greater than the combined quantities of chemical, battery and ferruginous ore produced and exported,14/ indeed, most of the latter is improved to metallurgical-grade quality before export. Any small distortion which is produced by this amalgamation of disparate ores can be corrected by omitting from the aggregate value and aggregate quantity of exports the values and quantities of exports of those few countries which produce relatively large quantities of chemical, battery, and ferruginous ores, before calculating the export unit value for a particular year. The corrected unit value so computed is taken as the "price" of (metallurgical grade) manganese ore.

14/ Although prices of chemical-grade and battery-grade ores exceed that of metallurgical-grade ore, the differences are not nearly of such magnitude as to offset the quantity advantage of metallurgical ore.

Data on C/OTH were formed as follows. There exists a rigid technological relationship between crude steel produced and manganese ore consumed. Given crude steel production in that portion of the developed market economies and developing countries that falls outside the eleven major ore consumers (from published data), it is a straightforward task to estimate manganese ore consumption in that area. Conceptually, the figures so generated could be distorted if the area outside the eleven major consumers was an importer of significant quantities of ferroalloys from the eleven to use in its steel production. In practice, however, this is not the case.

The commercial inventory variable, I/COM, is defined as follows. The following identity holds:

$$I/COM(t) \equiv I/COM(0) + L(t),$$

where

$$L(t) \equiv \sum_{\tau=0}^{t-1} \triangle I/COM(t-\tau).$$

That is, inventories at the end of year t are equal to what they were at the end of a preceding year (0), plus the algebraic sum of stock changes since that time. Now L(t), computed since the end of 1950, is known, though unfortunately, 1950 year-end stocks are unknown. Operationally I/COM(t) is defined as follows:

$$I/COM(t) \equiv L(t).$$

The estimation of the coefficient of commercial inventory in the price equation is unaffected by the omission of the element I/COM(1950) in the data since the I/COM(1950) is amalgamated into the intercept of that equation.

Data on United States Government stockpile releases ($\triangle$I/USG) were also synthesized. Figures relating to stockpile operations of the United States General Services Administration are published in <u>Stockpile Report to the Congress</u>. Data are published in a comparable form, however, only as far back as 1966. Since this source did not provide a time series sufficiently long for present purposes, the data were synthesized utilizing the following identity:

$$\triangle I/USG \equiv O/US - C/US - T/US - \triangle I/USCOM,$$

where O/US, C/US, T/US, and $\triangle$I/USCOM are United States output, consumption, net trade, and commercial stock change of manganese ore, respectively. All variables on the right side of the identity are statistical measurements from the United States Bureau of Mines <u>Minerals Yearbook</u>; the variable $\triangle$ I/USG follows. The figures thus generated differ as to level, but not as to sign, from those published in the official stockpile report.

A listing of the basic data employed, with sources, is given below.

Table 2

A listing of data employed[a/]

	C/MAJ (1)	OF/MAJ (2)	OS/MAJ (3)	C/OTH (4)	O/LND (5)	P (6)	I/USG (7)	I/COM (8)	M/SOC (9)
1953	3632.9	1921.4	173180	285.[illegible]	5872.9	27.[illegible]	1429	8403	162
1954	3200.1	1661.3	156400	403.9	4879.9	26.7	670	9203	194
1955	3949.0	2090.0	196000	433.2	5179.1	25.0	423	9917	340
1956	4520.7	2417.4	220260	500.0	5855.0	27.4	364	10704	317
1957	4546.3	2482.6	205480	561.8	6464.3	37.5	754	11684	378
1958	3488.4	1946.2	175360	480.4	5716.6	38.8	711	13090	369
1959	3651.8	2014.7	194680	585.0	5993.8	30.4	337	14963	453
1960	4420.0	2421.6	219540	720.8	6067.2	27.0	698	15499	308
1961	4352.7	2410.8	220350	868.2	6201.9	28.5	713	16079	312
1962	4482.7	2410.8	218630	995.6	6591.0	26.7	517	17007	332
1963	4419.3	2335.0	235510	971.9	6204.0	22.7	284	17862	326
1964	5324.8	2800.0	274420	1084.0	6959.8	21.7	-45	18643	185
1965	6050.2	3036.3	284500	1271.7	7815.3	22.7	-202	19566	228
1966	5725.6	2859.2	289660	1254.1	8319.6	24.2	-148	21473	419
1967	5996.4	3011.2	301910	1362.9	7998.9	23.7	-345	22938	480
1968	6414.7	3241.3	322780	1485.0	8412.6	21.0	-227	24021	343
1969	6726.9	3458.6	354530	1561.3	8877.3	18.4	-199	25129	320
1970	7592.5	3905.4	361700	1837.5	9291.7	18.0	-533	25930	406

a/ All physical quantities are given in thousands of metric tons of ore (gross weight). The variable "P" is in United States dollars per metric ton. The dummy variable DD1 assumes the value one in 1957 and 1958, zero otherwise. The trend variable "t" was taken as unity in the first year (1953).

Source: Columns 1,2,3 : United States Bureau of Mines, Minerals Yearbook, various issues; Statistical Office of the European Communities, Sidérurgie, various issues; for Canada, Japan, Sweden and United Kingdom, national sources.

Columns 4,6,7,8 : synthesized.

Column 5 : United States Bureau of Mines, Minerals Yearbook, various issues.

Column 9 : Various national sources; OECD, Statistics of Foreign Trade - Trade by Commodities, various issues.

Since the consistency of OLS estimators rests on the assumption of diagonality of EU_tU_t', it is worth while considering a statistical test of this assumption. If EU_tU_t' is diagonal, then the four disturbances in the behavioural equations are contemporaneously uncorrelated, and conversely. It is wished to test:

$$H_o : \rho_{ij} = 0 \qquad (i, j = 1, \ldots, 4; i \neq j)$$

against $$H_1 : \rho_{ij} \neq 0.$$

Since the distribution of r_{ij} is very sensitive to ρ_{ij} and N, the sample size, it is more convenient to work with:

$$\gamma_{ij} \equiv \frac{1}{2} \ln \frac{1 + r_{ij}}{1 - r_{ij}} ,$$

which is approximately normally distributed with

$$\gamma_{ij} \equiv \frac{1}{2} \ln \frac{1 + \rho_{ij}}{1 - \rho_{ij}}$$

$$\sigma_{\gamma_{ij}} \equiv \frac{1}{\sqrt{N-3}}$$

The hypotheses above immediately translate into:

$$H_0 : \mu_{\gamma_{ij}} = 0$$

$$H_1 : \mu_{\gamma_{ij}} \neq 0.$$

At the 0.05 significance level, in a two-tail test, the critical value of γ_{ij} is 0.88. Since the largest sample value of γ_{ij} is 0.45, it is possible to accept the null hypothesis and assume that the disturbances are contemporaneously uncorrelated. This test must be considered somewhat suspect because the approximation of the normal distribution to that of γ_{ij} is very close only for, say, $N > 30$.

Nevertheless, as a practical matter, there is no good alternative to the diagonality assumption and OLS estimation. It will be noted that only one equation (number 4) permits of estimation by a k-class estimator (e.g., two stage least squares), because it is the only one that contains a jointly dependent variable as an explanatory variable. Moreover, the requisite computer software for a full system estimation was not available.

Annex II

A NOTE ON STATISTICAL ASSUMPTIONS

A word about the statistical model imposed upon the data may be in order. Let U_t be the vector of disturbances from the four behavioural equations of the model, and let X_t be the vector of eleven predetermined variables which appear in the model. It is assumed that for s, t = 1, ..., 18 (18 annual observations, 1953-70):

(1) $EU_t = 0$

(2) U_t' is distributed independently of U_s for all s, t ($s \neq t$)

(3) EU_tU_t' is a matrix of finite constants for any t, identical for all t, non-negative definite, and diagonal

(4) $EX_tU_t = 0$

It is well known that, in a simultaneous equations context, the disturbance in an equation is usually correlated with any contemporaneous endogenous variable which appears in that equation. Under these circumstances, assumption (4) is violated and OLS estimators are inconsistent (in the technical statistical sense). It will be noted, however, that the present model is only superficially simultaneous, and is, in fact, recursive. The latter characteristic, in combination with the diagonality specification of assumption (3), renders any contemporaneous endogenous explanatory variable in an equation predetermined.15/ Thus assumption (4) is satisfied and the OLS estimatores employed are consistent.

15/ See Henri Theil, Principles of Econometrics (New York, John Wiley and Sons, Inc., 1971), p.460.

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The effects of possible exploitation of the sea-bed on the earnings of developing countries from copper exports

Report by the UNCTAD secretariat

This report is the third in a series of quantitative analyses whose purpose is to estimate, in relation to one of the metals under consideration, how any exploitation of the sea-bed would be likely to affect the export earnings of the developing countries.

The report has been prepared pursuant to the instructions of the Conference which, in its resolution 51 (III), decided that "the question of the economic consequences and implications for the economies of the developing countries resulting from the exploitation of mineral resources shall be kept constantly under review by the Conference and its subsidiary organs, in particular the Trade and Development Board", and invited the Secretary-General of UNCTAD "to continue to study the measures necessary to avoid the adverse economic effects which the exploitation of the sea-bed ... may have on the prices of minerals exported primarily by developing countries ...".

This study is based on a simulation model of the copper market prepared by Professor F.G. Adams of the University of Philadelphia.

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CONTENTS

Except as otherwise indicated, the term "dollars" or the sign $ means US dollars.

Summary and conclusions

1. The consumption of copper has increased in the last two decades at an average annual rate of 5 per cent, and in the non-socialist world reached an annual average of 8 million metric tons in the period 1969-1971.

2. Mine production over that period totalled about 5 million tons of copper content, corresponding to a value of $6,000 million, the difference between mine production and consumption being accounted for largely by the use of secondary copper. The share of the developing countries in that output was about 40 per cent.

3. The characteristics of the copper market, and in particular the existence of two relatively independent sub-markets, were taken into account in an econometric model which was used to simulate the behaviour of the market in the event of exploitation of the sea-bed. As in the UNCTAD secretariat's previous reports, four assumptions were made concerning the intensity of exploitation of the sea-bed. On the low assumption 14,100 tons of copper would be extracted from the sea-bed in 1980, on the medium-low assumption 42,300 tons, on the medium-high assumption 98,800 tons, and on the high assumption 141,000 tons.

4. By that date, even in the last-mentioned case, the volume of copper extracted from the sea-bed would not account for more than 2 per cent of mine production, or for more than 1 per cent of consumption in the non-socialist world. Again by 1980, according to the results of the quantitative analysis, the effect of this production might be summarized as follows, by comparison with the case of no exploitation of the sea-bed: contraction of mine production on land by 0.7 per cent, expansion of total mine production (on land and on the sea-bed) by 1.2 per cent, and expansion of consumption by 0.4 per cent in the non-socialist world. London Metal Exchange prices would drop by 2.2 per cent and United States producer prices by 1 per cent. The export earnings of the developing countries would shrink by about $200 million, or about 3 per cent of the total.

5. For reference purposes, this figure may be compared with the value of the copper that would be extracted from the sea-bed on the same assumption - about $300 million. Assuming that the profits of firms engaging in that activity would hardly be likely to exceed half their gross receipts, it will be seen that a transfer of all or part of those profits to the developing countries would not offset the shrinkage of their potential export earnings.

I. Characteristics and prospects of the copper market

6. Any estimate of the effects that exploitation of the sea-bed might have on the copper market must obviously be based on an analysis of that market's characteristics and a projection of its trends. Part I of the report contains a brief description of those characteristics and trends.

7. The average annual mine production of copper in the non-socialist world over the period 1969-1971 came to about 5 million metric tons of copper content, representing in value about $6,000 million. The share of the developing countries in that output was about 2 million tons, or some 40 per cent of the total.

8. Over the same period the non-socialist world consumed an average of some 8 million tons of copper annually, the difference between mine output and consumption being largely accounted for by the use of secondary copper. The development of the copper market over the last two decades has been characterized by an average annual growth in demand of about 5 per cent.

9. An important peculiarity of the world copper market is the existence of two relatively independent sub-markets: the copper market in the United States and the copper market outside the United States. The United States copper market is very much a "managed" market in style, and the producer prices, fixed on the basis of medium-term targets and for a time controlled by the Government, have in the past proved more stable than the prices ruling on the London Metal Exchange. These two sub-markets, although relatively independent, are nevertheless interconnected in various ways. In the first place, copper price fluctuations on the London Exchange have some - though a mitigated - effect on producer prices in the United States. Secondly, the volume of United States imports depends in part on the disparity between United States producer prices and London Metal Exchange prices. Lastly, the price of secondary copper and hence the volume of such copper entering the market in the United States can be seen to be closely linked to the London market prices.

10. While copper has distinctive physical properties of its own, such as high electrical and thermal conductivity, it nevertheless competes for certain uses with aluminium, which is of lower conductivity but much less expensive. Consequently the price of aluminium ranks as one of the variables determining the level of copper consumption, alongside industrial activity, the volume of investment and, of course, the price of copper, which also plays a dominant rôle in determining output.

11. Fisher and Cootner, in collaboration with Baily, developed a model of the copper market which takes into account the various characteristics described above.1/ Professor F. G. Adams revised this model and brought it up to date for the benefit of the participants in a project for building a world economic model: the LINK project. At the request of the UNCTAD secretariat, which is one of the participants, Professor Adams used his model, which will be published in the proceedings of the LINK project, to estimate the effects of a possible exploitation of the sea-bed on the copper market. The present document is based on the results communicated to the secretariat by Professor Adams.

1/ F. M. Fisher and P. H. Cootner, in collaboration with M. N. Baily: An Econometric Model of the World Copper Industry, Bell Journal of Economic and Management Science, Vol.3, No.2, autumn 1972.

12. At whatever rate the sea-bed may be exploited in the future no projection of the copper market can be made without first formulating some assumptions concerning the development of the exogenous variables in the model. These assumptions are set out below.

13. The level of economic activity up to 1975 was projected through the LINK model on the basis of the results of an OECD study 1/ covering the period 1975-1980. On that basis, the growth of economic activity in the industrialized countries may be expected to slacken in 1974 and 1975 but should speed up again in the second half of the decade.

14. It is assumed that, in average annual rates over the entire period 1973-1980, the price of aluminium (current value) will rise at the rate of 3.2 per cent and that the wholesale price index will increase at the rate of 5 per cent in the United States and 3.9 per cent in the United Kingdom.

15. On these assumptions and in the absence of any exploitation of the sea-bed, the mine production of copper would grow during the period 1973-1980 at an average annual rate of 1.8 per cent in the United States, 5.7 per cent in Canada and 5 per cent in the rest of the non-socialist world, or at an average rate of 4.3 per cent per annum for the entire non-socialist world.

16. Throughout that period, the consumption of copper would increase by an average of 2.3 per cent per annum in the United States and 4 per cent per annum in the non-socialist world as a whole, while United States imports would double (average annual growth rate 10.4 per cent); stocks in the United States would diminish by 4.5 per cent and those of the rest of the non-socialist world by 37.3 per cent.

17. Still for the period 1973-1980, the average annual rise in the price of copper would be 7.5 per cent in current money terms and 3.5 per cent in constant pounds on the London Metal Exchange, while United States producer prices would rise at an annual average rate of 7.8 per cent in current dollars and of 2.6 per cent in constant dollars.

II. Effects of exploitation of the sea-bed on the copper market

18. The effects of possible exploitation of the sea-bed on the copper market and on the export earnings of the developing countries will depend on the intensity of such exploitation. That intensity, in its turn, will depend firstly on the measures taken by national or international authorities to regulate such exploitation, and secondly on the relationship between the costs of exploitation and the market prices for the metals concerned: copper, nickel, cobalt and possibly manganese. 2/ Although great progress has been made recently in estimating these costs,

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1/ OECD, The growth of output, 1960-1980: retrospect, prospect and problems of policy, Paris, 1970.

2/ The extraction of manganese would probably entail additional expense over and above that incurred, first in extracting and transporting the nodules themselves, and secondly in processing the nodules to extract nickel, copper and cobalt. Under these conditions, and in view of the prices of manganese, the extraction of that metal might seem to be barely or not at all profitable.

they are still far from exactly known and it was not considered feasible to include them as a variable in the model. Therefore, as in the two previous studies by the UNCTAD secretariat on the consequences of exploiting the sea-bed, 1/ one concerning the cobalt market and the other concerning the manganese market, a number of assumptions were made regarding the intensity and yields of exploitation of the sea-bed, including the implicit assumption that such exploitation would be economic at the degrees of intensity envisaged. In other words it was assumed that:

(i) Total receipts from the sale of the metals extracted from the nodules would cover the costs involved and would leave a sufficient profit margin to encourage industry to engage in such exploitation;

(ii) The receipts from the sale of copper at the prices indicated by the model would cover the additional costs involved in its production (in the case of copper there is hardly any doubt that, if the first assumption is correct, the second is likewise correct).

As in the previous studies on cobalt and manganese, the assumptions made about the intensity and yields of exploitation of the sea-bed are based on data presented in a report by the Secretary-General of the United Nations to the Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor Beyond the Limits of National Jurisdiction. 2/ It was assumed that every mining operation on the sea-bed would lead to the annual extraction of 1 million tons of dry nodules from which, in addition to nickel, cobalt and possibly manganese, 14,100 tons of copper could be extracted.

19. The various hypothetical programmes for exploitation of the sea-bed considered in this analysis are the same as those considered in the two studies mentioned above concerning cobalt and manganese, and are summarized in the following table.

20. These various assumptions look extremely implausible at the present time. It is hardly conceivable that commercial exploitation of the sea-bed could attain any appreciable level of activity by 1976 or perhaps even by 1978. Furthermore it would appear that some future mining operations on the sea-bed might involve a larger quantity of nodules than that postulated here, perhaps 3 million tons.

1/ Exploitation of the mineral resources of the sea-bed beyond national jurisdiction: issues of international commodity policy; Case study of cobalt (TD/B/449/Add.1);

The effects of production of manganese from the sea-bed, with particular reference to effects on developing country producers of manganese ore (TD/B/483);

An econometric model of the manganese ore industry (TD/B/483/Add.1).

2/ Possible impact of sea-bed mineral production in the area beyond national jurisdiction on world markets, with special reference to the problems of developing countries: a preliminary assessment, report by the Secretary-General (A/AC.138/36).

Table I

The various assumptions made concerning the programme for exploitation of the sea-bed

	Low assumption		Medium-low assumption		Medium-high assumption		High assumption	
	Number of mining operations 1/	Production of copper 2/	Number of mining operations 1/	Production of copper 2/	Number of mining operations 1/	Production of copper 2/	Number of mining operations 1/	Production of copper 2/
1974	0	0	0	0	1	14.1	1	14.1
1975	½	7.1	½	7.1	2	28.2	2	28.2
1976	1	14.1	1	14.1	3	42.3	3	42.3
1977	1	14.1	1½	21.1	4	56.4	5	70.5
1978	1	14.1	2	28.2	5	70.5	7	98.7
1979	1	14.1	2½	35.2	6	84.6	9	126.9
1980	1	14.1	3	42.3	7	98.7	10	141.0

1/ Covering 1 million tons of dry nodules.

2/ Thousands of metric tons.

Source: United Nations.

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However, since the future remains very uncertain, it was thought desirable to continue to use in the present study the hypotheses adopted for the two previous secretariat studies, so that comparisons may be made regarding the implications of sea-bed exploitation for the markets of the various metals concerned.

21. In the case of copper, the effects of such exploitation will depend not only on the volume of copper extracted but also on the proportion of that copper reaching each of the two partly independent sub-markets (United States and non-United States) which were mentioned at the beginning of this note. At the present stage it is very difficult to formulate any assumptions concerning that apportionment. It is known only that some American, Japanese and European firms have already evinced interest in possible commercial exploitation of the sea-bed and have undertaken research on the subject. That being so it seemed desirable to assume that all the copper extracted would be channelled into the non-United States market, for that is the situation in which exploitation of the sea-bed would have the most pronounced effects on the copper market as described in the model. 1/ An attempt was thus made to determine the upper limit of impact of the hypothetical programmes of sea-bed exploitation considered in this report.

22. Hence, in the various situations assumed, the mine production, consumption, level of stocks and prices of copper would reach the levels indicated in the table below:

Table II

Effects of possible exploitation of the sea-bed on the copper market in 1980

	Base situation 1/	Low assumption 2/	Medium-low assumption 2/	Medium-high assumption 2/	High assumption 2/
	Mine production (in thousands of metric tons of copper content)				
Canada	1 022	1 021	1 020	1 016	1 013
United States	1 673	1 672	1 669	1 664	1 660
Rest of the world 3/	4 627	4 623	4 620	4 608	4 597
Sea-bed	0	14	42	99	141
Total	7 322	7 330	7 351	7 387	7 411
	Consumption (in thousands of metric tons)				
United States	3 998	3 998	3 999	4 002	4 004
Non-United States 3/	8 899	8 903	8 909	8 922	8 939
Total	12 897	12 901	12 908	12 924	12 943

1/ The model reflects the fact, which was mentioned at the beginning of this note, that the producer prices in the United States are "managed" prices and hence less sensitive to fluctuations in supply and demand than the prices on the London Metal Exchange.

Table II (contd)

	Stocks (in thousands of metric tons)				
United States	1 075	1 072	1 071	1 065	1 064
Non-United States 3/	2 060	2 091	2 133	2 241	2 314
Total	3 135	3 163	3 204	3 306	3 378
		Prices			
London Exchange					
Current pounds per long ton	1 208	1 207	1 201	1 192	1 181
1973 pounds per long ton 4/	925	924	920	913	904
United States producer prices					
Current dollars per lb	0.98	0.98	0.98	0.98	0.97
1973 dollars per lb 5/	0.70	0.70	0.70	0.70	0.69

Notes:

1/ In the absence of exploitation of the sea-bed.

2/ See table I.

3/ Excluding socialist countries.

4/ Corrected by the United Kingdom wholesale price index.

5/ Corrected by the United States wholesale price index.

The foregoing figures make it clear that a possible exploitation of the sea-bed would have only a very mild impact on the copper market: the copper from the sea-bed would at most account for 2 per cent of total mine production and 1 per cent of total consumption in the non-socialist world. It should be stressed that the volume of copper from the sea-bed is well below the annual fluctuations of mining output around the mean.

23. In these circumstances it is not surprising that the impact of sea-bed exploitation on mine production, consumption, stocks and prices should be very slight. If the high assumption is compared with the base situation, it will be seen that such exploitation would cause mine production on land to diminish by 0.7 per cent (almost half the reduction being borne by Canada and the United States) and total mine production (including that on the sea-bed) to increase by 1.2 per cent.

Total copper consumption in the non-socialist world would increase by 0.4 per cent in response to the decline in prices caused by the increase in supply, and that decline would attain 2.2 per cent on the London Metal Exchange and 1 per cent in the case of United States producer prices. Since the increase in consumption would not completely offset the increase in production, the level of stocks in the non-socialist world would rise by 7.8 per cent.

III. Effects of exploitation of the sea-bed on copper exports from developing countries

24. Copper is a very important source of export earnings for the developing countries which, as we have seen above, accounts for about 40 per cent of the world's mine production of copper (socialist countries excluded.) These earnings averaged \$2,800 million a year in 1969-1970, the last two years for which detailed figures are known. This being so, any working of the sea-bed, although likely to have only a very limited impact, in relative value terms, on the copper market, could lead to a reduction in earnings that would be far from negligible in absolute terms. In part III of this report we shall try to estimate the likely order of magnitude of that reduction.

25. The preparation of this estimate entailed making a number of further assumptions which are presented below.

26. In the first place, it was assumed that in 1980 the developing countries' share in mine production on land outside Canada, the United States and the socialist countries would be at the average level recorded in 1969-1970, or 78 per cent. Since the model shows different growth rates of production for the United States, Canada and the rest of the non-socialist world (see paragraph 15 and table II), the mine production of the developing countries would under these conditions account in 1980 for about 50 per cent of that of the non-socialist world, as against 40 per cent in 1969-1970.

27. Total exports of copper from the developing countries (including those countries' trade with one another) accounted for 95 per cent of their copper production in 1969-1970, and it was assumed that this would also be so in 1980. This is tantamount to assuming that the consumption of copper in the developing countries which produce it would increase at the same rate as their production, namely by an average of 5 per cent a year.

28. In order to estimate the earnings from the developing countries' copper exports on the various assumptions made in this note with regard to sea-bed exploitation, it remains to set a unit value on such exports. In response to several factors - which sometimes work in opposite directions - these unit values differ from the prices prevailing on the London Metal Exchange. The first point to note is that these prices relate to refined metal, whereas the developing countries export blisters and ores as well as metal, as shown in the table below. Again, the London Exchange prices quoted c.i.f. include insurance and freight, whereas unit values expressed f.o.b. do not. Lastly, the value of exported ores depends on their content not only of copper but also of other metals such as silver.

Table III

Copper exports from developing countries
Annual average, 1969-1970

	Quantity (thousands of metric tons of copper content)	Value (millions of US$)	Unit value (US$ per metric ton of copper content f.o.b.)
Ores	282.0	290.2	1 029
Blisters	640.3	814.6	1 272
Refined copper	1 264.1	1 676.0	1 326
Total	2 186.4	2 780.8	1 272

Sources: National statistics.

29. The average price of copper on the London Exchange in 1969-1970 was $1,440 per metric ton, so the ratio of the average unit value of the developing countries' copper exports to this average price was 0.88. In the absence of more precise information it was assumed that this ratio would prevail in 1980, although it may be thought that the developing countries will seek to refine an increasing proportion of the copper they export. On the basis of these assumptions and the results given by the model, the following table can be established.

30. The above figures confirm that the impact of any sea-bed exploitation on the copper export earnings of developing countries would be relatively slight. As already noted, the difference in the amount of these earnings between the high assumption and the situation of no sea-bed exploitation is less than the annual fluctuation in those earnings, for it represents only 3 per cent of the total. In absolute value, however, the reduction is appreciable since, again on the high assumption, it amounts to 79 million 1973 pounds or, at the average 1973 rate of exchange, $194 million. On the basis of the figures given in the study on manganese already mentioned 1/, this sum represents about five times the reduction in manganese export earnings which, on the high assumption, sea-bed exploitation would inflict on the developing countries. It should be stressed, however, that in the case of manganese the reduction in export earnings would represent about 40 per cent of the total which those earnings would attain in the absence of sea-bed exploitation. This over-simplified comparison illustrates the difficulty of making any comprehensive analysis of the effects which the mining of metals on the sea-bed would have on the foreign exchange earnings of developing countries; furthermore such an analysis would also have to take into account the characteristics peculair to simultaneous production of the four metals under consideration.

31. It will also be noted that the reduction in the copper export earnings of the developing countries represents more than 60 per cent of the value of the copper extracted from the sea-bed. Although, as already stated, it is still far from clear what such production would cost, it seems hardly likely that the profits from the sale of such copper would offset the loss incurred by the developing countries which export the metal.

1/ The effects of production of manganese from the sea-bed (TD/B/483).

Table IV

Earnings of developing countries from copper exports in 1980 on various assumptions about sea-bed exploitation

	Base situation	Low assumption	Medium-low assumption	Medium-high assumption	High assumption
Price on London Exchange (current £s per metric ton)	1 189	1 188	1 182	1 173	1 162
Price on London Exchange (1973 £s per metric ton)	910	909	905	899	890
Unit value of developing countries' exports (current £s per metric ton of copper content)	1 046	1 045	1 040	1 032	1 022
Unit value of developing countries' exports (1973 £s per metric ton of copper content)	801	800	796	791	783
Mine production of developing countries (thousands of metric tons of copper content)	3 609	3 606	3 604	3 594	3 586
Exports from developing countries (thousands of metric tons of copper content)	3 429	3 426	3 424	3 414	3 407
For reference: sea-bed production (thousands of metric tons of copper content)	0	14	42	99	141
Copper export earnings of developing countries 1/ (millions of current £s)	3 587	3 580	3 561	3 523	3 482
Copper export earnings of developing countries 1/ (millions of 1973 £s)	2 747	2 741	2 726	2 700	2 668
Reduction in copper export earnings of developing countries resulting from sea-bed exploitation (millions of 1973 £s)	0	6	21	47	79
For reference: value of sea-bed production (millions of 1973 £s)	0	13	38	89	125

1/ Gross export earnings: export content before deduction of profits accruing to parent companies.

Sources: Table II (see notes thereon).

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THE IMPACT OF COBALT PRODUCTION FROM THE SEA-BED

A review of present empirical knowledge
and preliminary appraisal

by

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Note: This report was prepared at the request of the UNCTAD secretariat to provide an initial assessment of the economic impact of the production of cobalt from the sea-bed on the world market for cobalt and on the export earnings of the developing countries. This request was made in pursuance of Conference resolution 51(III), inviting the Secretary-General of UNCTAD "to continue to study the measures necessary to avoid the adverse economic effects which the exploitation of the sea-bed ... may have on the prices of minerals exported primarily by developing countries ...". The views expressed in this study do not necessarily reflect those of the UNCTAD secretariat.

The terminology used in this study is that of the author.

The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the secretariat concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

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CONTENTS

I. INTRODUCTION

1. The vast potential of the resources available on the ocean floor has only recently been recognized and so far has scarcely been touched. With the discovery of the sea-bed's mineral resources and the development of the complex technology to exploit them, the time is fast approaching when such materials will reach world markets. Plans must be made to develop these resources economically and with the desired impact on quantities consumed, price, and earnings of developing countries. In order to plan the development of these resources and to manage their exploitation and marketing, information about the structure and responsiveness of markets is essential. The potential impact of new supplies under alternative development schemes must be evaluated.

2. Cobalt may be the metal most affected, in comparison to other non-ferrous metals, by the development of sea-bed mineral supplies.1/ Metal nodules found on the sea-bed would be exploited primarily for their content of copper and nickel. While much depends on the precise characteristics of the nodules mined, they appear generally also to contain cobalt and in proportions which are larger than the proportion of cobalt to copper or nickel in world consumption. This means that the quantities of by-product cobalt would be large in relationship to the total cobalt market even if only modest quantities of copper or nickel, relative to total copper and nickel consumption, were drawn from the ocean floor. The sensitivity of the cobalt market to new supplies, the potential impact on price, consumption and other sources of production, are thus important considerations in determining production plans, marketing policy, and related issues.

3. This paper reviews available empirical information on the cobalt market and applies the data in the form of a simple econometric model in order to make empirical estimates of market behaviour and sensitivity. The material forms the basis for some preliminary estimates of the impact of new supplies of cobalt from the exploitation of the ocean floor on the world market for cobalt. These calculations assume the continued applicability of the behavioural patterns observed during recent years as new cobalt production is developed. However, massive new cobalt supplies may induce changes in these relationships and may call for simulation studies using technological data as well as econometric estimates.

1/ United Nations, "Possible Impact of Sea-bed Mineral Production ...", A/AC.138/36 (mimeo, 28 May 1971), p.57.

II. STRUCTURE OF THE COBALT MARKET

4. The impact of new cobalt production from the ocean floor must be appraised in the light of the structure of demand, supply and price determination in the cobalt market. This section surveys the relevant characteristics of the cobalt industry. While this discussion focuses on recent trends and the current situation, it needs to be supplemented with an evaluation of the probable market organization and behaviour as new supplies from the ocean floor become available.1/

Demand

5. Cobalt is a minor but important alloying metal used because of its heat resistant, magnetic and chemical properties in a considerable variety of industrial products. In the 1960s cobalt consumption grew at an annual rate of approximately 6-1/2 per cent.

6. As is shown in Table I, United States consumption2/ of cobalt is accounted for approximately as to 70 per cent by metallic uses and as to 30 per cent by non-metallic uses and salts.

7. High temperature alloys account for approximately 25 per cent of United States consumption. The so-called cobalt super alloys are particularly suitable for use in jet engines, in rotor blades, afterburners, and similar parts. Cobalt contributes strength and corrosion resistance at high temperatures.3/ In these alloys, there appears to be only a limited possibility to substitute other metals, particularly nickel, for cobalt. For certain temperature ranges, new technology has developed nickel-based alloys with performance characteristics approximately similar to those of cobalt alloys, but there remain applications where cobalt alloys are superior. The required physical characteristics determine the alloy used in these applications "but as the price of cobalt increases there may be some substitution between high nickel content alloys and high cobalt content alloys."4/ And similarly there is likely to be scope for expanding the use of cobalt, perhaps to a considerably larger extent, at lower prices.

1/ Some possibilities in this regard are considered in section VII below.

2/ Data on consumption by use in other countries must be secured from scattered national sources. Data regarding United States consumption from the US Bureau of Mines give a detailed breakdown of the varied applications of cobalt.

3/ For a discussion of cobalt alloys see Centre d'Information du Cobalt, Cobalt Monograph, Brussels, 1960, also, Burrows, Cobalt: An Industry Analysis, Lexington, Massachusetts, 1971.

4/ Burrows, op.cit., p.61.

8. The second most important application of cobalt is in the permanent magnets which account for 17 per cent of United States consumption. Cobalt has exceptional magnetic properties in commbination with various other metals, in Alnico magnets used in loudspeakers, motors and generators, for example.1/ In these products the use of cobalt has ceased to expand as ceramics tend to be substituted for cobalt.2/ Since the late 1950s ceramic magnets have increasingly cut into the market for cobalt-based magnets in applications where their properties are acceptable. Since the raw materials for the ceramic magnets are inexpensive, there is little chance that much of this market would be recovered for cobalt, even at considerably lower prices.

9. Cobalt serves a variety of other uses, each of which accounts for a small share of total cobalt consumption.3/ The use of cobalt in steel alloys has been growing. Cobalt improves the characteristics of "high speed" cutting tool steels and has come into use in other high strength steel alloys. The disadvantage of cobalt has been its high cost. This has limited its use principally to aircraft and the space programmes, in tools, and in special parts where strength and dimensional stability are essential. In the long run, at a significantly lower price, cobalt could perhaps find a large market as a substitute for other non-ferrous metals. Other uses of metallic cobalt, for example in cemented cutting tools and welding rods, reflect the characteristics of cobalt in limited specialized applications and are not likely to offer larger new markets.

10. Cobalt salts are among the most effective dryers known.4/ Their use in paints and varnishes is important but is not likely to be price elastic, since cobalt salts account for a very small proportion of the value of the final product. Similarly, there is little price sensitivity in cobalt as a diet supplement for cattle, a use which is growing rapidly. There is some evidence of flexibility in the use of cobalt for electroplating. During the 1969 nickel strike, when nickel was in short supply, cobalt was substituted for nickel in electroplating; now that nickel is plentiful, cobalt plating has apparently ceased. While it appears that cobalt has certain advantages over nickel, there is some question as to its resistance to corrosion. If this disadvantage can be overcome at lower prices relative to nickel, cobalt may be competitive in electroplating.5/

1/ Cobalt Monograph, op.cit., and F.A. Nesbitt, "Magnetic, Electrical, and Electronic Applications", in R.S. Young, Cobalt, New York, 1960.

2/ New technical developments - magnets of rare earth and cobalt and cobalt-ferric oxide magnetic tapes - promise some limited new markets. Engineering and Mining Journal, March 1972, pp.159-160.

3/ For a discussion of other metallic uses of cobalt see Burrows, op.cit., pp.78-92.

4/ Cobalt Monograph, op.cit.

5/ Burrows, op.cit., pp.85-86. Burrows estimates a potential market of 7.5 million pounds in the United States.

TABLE I

UNITED STATES CONSUMPTION BY END USES 1964 AND 1969
(thousands of lb)

	1969	(%)	1964	(%)
High speed steel	570	3.7	305	2.9
Other steel	360	2.3	717	6.7
Permanent magnet alloys	2,560	16.6	2,210	20.8
Cast super alloys	3,675	23.9	2,798	26.3
Alloy hard facing	302	2.0	801	7.5
Cemented carbides	666	4.3	431	4.0
Other metallic	1,147	7.5	853	8.0
Total metallic (inc. not specified)	11,021	71.6	8,015	75.3
Ground coat frit	133	0.9	599	5.6
Pigments	191	1.2	209	2.0
Catalysts, other non-metallic	1,385	9.0	548	5.1
Total non-metallic	1,709	11.1	1,356	12.7
Salts, dryers, lacquers, varnishes, paints, pigments, feed (est.)	2,660	17.3	1,279	12.0
Total	15,390	100.0	10,650	100.0

Source: US Bureau of Mines, Minerals Yearbook.

11. Cobalt has come into increasing use as a catalyst in the desulphurization of petroleum and coal. This is a rapidly growing use but not one which is likely to be highly price sensitive. The use of cobalt in desulphurization catalysts depends principally on the construction of desulphurization plants.1/ The catalyst can apparently be reprocessed after use. The potentials of cobalt catalysts in afterburners for automotive exhaust gases are being considered.2/ This use could open a large new market if the desired technical performance can be attained and if cobalt is sufficiently low in cost. The cobalt content of the catalyst would account for only a small amount per vehicle, but in view of the large number of cars on the road and the need to replace the catalyst after some period of use the automotive market could account for a substantial and growing demand.

12. By and large, the use of cobalt is based on its special characteristics: heat resistance, magnetism and some special chemical qualities. Consequently, cobalt consumption can be expected to grow in line with the expansion of the principal end uses, except when technological substitutions occur. It follows also that the price elasticity of cobalt is likely to be relatively low within the recent range of prices. Empirical estimates of the demand and activity elasticities of the cobalt market will be discussed below. Little is known about market prospects for cobalt at altogether different prices, a possibility which should be considered further on the basis of economic and engineering information.

Supply

13. A little over half of the cobalt supply originates with one producer, the UMHK-SGB.3/ Production by UMHK and other producers is summarized in Table II. Despite the nationalization of the UMHK mines in 1967, SGB continues to carry out producing and marketing functions. UMHK-SGB produces cobalt as well as other metals copper, zinc, cadmium, and silver, largely from open pit mining operations in Zaire. While much of UMHK cobalt is produced in conjunction with the mining of copper, cobalt does not appear to be strictly speaking, a by-product. The deposits vary in cobalt content and it is possible to produce additional cobalt bearing ores without comparable increases in copper output.4/ In the past, the ratio of output of copper to cobalt in UMHK mines has varied from year to year. Cobalt recovery is also largely independent of the reduction of copper.

14. In contrast to the UMHK operation in Zaire, almost all other sources of cobalt are by-product operations.5/ The second largest producer, Rhokana Corp. Ltd. in Zambia is primarily a producer of copper. Cobalt produced in Canada is a by-product of nickel mining. In the United States, cobalt mines were viable only with Government support. United States production is minimal at present after a period

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1/ Conversation with Mr. Crockett, Sun Oil Company, Philadelphia, Pennsylvania.

2/ Conversation with Mr. Caplan, General Motors Corporation, Detroit, Michigan.

3/ Union Minière du Haut-Katanga and its parent company Société Générale de Minerais de Belgique. For discussion of market structure see Burrows, op.cit., chapter 2.

4/ Burrows, op.cit., p.20.

5/ Production in Morocco at Bou-Azzer was mined primarily for its cobalt content but production declined sharply in 1970 as economic reserves are being exhausted.

TABLE II

PRODUCTION OF COBALT BY COUNTRY, 1969 AND 1964

(thousands of lb. -- mine output, cobalt content)

	1969	(%)	Rate of change 1964-1969 (% p.a.)	1964	(%)
Canada	3,256 b/	(8.1)	5.0 b/	3,185	(9.1)
Zambia	3,994	(10.0)	12.9	1,426	(4.1)
Zaire	23,360	(58.3)	6.5	17,062	(48.8)
Morocco	3,108	(7.8)	-3.5	3,700	(10.6)
Cuba	3,400	(8.5)	16.3	1,600	(4.6)
US	*			*	
Other	2,920	(7.3)	-22.3	7,989	(22.8)
Total (excluding USSR) a/	40,038	(100.0)	4.2	34,962	(100.0)

Source: Bureau of Mines, Minerals Yearbook.

* Not available, but known to be very small.

a/ This report deals entirely with non-USSR production and consumption. In 1969 USSR production was 3,300,000 lb.

b/ 1969 production in Canada was about 20 per cent below normal because of strikes; rate of change is for 1964-1968.

of growth and then decline during the 1950s and 1960s, with high price Government purchase contracts. The amount of cobalt reaching the market as a by-product of new mining operations is difficult to predict. Some new cobalt production as a by-product of newly developed nickel plants in Canada and Japan is not expected until the second half of the 1970s. Cobalt production depends partly on the price of cobalt since it has generally taken costly technology to process new by-product sources of cobalt. The prospects for cobalt production from the ocean floor are not yet known,1/ nor can stockpile disposal policies of the General Services Administration (GSA) be predicted.

Industrial organization and price determination

15. Industrial organization and price determination cannot be considered independently of supply in the cobalt market. Owing to the domination of supply sources by one major producer, UMHK-SGB, the price and production decision of this firm have a major influence on the overall market. UMHK-SGB does not control production outside its own mines. Indeed, it would be difficult to limit production since cobalt is largely a by-product of other mining activities. On the other hand, there are only a small number of major producers. Moreover, production of raw cobalt ores is not sufficient for successful entry into the market since complex and costly cobalt refining facilities must be available. The major cobalt producers have their own refining facilities and apparently also refine cobalt for less important producers. This means that the supply of refined cobalt is in the hands of the major producing firms.

16. In this setting, there are limited possibilities for price determination. It is not likely that the traditional mechanism for price determination in competitive markets, which ultimately depends on cost considerations, applies. In view of the small number of producers and the domination of UMHK-SGB, it is reasonable to assume a system of profit maximization by the suppliers. This can take the form of joint profit maximization, given the needs of the market, shipments from government stockpiles, and the elasticity of demand. Or alternatively, since suppliers outside Zaire are scattered and principally by-product producers, it may be assumed that prices are set by UMHK-SGB, which seeks to maximize its profit and takes into consideration not only the demand for cobalt but also the supplies from other sources. Previous investigations of the characteristics of price determination in the cobalt market have tended to confirm the latter hypothesis.2/

1/ In our discussion below we have made use of estimates presented in "Possible Impact ...", op.cit.

2/ Burrows, op.cit., chapter 8.

III. EMPIRICAL MODEL OF THE COBALT MARKET

17. There is a growing body of econometric studies and formal models of commodity markets 1/ but, so far, only very limited empirical work has been carried out on cobalt. The econometric model by Burrows 2/ is the only systematic empirical investigation of the industry. Starting with the Burrows model, the present study has reestimated and, in important ways, modified the equation system to make it more useful for the present purpose. This section considers the structure of the revised cobalt model and appraises its properties.

18. The structure of commodity market models must be linked closely to the institutional, technical, and theoretical considerations which determine the nature of the market mechanism which applies. Moreover, the model is constrained not only by the limited availability of data but also by uncertain knowledge of how the commodity market actually operates.

19. Models of commodity markets have broadly taken two very different forms:

(a) Market models - where production decisions are largely related to prices without direct recognition of quantities desired by consumers and where price is determined by reconciliation of supply and demand. The most typical models of this kind apply to markets for agricultural commodities, such as the market for natural rubber where there are a fairly large number of independent buyers and sellers.

(b) Industry models - where production is directly attuned by the producers to estimated market needs and where prices are set by producers on the basis of the mark-up over cost or profit maximization. While these models typically apply to manufactured products, they may in some cases apply to raw materials as well.

20. As the discussion of the characteristics of the cobalt market suggests, UMHK-SGB appears to have played the role of dominant producer and, at least implicitly, of price setter. In effect, UMHK-SGB appears to determine its cobalt production with a direct eye to estimated market requirements and to establish prices with a view to profit maximization. A model reflecting this type of behaviour falls more into the category of an "industry" model than that of a "market" model. The up-dated cobalt model takes this into consideration.

21. The model structure falls into three broad categories:

(a) Demand - Demand for cobalt by principal use categories depends on activity in the industries where cobalt serves as an input, the price of cobalt, and the price of alternative non-ferrous metals. The impact of technological change on the rate of use must be considered in specific applications.

1/ See, for example, L.R. Klein, ed.: Essays in Industrial Econometrics, Vols. I-III.

2/ Burrows, op.cit.

(b) Supply - Production by producers other than UMHK-SGB in principle may depend on the production of metals with which production of cobalt is associated as a by-product. However, the expansion of cobalt production in the world has been influenced to a large extent by the rate of development of new non-ferrous metal mining and ore reduction technology, so that production outside Zaire is difficult to explain in substantive terms. The production by UMHK-SGB is best explained as meeting market requirements after allowing for supplies available from other sources.

(c) Price determination - The price determination equation follows Burrows.1/ It assumes that UMHK-SGB sets a market price in relation to demand less alternative supplies. Such a formulation has been justified as representing profit maximization by UMHK-SGB, the dominant cobalt producer.

22. New econometric estimates for the cobalt market have been prepared. The new calculations follow the spirit of the original Burrows study but there are important differences. The estimates are for broad aggregates and represent a preliminary step toward a detailed econometric description of the interrelated markets for cobalt and other non-ferrous metals. The model is a system of four demand equations, one price determination equation, one behavioural supply equation for production outside Zaire, and one supply identity. The latter clears the market by adjusting UMHK-SGB output to market requirements at the established price. The model presented here is considerably less detailed on the United States demand side than the Burrows model, although probably not at the expense of accuracy. 2/ On the other hand, Burrows does not present equations for foreign demand, which accounts for a large and growing share - about two-thirds in recent years - of world consumption, nor does he deal explicitly with UMHK-SGB production behaviour. Despite the simplicity of the new estimates, they provide important information of the properties of the cobalt market and a framework for the present calculations. The results are discussed and compared with the Burrows estimates below.

Demand for cobalt

23. Demand for cobalt has been estimated for three use categories in the United States and in the aggregate for the world outside the United States for the period 1955 to 1970. Extensive data collection from national sources will be necessary to obtain reliable cobalt consumption statistics, by use, for countries other than the United States.

24. The demand functions reflect considerable empirical experimentation. We sought the most effective yet easily predictable activity variables to determine the operation of industries consuming cobalt. We hoped to find significant and accurate estimates for the price elasticity for cobalt and to determine, if possible, if there are non-linearities in the price effect. Finally, we hoped to measure the impact of the prices of competitive non-ferrous metals on the demand for cobalt.

1/ Burrows, op.cit.

2/ The three end use categories formed by combining components of the Bureau of Mines consumption breakdown are sufficient to capture the different characteristics of the end uses in which cobalt is consumed at present.

25. The equations have been framed in a double log format where the coefficients may be interpreted directly as elasticities. Alternative lags have been tested with the notion that responses to price are not likely to be immediate. However, to retain sufficiently long time series, lags in the equations used have been limited to a three year period at the maximum. Technological developments necessary for substitution among non-ferrous metals may involve very long and possibly irregular lags for which empirical estimates cannot be obtained on the data available. The demand equations obtained are as follows: 1/

(1)
$$\text{Log CMHS} = \underset{(4.99)}{1.1454} \text{ Log INUS} - \underset{(2.07)}{.8822} \text{ Log W3PC}$$
$$- \underset{(2.73)}{.4106} \text{ Log IMA} + \underset{(1.40)}{.1527} \text{ NSDUM}$$
$$- \underset{(2.73)}{2.1987}$$

$$R^2 = .6853 \quad SE = .0821 \quad DW = 2.3040$$

(2)
$$\text{Log COS} = \underset{(8.92)}{1.0839} \text{ Log INUS} - \underset{(2.45)}{.2253} \text{ Log W3PC}$$
$$+ \underset{(4.05)}{.4525} \text{ Log W3PN} - \underset{(6.83)}{4.1658}$$

$$R^2 = .9636 \quad SE = .0664 \quad DW = 2.1111$$

(3)
$$\text{Log CEH} = \underset{(6.62)}{1.0888} \text{ Log INUS} - \underset{(3.58)}{.5375} \text{ Log W3PC}$$
$$- \underset{(4.48)}{3.6571}$$

$$R^2 = .9049 \quad SE = .1121 \quad DW = 2.1160$$

(4)
$$\text{Log CTUS} = \underset{(6.06)}{1.0821} \text{ Log INUS} - \underset{(1.53)}{.5055} \text{ Log W3PC}$$
$$- \underset{(1.60)}{0.1867} \text{ Log IMA} + \underset{(1.17)}{.0991} \text{ NSDUM}$$
$$- \underset{(3.13)}{1.9572}$$

$$R^2 = .9051 \quad SE = .0637 \quad DW = 2.3971$$

(5)
$$\text{Log CNUS} = \underset{(6.51)}{1.0775} \text{ Log} \left[\frac{1}{6} \text{ INJA} + \frac{5}{6} \text{ INEUK} \right]$$
$$- \underset{(1.40)}{.3078} \text{ Log W3PC} - \underset{(2.32)}{2.1503}$$

1/ The values of t are shown in parentheses under the regression coefficients. $\bar{R}^2$ is the adjusted coefficient of determination; SE is the standard error of estimate, DW is the Durbin-Watson statistic.

R^2 = .8964 SE = .1404 DW = 1.8446

where:

- CMHS = United States consumption of cobalt in magnets, high temperature alloys, tool steel and cutting and wear resistant alloys, millions of lb.
- INUS = United States gross national product originating in durable manufacturing, billions of 1958 dollars
- PC = Deflated market price per lb of cobalt, $ price deflated by United States wholesale price index for metal and metal products
- W3 = Distributed lag weights; t = 1/6, t - 1 = 1/3, t - 2 = 1/3, t - 3 = 1/6
- DMA = Magnet demand shift dummy to take account of the introduction of ceramic magnets
- NSDUM = Dummy for the nickel strike in 1969 and 1970
- COS = United States consumption of cobalt in salts and driers and in other non-metallic uses, millions of lb.
- PN = $ price of nickel deflated by United States wholesale price index for metal and metal products
- CEH = United States consumption of cobalt in hard facing rods and residual uses, millions of lb.
- CTUS = United States demand for cobalt, millions of lb., CMHS + COS + CEH
- CNUS = Demand for cobalt outside the United States, millions of lb.
- INJA = Index of industrial production in Japan
- INEUK = Index of industrial production for members of the [then] European Economic Community and the United Kingdom.

26. The threefold categorization of cobalt uses appears adequate for the United States. Equation (1) deals with consumption in metallic uses, in specialized alloys such as those for high temperature alloys and magnets. The elasticity with respect to activity in the manufacture of durables is a little greater than one. The elasticity with respect to the price of cobalt is .88. A trended dummy variable accounts for the technological substitution of ceramic for metallic magnets from 1958 to 1965. It was not possible to find a substitution price elasticity with respect to the price of other non-ferrous metals. However, there appears to have been a response to the shortages of nickel during the strike period, 1969 and 1970, and this is captured with another dummy variable. This effect reflects not only shortages but also a drastically changed price relation between nickel and cobalt. On one hand, it is well to remember that the change was entirely a temporary phenomenon, and the response may be smaller than would occur if the price relation between the two metals were drastically changed over the long term. On the other hand, the use of cobalt in place of nickel may have reflected outright shortages of nickel which would not persist in the long run.

27. Equation (2) deals with the demand for cobalt in non-metallic uses and in salts and dryers. The elasticity with respect to activity is again somewhat above unity. The price elasticity with respect to cobalt is quite low, .23, but in this equation there is a significant cross elasticity with respect to the price of nickel of .45. This elasticity may reflect at least in part the substitution of cobalt for nickel for electroplating during the nickel strike period. Together the two price elasticities indicate that a 1 per cent change in the cobalt price affects cobalt consumption by 0.7 per cent.

28. The remaining use categories are less likely to show important price responses. In fact, demand equation (3) indicates a **significant** elasticity of .54 with respect to the price of cobalt but no substitution elasticities were found to be significant. Equation (4) which is not used in the model, explains aggregate demand for cobalt in the United States. As one would expect, the elasticities are approximately weighted averages of those observed for the more detailed categories. The elasticity with respect to durables output is 1.08 and the elasticity with respect to cobalt price is 0.51, and there is a dummy for the period of nickel supply shortages. These results appear to be reasonably firm for the range of cobalt and substitute prices observed. While the demand elasticity for cobalt with respect to price varies among the consuming categories, on the average it is quite low and there appear to be only limited substitution elasticities. 1/

29. The consumption data for the world outside of the United States are less robust than the material used for the United States demand equations. The results are nevertheless reasonably comparable. Cobalt consumption is linked to real economic activity (industrial production) in Japan and Europe with an elasticity of 1.08. The price elasticity is lower even than in the United States at 0.31. No substitution effects were apparent.

30. In no case was it possible to find a non-linear price effect except for the NSDUM dummy, which accounts for the nickel industry strike and attendant supply shortages and price shifts. It is possible that higher price elasticities would appear if the price of cobalt were radically different with respect to other non-ferrous metals than in the sample period for a persistent period of time. Moreover, Burrows has emphasized the possibility of induced technical change which would link cobalt use to price but only after long and irregular lags as new applications await the development of new technology. 2/ The price elasticities of our computations are compared with the Burrows estimates in Table III.

1/ It is interesting to note that in a study by Charles River Associates of the nickel market, cobalt appears as a substitute for nickel only in the equation for high temperature and electrical resistance alloys. While the overall elasticity of nickel consumption with respect to the cobalt price is only 0.043, this works out to be an elasticity near unity in terms of cobalt consumption since the cobalt market is so much smaller than the nickel market. See Charles River Associates, Economic Analysis of the Nickel Market, mimeo, Boston, 1968.

2/ Burrows, op.cit., p. 98. Burrows suggests an entirely arbitrary adjustment of -0.5 in the price elasticity for such effects. But there is no basis in the data for such a figure.

31. In general the new estimates are comparable to those obtained by Burrows. The measured price elasticities are substantially below unity in all cases. Our estimates are somewhat lower than those of Burrows but it is difficult to make a clear comparison because of the allowance for nickel supply shortages or nickel price in our equations which yield somewhat higher effective elasticities than the price coefficients alone.

32. These estimates do not catch the full potential impact of new technological applications induced by price particularly at relative prices very different from those encountered in the sample period. This must be emphasized when these calculations are used for making long term projection under changed conditions.

Supply of cobalt

33. Burrows considers the supply of cobalt from producers outside the Congo and from government stockpiles as exogenous. There has been no prior empirical work on cobalt supply. A number of experimental calculations were carried out to estimate a supply function. These involved the hypothesis that cobalt production outside Zaire is largely a by-product of the production of other non-ferrous minerals which moved closely with the business cycle. The possibility that production would respond to price was also considered in view of the fact that cobalt bearing mine residues are not exploited unless the price of cobalt justified the cost of reducing the residues. These formulations were not successful, however. Since the supply response to price is an important consideration detailed regressions for each of the principal supplying areas were carried out. The coefficient of price was significant and positive only in the case of Canada (an elasticity of approximately unity on lagged price) which accounts for only a modest share of total non-Zaire production. This is not conclusive evidence. In fact, price is likely to influence the development of supplies in the long run. But the development of production in the various minor producing countries has been very erratic and frequently depends on special circumstances. In the future, it appears that the expansion of cobalt production outside Zaire will be related to the growth of other non-ferrous mining and to the development of ore reducing technology. A linear time trend - a linear trend proved better than a semi log trend - approximates expansion of the production of cobalt outside Zaire. There is a dummy variable to allow for the temporary stimulus to production in the United States as a result of the Government's purchase contracts. In alternative projections, assumed cobalt production from the sea-bed was added to other production from outside Zaire.

34. For Zaire itself, it is possible to estimate a supply equation relating supply to price. But the underlying theory of price determination which has been used here suggests a price equation based on demand side considerations and a supply process where UMHK-SGB adjusts its output to market requirements. A conventional supply equation was estimated but it proved to behave erratically in model simulations so that it was not used.

TABLE III

LONG RUN PRICE ELASTICITIES FOR COBALT IN THE UNITED STATES

End use	Burrows estimate[a]	New estimate[b]
High temperature alloys	-0.37	
Cutting tool alloys	-0.69	
Magnets	-0.92	-0.88
High speed steel	-0.86	
Other steel alloys	-3.10	
Salts and dryers	-0.54	-.23
Other non-metallic	-1.90	
Cemented carbides	-0.63	
Hard facing materials	-0.46	-.54
Other uses	n.a.	
Total	-0.86[c]	-0.51

a/ Burrows, op.cit., p. 97.

b/ Not inclusive of effect of NSDUM a nickel price effect. For salts and dryers and other non-metallic uses this changes the elasticity to -.7.

c/ Not inclusive of "other uses."

35. Supplies from government stockpiles are exogenous. In the forecast period neither stockpile purchases nor sales have been assumed. The supply equations are:

(5) $$\underset{(4.08)}{NCON = 4.0688\ USSUP} + \underset{(6.25)}{.6551\ TIM} + \underset{(1.47)}{3.0426}$$

$\bar{R}^2 = .7356 \quad SE = 1.0484 \quad DW = 1.4424$

(6) $CON = CT - NCON.$

Where:

NCON = Production of cobalt outside Zaire, millions of lb.

USSUP = Dummy for United States support for cobalt producers in United States

TIM = Time trend, 1947 = 1

CON = Production of cobalt in Zaire, millions of lb.

CT = CTUS + CNUS + GOVT

GOVT = Purchases (+) or disposals (-) by United States General Services Administration, millions of lb.

<u>Price determination</u>

36. The price determination equation is based on the theory of profit maximization by the dominant producer. This approach, as proposed by Burrows, 1/ assumes demand for UMHK-SGB cobalt,

$$CON = CT - NCON \qquad (A.1)$$

where $CT = AP^{\beta} Y^{\gamma} + GOVT \qquad (A.2)$

i.e. industrial consumption is a log function of price and activity. Suppose an arbitrary cost function is assumed,

$$C = f\ (CON). \qquad (A.3)$$

The profit identity is

$$\pi = P * CON - C. \qquad (A.4)$$

Profit maximization implies

$$\frac{\partial \pi}{\partial CON} = P + CON \frac{\partial P}{\partial CON} - f'\ (CON) = 0. \qquad (A.5)$$

1/ The derivation of a similar function is presented in Burrows, <u>op.cit.</u>, pp. 137-139.

This can be transformed to a price function as follows:[1]

$$\frac{1}{FC} = \left(\frac{1}{k} + \frac{1}{\alpha k}\right) + \frac{1}{\alpha k}\left(\frac{GOVT}{CT}\right) + \frac{1}{\alpha k}\left(\frac{NCON}{CT}\right) \qquad (A.6)$$

where $k = f'(CON)$.

This functional form, allowing the coefficients to be freely estimated by regression, corresponds roughly to the Burrows formulation. It has been used in this analysis.

The price equation estimated is as follows:

$$\frac{1}{FC} = \underset{(1.24)}{.1843}\,\frac{NCON}{CT} - \underset{(4.25)}{.3688}\,\frac{GOVT}{CT} - \underset{(7.48)}{.0975}\,PODUM + \underset{(9.04)}{.5888} \qquad (7)$$

$\bar{R}^2 = .913$ SE = .0188 DW = 1.324

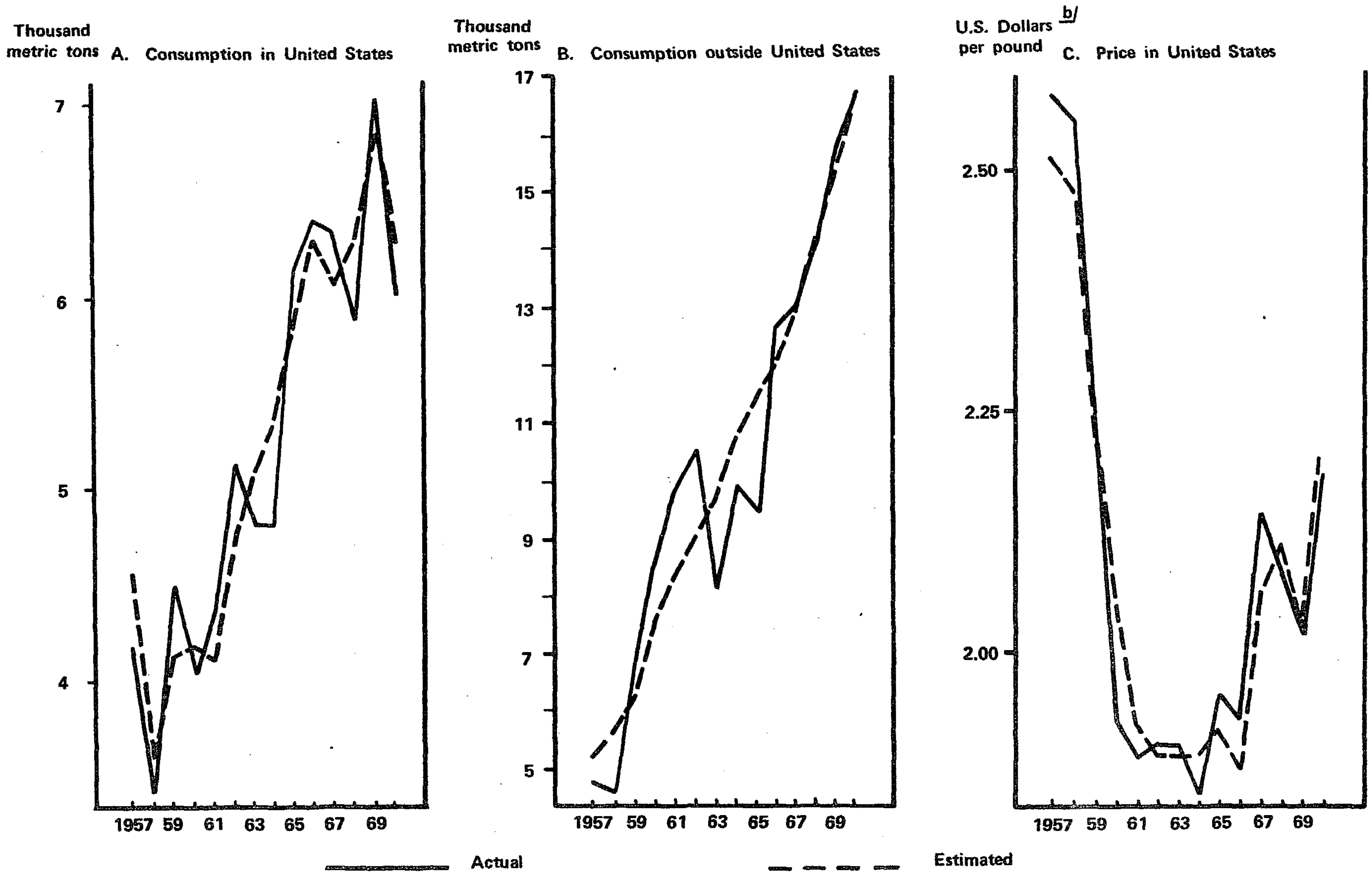
where PODUM is a dummy variable for the effect of political turmoil on UMHK-SGB operations in the country of production.

37. The reasoning which supports this equation is similar to that of Burrows, discussed above, but the equation may also be justified as an empirically based approximation of the behaviour of UMHK-SGB over the sample period. From this point of view it was compared with other forms of price determination and supply equations. While it was possible to obtain single equation estimates for a straightforward supply equation, for example, the estimates were considerably less precise then and caused serious difficulty in the simulation of the entire equation system. One may see the equations used here simply as an approximation of the fact that UMHK-SGB sets the price in the light of demand and alternative supplies, [2] and that its behaviour with regard to quantity must be consistent with its price decisions. No doubt, in large part because supply arrangements are maintained with regular customers, the output of UMHK-SGB is directly adjusted to its estimate of market requirements.

1/ The derivation of a similar function is presented in Burrows, op.cit., pp. 137-139.

2/ One problem with the profit maximization approach is that it requires a demand elasticity for cobalt from the Congo of less than -1.0, in order to fulfil the assumption $\frac{\partial \pi}{\partial CON} = 0.0$ Burrows argues that the long run elasticity is more negative than his empirical estimates show because of induced long run shifts in technology. Similar arguments must be made to support the reestimated equation presented here since the direct estimates of the elasticities are between 0 and -1.

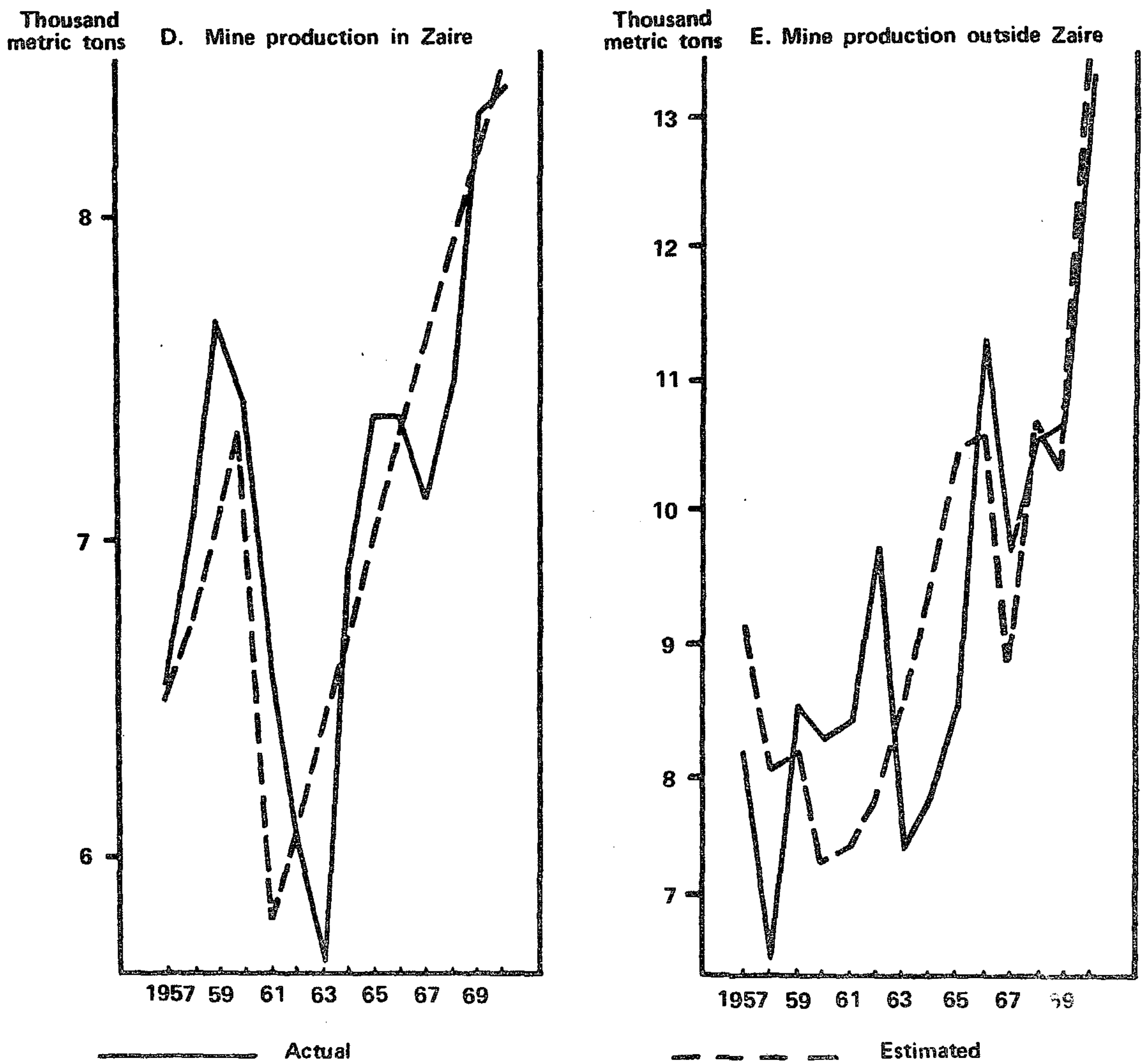
CHART 1 COBALT CONSUMPTION, PRODUCTION AND PRICE : ACTUAL AND ESTIMATED [a], 1957-1970



Source : F. Gerard Adams, The impact of cobalt production from the ocean floor, University of Pennsylvania, 1972

a/ Estimates are derived from simulation of econometric model. b/ At 1970 prices

CHART 1 (cont.)


Thousand metric tons
D. Mine production in Zaire
8
7
6
1957 59 61 63 65 67 69
Thousand metric tons
E. Mine production outside Zaire
13
12
11
10
9
8
7
1957 59 61 63 65 67 69
Actual
Estimated

IV. PROPERTIES OF THE COBALT MODEL

38. The cobalt model has been simulated over the period 1957-1970 in order to check its behaviour as a system of equations. This is a dynamic simulation starting with lagged values prior to 1957 and introducing only values for the exogenous variables during the simulation period. The mean errors - root mean square error (RMSE) and mean absolute percent error (MAPE) - for the principal variables are summarized in Table IV. Chart I compares the actual and the predicted values of the principal model variables.

39. The estimated values of cobalt consumption in the United States are quite satisfactory, as are the price estimates. Consumption outside the United States is forecast with a substantial error, in part because of the aggregation and because of deficiencies in the underlying data. Production outside Zaire, which has been explained by little more than a time trend, retains a substantial error. Consequently there is also substantial error variance in the estimates for production in Zaire which, as noted above, serves in this system as the residual source of supply. The responses of this system to exogenous developments are summarized in Table V.

40. The impact on the price of additional cobalt production outside Zaire is modest, approximately a reduction of 1c per lb for each million pounds of production. This result occurs because the increase in production outside Zaire is almost entirely offset by a cutback in production in that country.

41. Additional industrial activity, an increase of 1 per cent, raises demand by approximately 1 per cent since there is little impact through the price.

42. The effect of the price of nickel is quite small, since the nickel price only appears in the equation for salts and dryers and other non-metallic uses. The impact of a shortage of nickel supply, which was accompanied by a high price, is more pronounced.

43. The responses of the model reflect behavioural properties over the sample period. Substantial changes in industry structure would probably imply different behaviour.

TABLE IV

SIMULATION ERRORS OF PRINCIPAL COBALT
MODEL VARIABLES, 1957-1970

Variable	RMSE	MAPE (%)
United States consumption (millions of lb)	.66	5.60
Consumption in rest of world (millions of lb)	2.31	10.1
Cobalt price ($/lb)	.046	2.27
Production outside Zaire (millions of lb)	.90	4.47
Production in Zaire (millions of lb)	2.53	11.7

TABLE V

RESPONSES OF MODEL TO EXOGENOUS DEVELOPMENTS[a/]

1.	Additional production of cobalt outside Zaire	Effect on price (1970 $ per lb)
	+ 1 million lb	-.01
	+ 10 million lb	-.08
2.	Change in industrial activity	Effect on consumption (millions of lbs)
	1% increase in industrial activity	.4
3.	Price of nickel relative to cobalt	Effect on consumption (millions of lbs)
	Change in price of nickel by $1 per lb	.2
	Nickel shortage (NSDUM = 1.0)	1.2

a/ All effects have been estimated for 1965.

V. FORECAST TO 1980

44. A forecast to 1980 has been prepared using the estimated equation system. This forecast is intended only to provide an approximation of the magnitudes of the cobalt market which can be expected and it serves as a base solution which alternative may be compared. The exogenous assumptions which go into this forward estimate are based on probable trends and they are tentative. The dependence of the forecast on the underlying assumptions must be emphasized.

45. The exogenous assumptions which go into this forecast are summarized as follows:

(a) Industrial activity has been predicted on the basis of growth trends projected by the OECD, 1/ Wharton Long Term model prediction for the United States, 2/ and judgments concerning current business developments throughout the world. It has been assumed that production will be back on its normal growth trend by 1975. Trend growth rates assumed for industrial output are 10 per cent per annum for Japan and 5 per cent per annum for Western Europe. The forecast for durable manufacturing GNP for the United States averages at a growth rate of 4 per cent per annum.

(b) Government stockpile sales or purchases have been assumed at zero throughout the forecast period. 3/

(c) Price adjustments due to the devaluation of the US dollar have been made on the assumption that the $8\frac{1}{2}$ per cent devaluation of the dollar in terms of gold is governing. This means that the effect of the devaluation is to raise the United States price of cobalt in dollars by $8\frac{1}{2}$ per cent and to produce an approximate 4 per cent reduction in the price abroad. This assumption is in accord with recent developments. 4/

(d) The price of nickel has been assumed constant in real terms near its recent level (a price in 1970 dollars of $1.33 per lb).

(e) Production of cobalt outside Zaire is estimated by equation (6), but for the forecast period this equation represents simply a linear time trend. The principal dimensions of this forecast for 1975 and 1980 are summarized in Table VI. Given the rapid growth of industrial output as world economies are assumed to return to their

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1/ OECD, The Outlook for Growth, Paris, 1970.

2/ Wharton EFA Inc.

3/ However, the GSA carried out substantial sales during the first two months of 1972. See Engineering and Mining Journal, March 1972, p.17.

4/ The recent increase in the United States price of cobalt appears to reflect the devaluation. It may also follow from lower cobalt production outside Zaire than had been expected for 1971.

TABLE VI

BASE FORECAST OF COBALT MODEL, 1972-1980[a/]

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
					(millions of lbs)						
United States consumption	13.4	13.3	14.6	15.5	15.6	16.5	17.8	18.7	19.6	20.1	20.9
Consumption outside United States	37.3	38.2	40.4	44.6	48.7	52.4	56.4	60.7	65.3	70.4	75.9
Total consumption	50.7	51.5	55.0	60.1	64.3	68.9	74.2	79.4	85.0	90.6	96.8
Production outside Zaire[c/]	18.7	19.4	20.1	20.7	21.4	22.0	22.7	23.4	24.0	24.7	25.3
Production in the Congo	29.5	31.2	34.9	39.4	42.9	46.9	51.5	56.1	61.0	65.9	71.5
					1970 dollars per lb[b/]						
Price	2.20	2.25	2.48	2.50	2.51	2.52	2.53	2.54	2.55	2.56	2.57

a/ Figures for 1970 are actuals; figures for 1971 are model estimates; forward numbers are model forecasts.

b/ Beginning in 1972, the foreign price is assumed to be 12 per cent below the United States price as a result of dollar devaluation.

c/ Approximately 15 per cent of production outside Zaire has been coming from developed countries. The statistics do not permit a reliable apportionment of future output between developing and developed countries.

long-term growth trends, it is not surprising that this forecast expects a fairly rapid expansion of cobalt consumption. Total consumption increases at an annual rate of 4.6 per cent in the United States and 7.4 per cent in the rest of the world, to reach almost 70 million in 1975 and approximately 97 million pounds in 1980. This demand projection appears reasonable in the light of recent trends. It is, however, considerably higher than in earlier United Nations documents. 1/

46. The supply estimates match demand by definition. The forecast for the production from sources outside Zaire is quite arbitrary since it is based on the linear trend observed in the sample period. Production outside Zaire rises from 18.7 million pounds in 1970 to 25.3 million pounds in 1980 but over the same period supplies from Zaire show much more growth. In this equation system somewhat greater production from sources outside Zaire would be partially offset by a reduction in Zaire's output but as is apparent from the analysis of the model's response properties greater output from sources outside Zaire would also result in somewhat lower price.

47. The price forecast is for substantial price stability after the devaluation adjustment between 1971 and 1972. The price of 1972 is 10 per cent higher than in 1971. Of this increase $8\frac{1}{2}$ per cent represents an adjustment for dollar devaluation. In subsequent years the forecast shows price increase in 1970 dollars at a rate of approximately 0.5 per cent per year.

Demand estimates on alternative price assumptions

48. In order to evaluate demand prospects on the assumption of alternative prices of cobalt, the price equation of the system was exogenized and the equations were used to estimate demand given the price of cobalt. The estimates for 1975 and 1980 on alternative price assumptions are summarized in Table VII. These estimates compare

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1/ The United Nations study ("Possible Impact...," op.cit., p.56) projects a total market for cobalt of 80 million lb in 1980.

The OECD projections of world industrial growth call for somewhat more rapid growth in the period 1970 to 1980 than in the previous decade. To test the impact of somewhat slower growth on the cobalt market, an alternative forecast was made on the assumption that industrial activity would expand 1 percentage point less rapidly in the United States and in Western Europe and 2 percentage points less rapidly in Japan. This calculation showed the following results for 1975 and 1980:

	1975	1980
	(millions of lb)	
Total consumption	65.1	84.3
Production outside Zaire	22.0	25.3
Production in Zaire	43.0	59.0
	1970 $ per lb	
Price	2.51	2.54

with the base forecast (at prices of $2.52 in 1975 and $2.57 per lb in 1980) of 68.9 million lb in 1975 and 96.8 million lb in 1980. While, as has been noted earlier, the overall demand elasticities are quite low, the range of possible prices considered here is large, from 50 per cent above the prevailing price to 50 per cent below the prevailing price, and consequently the impact on the quantity of cobalt consumed in 1980 is substantial, ranging from 83.2 million pounds for the high price estimate to 127.0 million pounds for the low price estimate. In each of these alternatives it is assumed that nickel prices remain near their current level and that the nickel shortage dummy, NSDUM, does not apply.

49. It is conceptually possible to evaluate demand at still lower cobalt prices. This exercise has not, however, been undertaken in this study since it is doubtful that the same substitution relationships would prevail as those embodied in the equations estimated over the sample period. While it was not possible to find non-linearities in the price response - in terms of logarithms - it is probable that persistent extremely low levels of the cobalt price in comparison to those of other non-ferrous metals would reveal use possibilities which have not been previously considered. This raises the possibility of considerably greater long-term elasticities, but only in a price range different from that observed during the same period. 1/

1/ Needless to say it would not be possible to investigate this question statistically with sample period data. A technological study of cobalt utilization possibilities may provide such information which may be used in simulation studies. An illustrative calculation is presented in section VII below.

TABLE VII

DEMAND ESTIMATES UNDER ALTERNATIVE PRICE ASSUMPTIONS

Cobalt price 1970 $ per lb[a/]	(millions of lb) 1975	1980
3.84	58.6	83.2
3.20	62.8	89.0
2.55	68.4	96.8
1.92	76.5	108.2
1.28	90.2	127.1

a/ Adjusted for devaluation; the foreign price is assumed to be 12 per cent below United States price.

VI. ECONOMETRIC MODEL ESTIMATES OF THE IMPACT OF THE PRODUCTION OF COBALT FROM THE SEA-BED

50. Forecast simulations assuming alternative patterns of production of cobalt from the sea-bed have been carried out to 1975 and 1980. These calculations assume the persistence of behaviour patterns observed in the sample period. This is particularly important to note with regard to the price and production behaviour of UMHK-SGB. As was noted earlier, this firm has set the price with an eye to profit maximization and has adjusted production accordingly, in the process "making room" for new supplies originating outside Zaire. It is reasonable to assume that, short of a dramatic revision of the market, UMHK-SGB would continue this price policy. 1/

51. Three alternative possibilities of production from the sea-bed have been considered. The material relating to the prospects for such production presented in the United Nations document 2/ has been used as a base. That document assumes that each mining operation would produce 1 million tons of dry nodules per year with an assumed cobalt content of 0.3 per cent 3/ and a recovery factor in metal separation of 96 per cent. Each mining operation would produce 279,000 tons of manganese, 14,400 tons of nickel, 14,100 tons of copper, and 2,880 tons of cobalt. The economic justification for such operations would depend primarily on the value of the manganese and copper produced. Three alternatives were considered:

(i) Low alternative: One mining operation beginning production at reduced scale in 1975 and at full scale in 1976.

(ii) Medium alternative: One mining operation beginning production in 1975 at reduced rate and building up to three mining operations operating at full scale in 1980.

(iii) High alternative: One mining operation beginning full scale production in 1974 and building up to seven mining operations at full scale in 1980.

The production assumed from sea-bed mining operations under the various alternatives is summarized in Table VIII.

52. Forecasts incorporating these assumptions regarding production from the sea-bed are summarized in Table IX. These predictions assume the equation system as outlined above and they assume the same exogenous inputs, other than the addition of production from the sea-bed as the base forecast.

53. These calculations show that additional cobalt supplies from the sea-bed would not drastically reduce the cobalt price, given the type of market behaviour which has been observed in the 1950s and 1960s. The minimum production assumption yields a stable cobalt price to 1980, compared to a slight price increase in the base solution. The medium assumption shows a slight decline in the cobalt price, and the high assumption shows a decline of approximately 10 per cent in the cobalt price as the production from the sea-bed is assumed to increase to 7 mining operations producing 44 million pounds in 1980.

1/ The possibility of alternative profit maximizing policies of UMHK-SGB is considered further below.

2/ "Possible Impact ...," op. cit.

3/ However, it now appears that some Pacific nodule deposits have a higher cobalt content, as much as 2 or 3 per cent.

54. On the other hand, production of cobalt from new sources would quite substantially change the pattern of earnings among the producing countries. Production in Zaire would be held back substantially in favour of production from other sources. In comparison to production of 71.5 million pounds in Zaire and 25.3 million pounds elsewhere in 1980, the medium assumption would show 54.4 million pounds from Zaire and 44.4 million pounds from other sources. The high assumption would result in a considerably more drastic redistribution of production and revenues from Zaire to producers in other regions. If production from the sea-bed is to be in the hands of developed countries, the share of production originating in the developing countries differs greatly from one alternative to another. As an example, it is assumed that production of developed countries represents 15 per cent of production outside Zaire (excl. sea-bed production). In 1980, developed countries would be producing 10.1 million pounds, 22.8 million pounds and 48.2 million pounds on the minimum, medium,

TABLE VIII

ASSUMED SEA-BED PRODUCTION OF COBALT

(millions of lb)

	1974[a/]	1975	1976	1977	1978	1979	1980
Low alternative	-	3.2	6.3	6.3	6.3	6.3	6.3
Medium alternative	-	3.2	6.3	9.5	12.7	15.9	19.0
High alternative	6.3	12.7	19.0	25.4	31.7	38.1	44.4

a/ No sea-bed production assumed before 1974.

and high assumptions respectively. Production from the developing countries, including Zaire, would amount to 87.5 million pounds, 75.9 million pounds and 53.1 million pounds, respectively. The base forecast without any sea-bed production shows production of approximately 3.8 million pounds from developed countries and 93.0 million pounds from developing countries including Zaire in 1980.

55. Approximate estimates of the gross revenues available to the various sources in 1970 dollars are shown in Table X. Gross revenues of Zaire are lower in each case than in the base solution. If the same rough assumptions are made about production from developed and developing countries as above, gross revenues in 1980 (1970 dollars) would be $220.5 million, $183.6 million, and $119.5 million for developing countries (incl. Zaire) and $25.5 million, $55.2 million, $108.4 million for developed countries for the minimum, medium, and high alternatives respectively. The base forecast shows gross revenues of developed countries at $9.0 million and $239.0 million for developing countries. These gross figures do not allow for costs or for royalty and tax payments.

TABLE IX

FORECASTS WITH ALTERNATIVE ESTIMATES OF SEA-BED PRODUCTION

	1974	1975	1976	1977	1978	1979	1980
Minimum assumption							
Price (1970 $ per lb) a/	2.51	2.48	2.47	2.48	2.49	2.51	2.52
Total consumption (millions of lb)	64.3	69.0	74.5	80.0	85.8	91.5	97.7
Production outside Zaire (millions of lb)	21.4	22.0	22.7	23.4	24.1	24.7	25.3
Production in Zaire (millions of lb)	42.9	43.8	45.5	50.3	55.4	60.4	66.0
Production from sea-bed (millions of lb)	-	3.2	6.3	6.3	6.3	6.3	6.3
Medium assumption							
Price (1970 $ per lb) a/	2.51	2.48	2.47	2.44	2.43	2.43	2.42
Total consumption (millions of lb)	64.3	69.0	74.5	80.1	86.0	92.1	98.7
Production outside Zaire (millions of lb)	21.4	22.0	22.7	23.4	24.0	24.6	25.3
Production in Zaire (millions of lb)	42.9	43.8	45.5	47.2	49.3	51.5	54.4
Production from sea-bed (millions of lb)	-	3.2	6.3	9.5	12.7	15.9	19.0
High assumption							
Price (1970 $ per lb) a/	2.43	2.38	2.34	2.30	2.28	2.26	2.25
Total consumption (millions of lb)	64.4	69.5	75.5	81.5	87.9	94.3	101.3
Production outside Zaire (millions of lb)	21.4	22.0	22.8	23.4	24.0	24.6	25.3
Production in Zaire (millions of lb)	36.7	34.7	33.7	32.8	32.1	31.5	31.6
Production from sea-bed (millions of lb)	6.3	12.7	19.0	25.4	31.7	38.1	44.4
Base forecast							
Price (1970 $ per lb) a/	2.51	2.52	2.53	2.55	2.56	2.56	2.57
Total consumption (millions of lb)	64.3	68.9	74.2	79.4	85.0	90.6	96.8
Production outside Zaire (millions of lb)	21.4	22.0	22.7	23.4	24.0	24.7	25.3
Production in Zaire (millions of lb)	42.9	46.9	51.5	56.1	61.0	65.9	71.5
Production from sea-bed (millions of lb)	-	-	-	-	-	-	-

a/ Foreign price is 12 per cent below US price to allow for dollar devaluation.

TABLE X

ESTIMATED GROSS REVENUES FROM SALES OF COBALT[a]
(millions of 1970 dollars)

		1975	1980
Minimum assumption:	Zaire	108.6	166.3
	Sea-bed	7.9	15.9
	Other sources	54.6	63.8
Medium assumption:	Zaire	108.6	131.6
	Sea-bed	7.9	46.0
	Other sources	54.6	61.2
High assumption:	Zaire	82.6	71.1
	Sea-bed	30.2	99.9
	Other sources	52.4	56.9
Base forecast:	Zaire	118.2	183.8
	Sea-bed	-	-
	Other sources	55.4	65.0

a/ In 1970 US dollars at US prices; calculation based on US price.

56. The explanation for the relatively stable character of cobalt prices despite the development of new production lies largely in the price and production behaviour of UMHK-SGB. The model assumes that UMHK-SGB will continue their behaviour, which sets the price in accord with demand and supply from alternative sources and which determines production to clear the market at that price. While price behaviour allows for some reduction in price as supplies from alternative sources reach the market, and consequently for some response on the demand side as well, the bulk of the adjustment falls on UMHK-SGB. This has been the pattern of operation observed during the sample period on which the model is based. It is reasonable to assume a continuation of such behaviour on the part of UMHK-SGB as long as its growth and revenues are not drastically impaired. This would appear to be the case for the minimum and medium assumptions. Even in the case of the medium assumption, Zaire accounts for over 50 per cent of total cobalt production in 1980. It is important to recognize, however, that the high assumption implies a gradual decline in UMHK-SGB production from a peak of 39.4 million pounds in 1973 and a much lower ratio of Zaire's production to the total production. This may suggest a change in the mechanism of price formation. The higher the production rate from the sea-bed, the greater the structural changes which may be expected with regard to price determination and demand and supply elasticities.

VII. POTENTIAL CHANGES IN MARKET STRUCTURE

57. As new cobalt supplies from the ocean floor become available in large quantities, the cobalt market may undergo changes.

58. The extent to which the structure of the market may alter depends primarily on the quantity of the new cobalt supply and on the responses of cobalt demand and of production from conventional sources. The time scheduling of new production, market conditions at the time when new production becomes available, the marketing arrangement for cobalt produced from the sea-bed, and long-term expectations with regard to this new source will also influence prospective developments. Only the broadest evaluation of alternative possibilities can be made, on the basis of the empirical and quantitative materials available at this time.

59. The effects will be very different in the case of modest additions of cobalt production from the sea-bed stretched over a fairly long period, as compared to the case where massive new production reaches the market over a short time span.

60. The case where production from the sea-bed represents a relatively small addition to cobalt output may be called the minimum impact case. The minimum and medium assumptions of sea-bed production made above represent this type of situation. It is probable that in these circumstances, the basic pattern of market behaviour observed during the past 15 years would be continued. Even over this past period, the market adapted to an inflow of new supplies from sources outside Zaire. As the market grew, part of the expansion was supplied from these new sources. The price setting behaviour of UMHK-SGB may continue approximately as in the past. While new production can be expected to have a depressing effect on the price of cobalt, it is probable in this case that prices would remain in the range observed during the 1950s and 1960s as projected in the base forecast. The demand and supply equations estimated over the sample period would continue to be valid approximations. In this case, the econometric calculations above, based on a sample period of recent years, should give valid information concerning probable developments.

61. The case of massive production from the sea-bed - what may be called the maximum impact case - leads to an altogether more speculative analysis. It pre-supposes that the inflows of new cobalt production from the ocean floor will be of such magnitude that significant changes would result in demand, supply, and price formation. The results of the "high" assumption regarding sea-bed production begin to suggest probable changes in market behaviour as production of UMHK-SGB is cut back. Still larger output from the sea-bed would cause a considerable reorganization of the cobalt market. Few of the elements of empirical information from the sample period would continue to apply. Behavioural patterns themselves may be expected to change, or the variables, price for example, would be carried to values well outside the range observed during the sample period. In this case, simulation studies require new theoretical formulations of market structure and must make use of engineering data. Such an analysis is beyond the scope of this paper. But it will consider briefly how a model may be modified to take these changes into account and we will present an example of such a calculation.

62. The principal areas where changes in the operation and structure of the market may occur are:

(a) Demand: As the price of cobalt drops in relation to that of other non-ferrous metals, there is likely to be increasing substitution. At present price relationships, cobalt is purchased for its special metallurgical or chemical characteristics. At lower prices, it may replace nickel on the strength of more ordinary qualities. The possibilities for substitution are very great - the market for nickel in the United States is about 30 times as large as the market for cobalt. Engineering information is essential to gauge to what extent cobalt could invade markets for other metals if its price declined substantially. It is not unreasonable to suppose that the price of nickel would be an effective price floor for cobalt, since it may be possible to replace nickel with cobalt in many applications. Increasing substitution of cobalt for other non-ferrous metals would, moreover, intensify the interrelationships among non-ferrous metal markets and require simultaneous study of the various competing metal markets.

(b) Supply: Prices observed in the post-war period have justified the production of cobalt and the refining of cobalt bearing mine residues in Zaire and elsewhere. In the United States, however, cobalt production has been economic only with government support. Engineering information is needed to determine costs of production and probable supplies at altogether different prices from various sources. Whether present cobalt refining ventures would be extended or even continued depends on cost, i.e. whether the price obtained justifies the marginal cost of cobalt production and refining.

(c) Price determination: Price determination depends not only on the size of new production ventures but also on the régime of price and supply determination used. As major new supplies reach the market, the role of UMHK-SGB may change drastically. But it is not clear whether this would mean a turn to competitive price determination or whether formal or informal production agreements would limit the flow of supplies reaching the market in order to maintain desired price levels. Theoretical analysis is necessary to explore the implications of the possible alternatives. Simulation studies could investigate the effect of alternative regulatory schemes.

An illustrative calculation

63. In order to illustrate the possibilities of simulation outside the scope of a model based on past data, some consumption estimates are given below using assumed demand elasticities. This calculation is analogous to the demand estimates on alternative price assumptions presented in section V above.

64. On the basis of available empirical evidence an elasticity of 1.0 has been used with respect to economic activity. For prices near those observed in the sample period, it was proposed to use a price elasticity approximately in accord with that observed in the past. But it was hypothesized that the elasticity would increase as the price of cobalt dropped with respect to the price of nickel, opening up the much larger nickel market for cobalt. At a cobalt price equal to (or a little below) the price of nickel, it was assumed that the two metals would be practically interchangeable, so that a very large or infinite demand elasticity for cobalt could be assumed. Such a relationship was obtained with the following relation between the elasticity and nickel and cobalt prices:

$$(7) \quad \left(\frac{\partial CT}{\partial PC} \cdot \frac{PC}{CT}\right) = \frac{1}{\sigma - \frac{PC}{PN}}$$

A value of .8 has arbitrarily been assumed here for δ to yield a high elasticity (5.0) but not infinity when the price of cobalt equals the price of nickel.

65. No attempt to model the supply side or to explain the mechanism of price determination is included. These calculations are intended to illustrate the absorptive capacity of the cobalt market on alternative price assumptions. The calculation is presented only for 1980, on the supposition that over the period until then the adaptation of cobalt use to the assumed price level will have taken place. The exogenous assumptions for industrial growth are the same as for the base forecast solution. The price of nickel has been assumed at $1.37 per lb (1970 dollars). The results of this calculation are summarized in Table XI. At a price corresponding to the forecast solution ($2.57 per lb), consumption is almost 90 million pounds in 1980, somewhat less than the earlier estimate. It should be stressed that this is entirely due to the assumptions made concerning the coefficients (particularly the elasticity with respect to industrial activity of 1.0) and the assumed price of nickel. At a cobalt price of $2.00, world consumption would be 118 million pounds. As the price drops closer to the price of nickel, the elasticity increases so that demand expands very sharply at lower prices. In this calculation, on the basis of the assumed δ coefficient of .8, all possible cobalt consumption would be absorbed by the market if the price of cobalt were eight-tenths the price of nickel. While this is unrealistic, it illustrates the notion that the nickel price may provide a floor below which ultimately the price of cobalt is not likely to fall.

TABLE XI

1980 COBALT CONSUMPTION SIMULATION
ILLUSTRATION BASED ON ASSUMED COEFFICIENTS

Cobalt price a/ (1970 $ per lb)	Cobalt consumption b/ (millions of lb)
2.70	85.1
2.60	87.3
2.50	90.6
2.40	94.2
2.30	98.3
2.20	102.9
2.10	109.8
2.00	117.7
1.90	127.0
1.80	139.7
1.70	158.2
1.60	188.1
1.50	243.0
1.40	380.8
1.30	1,219.6

a/ Nickel price has been assumed at $1.37 per lb.

b/ Approximate computer calculation using interpolation of line segments.

66. The above example may be extended to include an alternative approach to output and price determination. As has been indicated, there is no assurance that UMHK-SGB would adhere to its past price behaviour under radically different conditions. For example, suppose that UMHK-SGB maintained its output over the decade as shown in the base forecast (an annual rate of growth of 9.2 per cent) irrespective of the quantity produced from the sea-bed. In that case, total cobalt output in 1980 would be 141 million pounds on the high assumption regarding sea-bed production. Calculated roughly on the basis of Table VII, the price would fall to around $1.00 per pound, and gross receipts to UMHK-SGB would be about $71 million. Alternatively, suppose the elasticity declines as the relative price of cobalt falls, as in the illustration above; on the basis of Table XI the price would then be approximately $1.80 per pound and gross revenues to UMHK-SBG would amount to approximately $129 million. In this case, a policy of continuing to produce regardless of sea-bed production would yield significantly greater gross revenue for the company than a policy of cutting back output. The greater the likelihood of a significant decline in the price elasticity, as in the illustration, the greater would be the incentive for UMHK-SGB to adopt another production policy.

67. These calculations are entirely artificial. They serve only to illustrate the possibility of simulating cobalt demand and pricing on the basis of assumed relationships if the market situation changes drastically. The validity of such simulations depends on the realism of the assumptions regarding behaviour and coefficients used. They should be based on the best economic and engineering information available. At a cobalt price close to the price of nickel, the computation is extremely sensitive to the nickel price assumed, and of course the nickel price itself is not independent of what happens on the cobalt market. These considerations suggest the need to construct one simultaneous model system for competitive non-ferrous metal markets.

VIII. CONCLUSION

68. This paper has considered the behavioural characteristics of the cobalt market in order to evaluate the potential impact of the exploitation of the cobalt resources of the ocean floor. The analysis of an econometric model of the market showed that the principal producer established the price in relation to demand and to supplies from alternative sources. This type of adaptive behaviour, if continued, would limit the impact of new production on the price. Econometric estimates suggest that, without new production from the sea-bed, consumption of cobalt would be 96.8 million pounds in 1980 at a price of $2.57 (1970 $ per lb.). In 1980, the "minimum" hypothesis regarding sea-bed production (one mining operation) indicates a consumption of 97.7 million pounds at $2.52 per lb. The medium alternative (three mining operations) suggests consumption of 98.7 million pounds at $2.42 per lb. A substantial redistribution of revenues would result, since production in Zaire would be cut back to allow for production from the ocean floor. The high alternative (seven mining operations) projects cobalt consumption of 101.3 million pounds in 1980 at a price of $2.25 per lb. but it is probable that market structure and behaviour would be significantly changed in consequence of high levels of cobalt production from the ocean floor. The paper suggests the need to supplement econometric estimates with theoretical analysis and simulation based on engineering data in order to investigate price and production situations very different from those observed in the sample period.

STATISTICAL APPENDIX[a/]

	Consumption				
	United States				Non-US
	CMHS	COS	CEH	CTUS	CNUS
1949	2.879	0.849	0.974	4.702	4.221
1950	5.470	1.146	1.667	8.283	3.771
1951	7.625	0.879	1.429	9.933	6.329
1952	8.927	0.744	1.147	10.818	7.958
1953	8.247	1.037	1.464	10.748	7.362
1954	5.215	0.928	1.207	7.350	9.953
1955	6.749	1.209	1.782	9.740	9.013
1956	6.589	1.104	1.869	9.562	13.703
1957	6.432	1.100	1.526	9.157	10.981
1958	4.930	1.101	1.421	7.542	10.555
1959	6.094	1.385	2.420	9.899	15.835
1960	5.202	1.450	2.278	8.930	19.461
1961	5.630	1.354	2.612	9.596	22.341
1962	7.215	1.446	2.607	11.268	23.689
1963	6.031	1.808	2.690	10.529	18.458
1964	5.898	1.827	2.925	10.650	22.144
1965	7.358	2.359	3.878	13.595	21.305
1966	7.866	2.200	4.139	14.205	28.514
1967	7.257	2.281	4.438	13.976	29.225
1968	6.865	2.576	3.557	12.998	31.672
1969	8.552	3.086	3.970	15.608	35.260
1970	6.625	3.025	3.717	13.367	37.298

a/ For definitions and units of the variables see the text, paras 25 and 35. Owing to revisions of data and differences in sources, the data in this appendix may not match certain data in the text.

	Activity variables		
	United States INUS	Japan INJA	Europe INEUK
1949	50.492	27.000	58.334
1950	60.785	33.000	64.978
1951	68.955	46.000	71.483
1952	71.460	50.000	71.414
1953	79.144	60.000	76.127
1954	71.169	66.000	82.414
1955	80.689	70.000	89.989
1956	79.430	86.000	94.494
1957	79.612	102.000	98.425
1958	69.634	100.000	100.000
1959	79.940	120.000	105.644
1960	80.965	150.000	115.218
1961	79.726	179.000	121.724
1962	89.955	194.000	126.586
1963	95.616	213.000	132.517
1964	102.395	250.000	141.517
1965	114.825	262.000	146.804
1966	125.055	293.000	152.310
1967	123.937	350.000	154.241
1968	131.794	413.000	165.815
1969	135.844	482.000	179.114
1970	127.902	560.000	188.000

	Supply and prices				
	Production		Stockpile purchases (+) disposals (-)	Price	
	Zaire	Non-Zaire		Cobalt	Nickel
	CON	NCON	GOVT	PC	PN
1949	9.600	2.720	3.397	2.551	0.580
1950	11.300	4.520	3.766	2.476	0.616
1951	12.600	5.920	2.258	2.682	0.667
1952	15.100	7.320	3.644	2.963	0.698
1953	18.300	7.020	7.210	2.907	0.716
1954	19.000	10.320	12.017	3.084	0.717
1955	18.900	11.430	11.577	2.889	0.717
1956	20.000	12.930	9.665	2.638	0.666
1957	17.900	14.430	12.192	2.036	0.742
1958	14.300	15.620	11.823	2.018	0.747
1959	18.600	17.030	9.896	1.749	0.731
1960	18.100	16.430	6.139	1.520	0.731
1961	18.400	14.640	1.103	1.490	0.771
1962	21.300	13.530	-0.127	1.500	0.799
1963	16.300	12.500	-0.187	1.499	0.789
1964	16.900	15.300	-0.594	1.459	0.768
1965	18.500	16.400	0.0	1.542	0.744
1966	24.900	16.300	-1.519	1.524	0.729
1967	21.400	15.800	-6.001	1.688	0.801
1968	23.300	16.600	-4.770	1.646	0.836
1969	23.400	18.400	-9.068	2.140	2.690
1970	29.500	18.700	-2.465	1.720	1.008

UNITED NATIONS

THIRD CONFERENCE
ON THE LAW OF THE SEA

PROVISIONAL

For participants only

A/CONF.62/C.1/SR.1
15 July 1974
ENGLISH
ORIGINAL: FRENCH

Second Session

FIRST COMMITTEE

PROVISIONAL SUMMARY RECORD OF THE FIRST MEETING

Held at the Parque Central, Caracas,
on Wednesday, 10 July 1974, at 10.40 a.m.

Chairman: Mr. ENGO United Republic of Cameroon

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Corrections to this record should be submitted in one of the four working languages (English, French, Russian or Spanish), preferably in the same language as the text to which they refer. Corrections should be sent in quadruplicate within five working days to the Chief, Documents Control, Room 9, Nivel Lecuna, Edificio Arauco, and also incorporated in one copy of the record.

AS THIS RECORD WAS DISTRIBUTED ON 15 JULY 1974, THE TIME-LIMIT FOR CORRECTIONS WILL BE 22 JULY 1974.

The co-operation of participants in strictly observing this time-limit would be greatly appreciated.

ORGANIZATION OF WORK

The CHAIRMAN* said that the Caracas meeting was the culmination of a long and arduous effort that had fostered an awareness of the multidimensional importance of the oceans to mankind and of the magnitude and complexity of the problems of their utilization. In the past some attempts at regulation and organization had been made, but had met with little or no success. In recent years, however, a considerable number of new countries had appeared on the scene and they had exerted revolutionary pressures on the existing order, which they had not helped to establish and whose rules they did not always accept, as witnessed by the increasingly frequent disputes over fishing, the unilateral extension of territorial waters and specialized jurisdictions, all symptoms of the need to alter the legal framework governing the oceans.

The task of the Conference, and more particularly of the First Committee, was therefore to build a new legal order for the oceans, pragmatic and durable enough to harmonize diverse interests, while taking account of the wider realities of history. The Committee must legislate for posterity, adopting treaty articles that could withstand inevitably changing times. The Conference was fortunate in being equipped with a number of new conceptual elements, and the First Committee would have as its working base the Declaration of Principles governing the sea-bed and the ocean floor and the subsoil thereof beyond the limits of national jurisdiction; it should also take account of the concept that the area and its resources constituted the common heritage of mankind, which transcended the inherent opposition between the doctrines of res nullius and res communis. That, together with the plan to establish an international régime and machinery to ensure the "orderly and safe development and rational management of the area and its resources" for the benefit of "mankind as a whole", offered a number of new approaches that promised to halt and reverse the descent into chaos. More specifically, the issues to be dealt with related to the status, scope and basic provisions of the régime to be established based on the Declaration of Principles, and the status, scope, functions and powers of the international machinery.

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* The full text of the statement made by the Chairman will be issued as document A/CONF.62/C.1/L.1

Each State or group of States was the best judge of its own needs, interests and priorities. It was therefore important to listen to others and to be heard by them, for there could be no true spirit of compromise without an understanding of what truly hurt others. In international relations it was becoming obvious that economic, political or numerical threats were no longer effective, and that was another important reason for trying to reconcile conflicting views born of the divergency of interests and needs. Every delegation should therefore be imbued with a sense of its responsibility towards its own country and also towards the international community as a whole.

Turning to the question of the organization of the work of the Committee, he said that the Conference had only 36 working days left to conclude its work. During that period, the First Committee must negotiate treaty articles and have them included in a larger framework to be submitted for adoption by the Conference as an integral part of the convention on the law of the sea. He therefore appealed to representatives not to waste time on procedural matters and, in organizing their work, to allow sufficient latitude to modify and adapt current positions to future requirements.

He also requested representatives to be fully aware of the nature and complexity of the task entrusted to the Committee. The Preparatory Committee had been able to do no more than assemble widely divergent views in a set of documents, while the task of the First Committee was to negotiate in order to reconcile divergent views and then to draft the actual provisions of a convention. He stressed the fact that the Committee had not only to take political and economic decisions, but to provide the juridical background for the convention as a whole.

In connexion with the organization of the work of the Committee, he said that, after consulting with members of the General Committee and geographical groups, he wished to make certain proposals. From those consultations it was clear that it would be prudent to start with a brief period of debate in which representatives would not only merely reiterate their national position, but would comment on fundamental issues, the resolution of which would facilitate a consensus on the main points of disagreement, and in particular would try to eliminate the list of alternatives that appeared in the documents of the Preparatory Committee. He proposed that the debate should open that same day, that it should be limited to one week, that the list of speakers should be closed on 12 July at 5 p.m., and that statements should be restricted to no more than 10 or 15 minutes at the most.

(The Chairman)

In consultations he had held on issues before the Committee, two problems had aroused strong feelings on the part of some delegations: the economic implications of sea-bed exploitation, and the rules and regulations covering such exploitation. Those two questions could not fruitfully be discussed in detail in the opening debate. The Committee would study them later, but the timing and method of their consideration should be the subject of further consultation.

After the short opening debate, the Committee could be converted into an informal body of the whole which would meet for two weeks while it attempted to eliminate unnecessary brackets and alternatives in the documents, thus providing a basis for realistic negotiations later. However, he did not exclude the possibility of eliminating all the brackets and alternatives if the Committee could immediately reach a consensus. After that period, the Committee would hear an oral report on its work. Meanwhile, he would hold further consultations on the next stage of the work of the Committee.

In view of the consultations he had held on the subject, he proposed that Mr. Pinto of Sri Lanka should head the informal body.

Mr. GALINDO POHL (El Salvador) paid a tribute to the Chairman, whose experience was known to all. He had been asked by the Latin American countries to express their support of the statement just made by the Chairman. The Latin American countries approved the division of the work of the Committee into official and informal meetings, and the nomination of Mr. Pinto as Chairman for the latter. They also approved the suggestion to conduct the general debate within the limits suggested by the Chairman, on the understanding that they represented not a rigid time-table, but an appeal to the delegations to show due restraint, and that the general debate would be sufficiently flexible to enable new participants in particular to express their views. The Latin American countries also agreed to proceed as soon as possible to the stage of informal discussions and to begin real negotiations. The appropriate starting-point for those negotiations appeared to be a third reading of the existing texts, in order to remove the square brackets which still remained and to identify the key points for negotiation.

Mr. ILLANES (Chile) wished to underline the importance of the question of the economic impact of the exploitation of mineral resources of the sea-bed on the production of countries, in particular of developing countries, which exploited land-based deposits of the same minerals. In addition to the report of the Secretary-General (A/CONF.62/C.25), there were also a number of UNCTAD documents on that subject which merited careful examination. It would be most useful if a representative of UNCTAD were able to attend to present those documents.

Mr. MWERA (United Republic of Tanzania) approved the proposals made by the Chairman and merely wished to say that, in his opinion, the primary task of the informal discussions should be to examine questions of substance; he did not think that it would be possible to overcome the existing difficulties in the course of official meetings.

Mr. MANNER (Finland), speaking on behalf of the group of Western European and other countries, welcomed the appointment of Mr. Engo as Chairman of the discussions. The group approved the Chairman's proposals as a basis for organizing the work of the Committee.

Mr. ADEDE (Kenya) supported the Chairman's proposals and pointed out that, while delegations which had not yet had an opportunity to express their views should be given an opportunity to do so, the discussions should be directed towards a search for solutions, without spending any time on policy statements which were already known. He endorsed the opinion of the representative of the United Republic of Tanzania on the importance of informal negotiations. It was to be hoped that a third reading of the text would enable a new document to be prepared which removed existing differences.

Mr. FONSECA (Colombia) said he agreed entirely with the Chairman's proposals and suggested that the text should be published in full.

Mr. de SOTO (Peru) agreed with the representative of Chile that the Committee should be able to examine in depth the economic impact of the exploitation of mineral resources from the sea-bed on the land-based production of the same minerals by developing countries. With regard to documents prepared by UNCTAD, he wished to know what those documents were and whether a representative of UNCTAD could attend in order to present them.

Mr. LEVY (Secretary of the Committee) explained, in reply to the question raised by the representatives of Chile and Peru, that there were, in addition to the report of the Secretary-General on the economic implications of sea-bed mineral development in the international area (A/CONF.62/25), several documents prepared by UNCTAD, a list of which was given in document A/CONF.62/26. The UNCTAD documents were available in Caracas in limited quantities but all were not yet available in all working languages. Documents TD/B/447, 449 and 483/Add.1 were available in all working languages; document TD/B/449/Add.1 was available in all working languages except Chinese, and document TD/B/483 was available in English only. The versions not available in Caracas had been asked for and would arrive shortly. A representative of UNCTAD was expected on 15 July, but it was not yet known how long he would stay in Caracas.

Mr. PINTO (Sri Lanka) congratulated the Chairman and assured him of the support of the Asian group for the proposals he had just made. He wished to draw attention to the importance of the question of the economic impact of sea-bed mineral development on the land-based production of minerals, and of the question of the general principles which should govern the exploitation of the sea-bed. He thought it would be difficult to ask delegations to refrain from discussing the subject He endorsed the opinion of the representative of Colombia that the Chairman's statement should be published in full.

Mr. JEANNEL (France) said he was particularly glad to have Mr. Engo as Chairman of the Committee. His delegation thought that the methods suggested were excellent. The Committee should dispense with theoretical discussions and come to grips with the concrete problems. His delegation welcomed the very valuable support which Mr. Pinto would give.

Mr. PALACIOS (Bolivia) said he fully agreed with the Chairman's proposals and would merely stress the need to make the work of the Committee as flexible as possible.

Mr. MABROUK (Tunisia) fully endorsed the Chairman's proposals. In particular, the general debate should be limited as much as possible, while States which had not participated in the work of the Sea-Bed Committee should be given an opportunity to express their views. He also endorsed the opinion of the representative of the United

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Republic of Tanzania that absolute priority be given to the negotiations, in order to reconcile different points of view. He also supported the suggestion of the representative of Chile that the Committee should examine the documents prepared by UNCTAD and hear a representative of that body.

His delegation would like to know whether a document existed or was being considered on the problem of the distribution of the profits from the exploitation of the international zone. If the Secretary-General's report (A/CONF.62/65) and the UNCTAD documents were not sufficiently specific on that point and did not provide the necessary background information, he asked whether the Secretariat could not prepare a working document on the subject.

Mr. LEVY (Secretary of the Committee) noted that the Sea-Bed Committee had examined the question of the distribution of profits from the development of the sea-bed and that documents had been prepared on it by the Secretariat in 1970 and 1971. No new document by the Secretariat on the subject existed and it was not possible to express an opinion on the suggestion without further details from the representative of Tunisia.

The CHAIRMAN said that, if there were no objections, he would consider that the Committee approved the proposals made in his initial statement, having regard to the observations which had been made subsequently, and decided to have the text of the statement published in full.

It was so decided.

The meeting rose at 11.55 a.m.

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Press Release SEA/60
15 July 1974

FIRST COMMITTEE OF LAW OF SEA CONFERENCE CONTINUES HEARING STATEMENTS ON SEA-BED REGIME AND MACHINERY

(The following has been received from a United Nations Information Officer attending the Conference in Caracas.)

General statements on the nature and functions of an international mechanism for the sea-bed area beyond national jurisdiction continued Friday morning, 12 July, in the First Committee (Sea-Bed Regime and Machinery) of the Third United Nations Conference on the Law of the Sea in Caracas. Representatives of Brazil, Venezuela and Trinidad and Tobago were heard, as well as an observer from the International Ocean Institute.

The Committee was to hear further statements when it met again at 10:30 a.m. today. The Chairman, Paul Bamela Engo (United Republic of Cameroon), announced that 51 more speakers had so far asked to be heard during this initial phase of the Committee's work, which is to be followed late next week by informal negotiating sessions.

Some of the views expressed Friday morning:

Sergio Martins Thompson Flores (Brazil): The future authority for the international sea-bed area should be given full responsibility for all activities in the area; only thus would it be able to obtain the comprehensive knowledge of exploitation which it needed to regulate production and divide the benefits among States. In contracting or associating itself with others for purposes of exploitation, it should ensure "a reasonable guarantee of tenure and of profitable returns on investments made while, at the same time, providing for the rational management of the resources". That management should be aimed at avoiding adverse consequences from sea-bed mining on the economies of land producers, without having to compensate them; ensuring technology transfer to developing countries enabling those countries to participate in future exploitation; and safeguarding the area against pollution from sea-bed activities. The best method would be for the authority to have direct control and participation in all sea-bed activities, including exploitation. No unreasonable difficulty should be placed in the way of States or companies ready to operate in the area, but their activities should be carried out in such a way as to guarantee that mankind as a whole, through the authority, would efficiently administer the area and benefit from its riches. For that reason, "no system of vetoes in any organ of the machinery could be accepted".

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Emilio Figueredo Planchar (Venezuela): It was necessary to minimize the adverse economic effects which might arise from uncontrolled exploitation of sea-bed minerals. He hoped the ghost of unilateral exploitation of those resources would be banished, and not merely on condition that there would be a legal regime adapted exclusively to the interests of large national and supranational consortiums. International ocean space should be viewed as a unity; it was difficult to conceive of an innovative regime for the sea-bed that would coexist with a regime for the waters above which continued to reflect archaic formulas inspired by national selfishness. Thus, it might be inevitable to take a step forward by giving the sea-bed authority functions in regard to environmental preservation and conservation of the living resources of the area as a whole. The authority, as proposed by 13 Latin American States, including Venezuela, should have sufficient powers to play an important role, directly exploiting sea-bed resources in the general interest of the international community rather than to satisfy particular interests. The machinery should be sufficiently democratic and representative of the world community so that a small group would not be placed in a privileged position.

Christopher W. Thomas (Trinidad and Tobago): His delegation favoured an approach that sought to maintain control over all sea-bed activities and the benefits derived therefrom, in the interests of the international community; such an approach would not exclude outside participation undertaken in conjunction with the authority. The approach favoured by some, under which the sea-bed authority would simply license exploitation by others, meant relinquishment of control to those for whom private profits were the primary consideration; he could not agree to such an approach in an area whose benefits were supposed to flow to all. The Committee must soon confront those two divergent approaches to the attributes of an international authority. No group or private entity should be given special advantages in view of the technological advancement of certain States. He did not see how the necessary safeguards could be applied without over-all control by the authority. He suggested that the Committee first concentrate on the safeguards required to preserve the principle that sea-bed resources were the common heritage of mankind. As the authority would be concerned with commercial undertakings, its structure should be fashioned to that end rather than an "undue imitation of the United Nations". Any implied veto or weighted voting that would reduce the power of developing countries in an organization that was supposed to act in their interest was a contradiction in terms.

Elisabeth Mann Borgese (International Ocean Institute): If the future authority was to be economically viable and if the developing nations were to have their share in decision-making and financial benefits, thought should be given to passing from the concept of a sea-bed authority to that of "a multipurpose ocean-space regime and machinery". Four years ago, the concept of the oceans as the common heritage of mankind took in more than three fourths of ocean space, with considerable economic potential in hydrocarbons and hard minerals and covering an area large enough to permit effective international measures for pollution control and independent research. Now, if there were

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to be broad economic zones under the jurisdiction of individual States, the sea-bed regime was viewed as covering only the ocean depths and the mining of manganese nodules, at least for the next few decades. The revenue from nodule exploitation might be expected to vary from $50 million to $200 million a year over the next decade, not much more than the authority would need to cover its operating costs. The sea-bed regime now being discussed could not fill "the jurisdictional and managerial vacuum in the ocean". Moreover, as individual States were evolving new forms of management to cover all uses of national ocean space, it would be meaningless to face such a system with "an array of fragmented organizations and competences in international ocean space".

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UNITED NATIONS

Press Section
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Press Release SEA/66
17 July 1974

FIRST COMMITTEE OF LAW OF SEA CONFERENCE HEARS ELEVEN SPEAKERS ON ISSUE OF SEA-BED REGIME AND MACHINERY

(The following was received from a United Nations Information Officer attending the Conference in Caracas.)

The First Committee (sea-bed regime and machinery) of the United Nations Conference on the Law of the Sea, at its meeting in Caracas on the morning of 16 July, continued debate on the main issues involved in creating a new body of rules and an international authority for the sea-bed area beyond national jurisdiction.

Statements were made by the representatives of Austria, Poland, Romania, Colombia, Kenya, Madagascar, Switzerland, Sweden, Liberia, Thailand and Bangladesh.

Further statements will be made when the Committee meets again at 3 p.m. the same day. Some of the points made on that morning include the following:

Gerhard Hafner (Austria): States without direct access to the sea, including land-locked countries like Austria, should be given such access on equal terms with coastal States, and should be able to participate with others in exploitation of sea-bed resources. They should also be duly represented in the future sea-bed authority. The authority should not be debarred from either licensing others to exploit sea-bed resources or participating directly in such exploitation; it should be able to apply the system that was most effective at a given moment.

Wojciech Goralczyk (Poland): Sea-bed exploration and exploitation should be open to all States, as well as entities acting under their authority and sponsorship. To give the sea-bed organization the exclusive right to explore and exploit could hinder the development of those activities; moreover, it might not be as beneficial for the developing countries as some had argued, for it might be misused by international monopolies that could use their power to dictate their terms. He regarded as constructive the idea that it might start by licensing and later move to direct exploitation.

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Dumitru Ceausu (Romania): Sea-bed mining by States or private enterprises on an individual basis would not correspond to the interests of the developing countries; therefore, there must be a world organization, open to all States, to regulate such activities. No State or group of States should be able to play a preponderant role in that organization, which should be able to carry out exploitation in any way the parties to the future sea convention determined. There must be non-discriminatory transfer of technology to enable countries to take part in exploitations.

Diego Oribe Vargas (Colombia): The sea-bed authority should have a democratic structure and the capacity to adapt to new realities. Its decisions should be taken by simple majority, and it should have the power to enforce them. In addition to an assembly composed of all members, it should have an executive board with adequate representation of all geographical regions, and a tribunal to settle disputes over the decisions of the board or other organs. Its authority should extend to the resources in the water above the international sea-bed area.

Andronico O. Adede (Kenya): The policy-making organ of the sea-bed authority should be an assembly of all States parties to the future convention; it would not merely rubber-stamp recommendations from the council. The council would ensure that the assembly's decisions were executed; it might have 48 members, combining equitable geographical distribution with "continuous representation of special interests" and taking decisions by a two-thirds vote. An enterprise would arrange the modalities of exploration and exploitation, and a tribunal would settle disputes.

Moise Rakotosihanaka (Madagascar): A sea-bed organization with limited powers, responsible only for co-ordination, would merely reaffirm the status quo; only a body with wide powers could ensure rational exploration and exploitation without discrimination. It must be a democratic body; membership of its organs must not be based on power or wealth. Political powers should be vested in an assembly of all members; to have a restricted council as the hub of the organization would perpetuate big Power control. No sea-bed activity should take place without the authority's approval.

Jean Monnier (Switzerland): The right of land-locked countries to access to the sea-bed must be established; those countries should also have due representation on the council of the sea-bed authority. The issuance of licences to outside entities for exploration and exploitation was not incompatible with the conduct of such operations by the authority itself, but licensing should be coupled with conditions to ensure that exploitation followed certain principles. The limits of the international sea-bed area should not be made uncertain because of unilateral claims.

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N. R. Larsson (Sweden): The authority should be able to issue licences directly to States, and possibly also to corporations if the State guaranteed ventures with others. It would be in a better position than the Conference to decide how and by whom exploitation should be carried out. Oceanic research should be encouraged and carried out openly, with advance notice to the authority, which should have the right to be present where the research was being conducted and to call for dissemination of the results.

Roland Barnes (Liberia): The Committee should begin by incorporating into a single draft the proposals on fundamental principles for the establishment of a sea-bed machinery, and then negotiate from that point. When agreement had been reached, it could turn to other matters such as the status of the authority and its subsidiary organs. Attention should be given not only to the rights of the authority, but also to the corresponding duties of States, developed or developing. The sea-bed should be used for peaceful purposes and the benefit of all mankind.

M. L. Birabhongse Kasensri (Thailand): The authority should begin to function as soon as possible. In its first stage, it might co-operate with the private sector, preferably in joint ventures in which it held no less than a 51 per cent share. Later, it might gradually increase its share, and, in a third stage, might function on its own, without direct participation by the private sector. Once it earned enough revenue, a significant part should go to geographically disadvantaged countries or those adversely affected by sea-bed mining. He favoured a strong assembly.

Abu Sayeed Chowdhury (Bangladesh): The future international regime should cover all ocean space, including the waters and their resources beyond national jurisdiction. He supported an authority empowered to undertake all activities in the area, including exploration, exploitation, research and environmental protection, either on its own or by any other means it might decide; all activities in the area should be under its effective control. It should function in a democratic manner, without vetoes or weight voting.

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Press Release SEA/69
17 July 1974

FIRST COMMITTEE OF LAW OF SEA CONFERENCE DISCUSSES ECONOMIC EFFECTS OF SEA-BED MINING

Hears Further General Statements on Sea-Bed Regime and Machinery

(The following was received from a United Nations Information Officer attending the Conference in Caracas.)

The possible harm that production of minerals from the sea-bed might cause to land-based mineral producers in the developing countries by lowering prices and therefore the income of producers was discussed in the First Committee (sea-bed regime and machinery) of the United Nations Conference on the Law of the Sea, at its meeting in Caracas on the afternoon of 16 July.

G.D. ARSENIS of the United Nations Conference on Trade and Development (UNCTAD) gave data to support his thesis that the future world sea-bed authority could not earn enough revenue to compensate land-based producers for the losses they would sustain when sea-bed mining got under way, and that the only way it could expect to produce a surplus for distribution to the developing countries was by a preventive approach that would fix prices for the minerals involved -- cobalt, manganese and copper -- by agreement between producers and consumers.

The Committee also heard further general statements on an international regime and machinery for the sea-bed, made by Nepal, Denmark, France, the Philippines, Israel, Burma, Iceland and the World Federation of United Nations Associations (WFUNA). It will meet again at 10 a.m. on 17 July, to hear more general statements.

The UNCTAD spokesman said that it would be difficult to organize sea-bed production without taking account of production from the land, which for years would continue to provide the bulk of the minerals in question. Whichever approach the sea-bed authority took -- compensatory or preventive -- it would be involved in substantial economic negotiations and would have to have broad economic powers.

Explaining why he did not believe the compensatory approach would work, Mr. Arsenis said it would require automatic lump-sum transfers from the developed consuming nations if the authority was to have enough money both to compensate land-based producers for their losses and to have enough left over to distribute to the developing countries generally; such transfers, he remarked, would be difficult to arrange. Under the preventive (price control) approach, the producer countries would not have to be compensated and the authority's net revenue would be available for all.

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Commenting on this point, SERGIO M. THOMPSON FLORES (Brazil) described the compensatory approach as unjust and difficult to maintain, while Mr. VARDAM (India) said there was no alternative but to sustain the prices of the minerals affected.

LEIGH S. RATINER (United States) questioned the statement by the UNCTAD official that sea-bed mining would bring direct benefits to the consumers of the minerals concerned, who were largely the mineral-using industries in the developing countries. He pointed out that many developing countries were consumers of goods containing manganese, for example.

Mr. ARSENIS replied that, while the developing countries would be important consumers of such products in future, the great bulk of the three minerals concerned went to the developed countries.

General Statements

Following are some of the points made in the general statements that afternoon:

Tribhuban P. Rana (Nepal): The international sea-bed area should be as large as possible; establishment of a machinery would be meaningless unless the area was economically viable. Land-locked States should be proportionately represented in the council of the machinery. The machinery should undertake exploration and exploitation of sea-bed resources; initially, it could license such activities by States or entities operating under the responsibility of States.

Eigil Pedersen (Denmark): Both the sea-bed organization and States and private companies should be able to carry out exploitation; the transfer of technology to the organization might be made a condition for granting licences. Each nation should be assigned a quota of the sea-bed area for exploitation. The authority should be concerned only with the sea-bed, not other resources or activities. States with established sea-bed technology or long coastlines should be included on the council.

Roger Jeannel (France): He suggested that the Committee concentrate on two subjects -- the structure of the sea-bed organization, and the limits of the area to be opened up for exploitation. The latter subject involved the question of whether the entire sea-bed should be opened up at once or whether exploitation should be concentrated in specific areas, reserving certain sectors for later exploitation by the developing countries once they acquired the necessary technology.

Samuel Soriano (Philippines): The sea-bed authority should have the power to exploit directly, but should also have licensing powers in the initial stage. No State should have veto power over its decision-making processes. An assembly of all States should be the supreme organ of the authority; there should also be a council of restricted but geographically representative membership to implement the assembly's policies, and a tribunal to settle disputes.

Yacob Doron (Israel): Every State should be permitted to take part in the sea-bed authority and to share in the benefits from exploitation. Equitable geographical distribution was a laudable principle, but it could be discriminatory if it was applied in a way that allowed some States which predominated by sheer numbers in a certain region to exclude others from participation in the group and election to any function. The structure of the authority should follow "business-like lines".

U Myo Htun Lynn (Burma): The authority should control all sea-bed exploration and exploitation, but could be left to decide whether to carry out exploitation directly or through contract with outside entities. No State or group of States should have an entrenched position in any decision-making organ. The authority should determine how the benefits from exploitation should be distributed among all countries. The area should be used exclusively for peaceful purposes.

Thor Vilhjalmsson (Iceland): He supported a strong authority with power to explore and exploit on its own and to enter into contractual arrangements. If there was a choice between immediate extensive exploration by all and more limited exploration by the authority, he would favour the latter. It was neither possible nor desirable for the sea-bed regime to be applied to the waters above; fisheries problems should be dealt with separately.

Roderick Ogley (WFUNA): Rather than allocating blocks of the sea-bed to States which would re-license them to companies, the authority should be able to treat directly, through licence or contract, with any public or private enterprise engaged in mining operations in the area. An effective voice in the authority should be given to non-governmental organizations, both those representing interest groups such as organized labour and those speaking for opinion groups such as scholars.

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Press Release SEA/69/Corr.1
17 July 1974

FIRST COMMITTEE OF LAW OF SEA CONFERENCE DISCUSSES ECONOMIC EFFECTS OF SEA-BED MINING

CORRECTION

In Press Release SEA/69 issued earlier today, the first sentence of the paragraph on page 2 should read:

"LEIGH S. RATINER (United States) questioned the statement by the UNCTAD official that sea-bed mining would bring direct benefits to the consumers of the minerals concerned, who were largely the mineral-using industries in developed countries."

In addition, the second sentence of the fourth paragraph on page 3, in the summary of the statement by THOR VILHJALMSSON (Iceland), should read:

"If there was a choice between immediate extensive exploitation by all and more limited exploitation by the authority, he would favour the latter."

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Press Release SEA/72
17 July 1974

FIRST COMMITTEE OF LAW OF SEA CONFERENCE HEARS 14 SPEAKERS ON SEA-BED REGIME AND MACHINERY

(The following was received from a United Nations Information Officer attending the Conference in Caracas.)

The views of 14 countries on international rules and an authority for the sea-bed beyond national jurisdiction were presented this morning, 17 July, in Caracas, in the First Committee (sea-bed regime and machinery) of the United Nations Conference on the Law of the Sea. The speakers were the representatives of Afghanistan, Portugal, Mexico, Ethiopia, Ireland, Kuwait, the United Republic of Tanzania, Fiji, the Republic of Korea, Iran, Pakistan, Yugoslavia, the Congo and Ecuador.

During the meeting, the United States objected that references by some speakers to the waters above the sea-bed were beyond the competence of a committee which was supposed to deal only with the sea-bed. However, the representatives of the United Republic of Tanzania, Mexico, Colombia and Venezuela stated that delegations which favoured a unified legal regime for the entire ocean space beyond national jurisdiction were entitled to present their views to the Committee.

The Committee will hear further statements at 3 p.m. today. Some of the points made by speakers this morning included the following:

Nangyalai Tarzi (Afghanistan): The new ocean regime should ensure that no State could unilaterally extend its sovereignty over any part of the international area. The future sea-bed authority should have broad powers over exploration and exploitation. Land-locked States should be equitably represented in all bodies of the authority, and no State should have preferential treatment such as the veto right.

Joaquim G. Boavida (Portugal): The authority should exploit the sea-bed either directly or through contracts or joint ventures with outside entities; if it were merely to license others to exploit the area, the richer parts might fall under the control of big consortiums. There was need to ensure conservation and regulate production so as to minimize price fluctuations that could harm land producers.

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Bernardo Sepulveda (Mexico): The new regime should not be limited to exploration and exploitation of the sea-bed; ocean space must be considered as a whole, and the future authority should administer all resources in the sea-bed as well as the water above. In its exploitation activities, the authority should act either directly or through service contracts under its control rather than licensing.

Hailu Makonnen (Ethiopia): Acceptance of States' claims to areas of the sea should not be at the expense of the common heritage of mankind. If any part of the sea-bed beyond the 200-mile limit could not be made part of the international regime, ways should at least be found to channel revenues from such areas to the world authority. He favoured a mixed system of joint enterprises and licensing.

Charles Lysaght (Ireland): Maximum control over sea-bed resources should be vested in a body where the developing countries had a predominant voice; there was "no reason why industrially powerful nations should dominate" the authority's council. The authority should be free to operate through licensing, contracts, joint ventures or directly; it should be able to license companies without going through States.

Ahmad A.K. Al-Ibrahim (Kuwait): The authority should have comprehensive powers for organizing, administering, controlling and co-ordinating all sea-bed activities; it should also deal with the possible adverse effects of sea-bed production on the economies of some developing countries. It should have a major role in training the personnel of developing countries and in the transfer of technology to them.

J.S. Warioba (United Republic of Tanzania): The authority must exploit the sea-bed itself, although it might have to do so with the co-operation of other entities whose role it must control. The idea of licensing companies to exploit reminded him of the German and British East African companies of colonial times and today's multinational corporations draining the resources of the third world.

Donald McLoughlin (Fiji): The authority should not exploit the sea-bed itself until it had enough funds, although it might enter into joint ventures on a non-contributory basis; its initial emphasis should be on control of exploitation. It should be empowered to direct increases or decreases in production, and to avoid hardship to resource-poor developing countries caused by high prices and shortages.

Soo Gil Park (Republic of Korea): The future treaty should include detailed regulations so that every country would know the conditions and possibilities for ocean mining. No State should have special privileges, such as a veto right, in the sea-bed authority. The authority might exploit directly or through contracts, joint venture or licensing; investors should be offered a reasonable return.

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Davoud H. Bavand (Iran): The authority should have the sole right to exploit the sea-bed, directly or through association with others under its effective control or supervision at all stages. It should control production, processing, marketing and, when necessary, prices. An assembly of all States should be the supreme organ, while a council would perform functions delegated by the assembly.

J.G. Kharas (Pakistan): The new regime should encompass all international ocean space and all activities related thereto. The authority must exercise direct control over such activities, although it could employ any suitable means in the initial stage to ensure optimum exploitation. Its powers should cover exploration, exploitation, distribution of benefits, conversation, and regulation of research.

Stojan Novakovic (Yugoslavia): The authority's policy and regulatory powers should be under the direct influence of all countries. Its assembly should have broad functions, while its council should be limited to executive tasks. Giving a special position in the authority to particular groups would create a field of struggle instead of co-operation. The authority should not be confined to licensing.

Mrs. Marie-Helena Mathey (Congo): Sea-bed exploitation must not harm the interests of the developing countries which also produced the minerals concerned. The authority should be empowered to explore and exploit, rationalize activities in the area and market the products from the sea-bed. In the initial phase, it might operate through joint ventures in which the public had a majority interest.

Oswaldo Ramirez Landazuri (Ecuador): There should be a single regime for the sea-bed and the waters above. The future machinery should regulate not only exploration and exploitation, but also pollution, scientific research and marketing. It should exploit the area either itself or through joint enterprises with States or entities under the responsibility of States, but not through a licensing system.

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Press Release SEA/77
18 July 1974

FIRST COMMITTEE OF CARACAS CONFERENCE ENDS INITIAL DEBATE ON MAIN SEA-BED ITEMS

(The following was received from a United Nations Information Officer attending the Conference in Caracas.)

The First Committee (sea-bed regime and machinery) of the Third United Nations Conference on the Law of the Sea completed yesterday afternoon, 17 July, in Caracas, a five-day debate at which 65 States presented their views on the main issues involved in setting up a new legal order and a world authority for the sea-bed beyond national jurisdiction.

The Committee will now start a series of informal meetings, starting tomorrow, 19 July, aimed at agreeing on a single text for treaty articles on the sea-bed about which there is general agreement, and reducing the number of alternatives for articles still in contention. It is to meet again formally on Friday, 26 July, to hear a progress report from Christopher W. Pinto (Sri Lanka), who will chair the informal meetings. The Committee Chairman, Paul Bamela Engo (United Republic of Cameroon), remarked today: "We are here not to lecture others.... but to negotiate".

Some of the points made by the 17 delegates who spoke this afternoon follow:

Mouldi Marsit (Tunisia): The proposed sea-bed authority should have the broadest powers to control exploration and exploitation of resources in the area. It could conclude service contracts with outside entities for exploitation. The authority's council should reflect the membership of its assembly.

Ke Tsai-Shuo (China): Exploitation of sea-bed resources must be undertaken by the proposed machinery or under its complete control. Its assembly should have all major Powers: if the council's powers were inordinately enlarged, the super-Powers would find it easy to manipulate the authority.

Akram Al-Witri (Iraq): All activities in the international area, including scientific research, should be conducted solely by the authority or under contract with it but under its control. The costs of exploration and exploitation could be met by a fund financed by the contributions of all States.

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Murat Angoni (Albania): The sea-bed authority must directly administer exploration and exploitation; a system under which it licensed others to do so would merely continue super-Power pillage of the seas. The Conference should formulate rules prohibiting the concentration of military fleets on the oceans.

Tobgyel Dorji (Bhutan): Extension of national jurisdiction in the seas would jeopardize the vital interests of the international community. The interests of land-based mineral producers could be affected if national jurisdiction was extended to 200 miles and exploitation took place in accordance with national needs.

Nguyen Thi Ngoc Lan (Republic of Viet-Nam): The authority should have full control over exploitation of sea-bed resources and power to regulate the conservation of migratory species in the area. It should take part in commodity agreements aimed at minimizing price fluctuations of the minerals produced from the sea.

Valentin A. Romanov (Soviet Union): Only States parties to the sea convention should receive exploitation licenses from the sea-bed authority; other entities could exploit the sea-bed if their States accepted responsibility. The authority should be concerned only with sea-bed exploitation beyond the continental shelf.

Emmanuel Kalpadakis (Greece): During an initial period the authority might contract with private entities for exploitation, until it decided that it was able to carry out such activity itself. Members of its council should be elected on a geographically equitable basis; there should be no veto or weighted voting.

Zhagvaralyn Ganibal (Mongolia): All States should have equal access to the sea-bed and the benefits derived therefrom. Freedom of navigation, scientific research, overflight, fisheries, and the laying of undersea cables and pipelines should be assured in the international area.

Rafael Pastor Ridruejo (Spain): The authority must have broad powers to explore, exploit and market sea-bed resources. It must have a democratic structure, with its assembly as the predominant organ. Rich nations should provide it with the funds and technology it needed to exploit the sea-bed.

Yefim K. Kachurenko (Ukraine): Freedom of scientific research on the sea-bed would make possible effective and rational exploitation of its resources; obstacles to such research should be removed. No doubt should be cast on the principle that the sea-bed regime must not affect the legal status of the water above.

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Mohamed Lamine Allouane (Algeria): The assembly of the authority should have power over exploration, exploitation, marketing, and distribution of the benefits from sea-bed resources. The authority should fix prices so as to avoid harm to land-based mineral producers; there should also be compensation for at least part of their losses.

Bengt Broms (Finland): The authority should have power not only to control sea-bed mining but also to carry out new projects and promote such activity. It could begin by issuing licenses to States and possibly also to private persons and corporations; once it had enough capital it could carry out exploitation on its own.

Sergio Palacios de Vizzio (Bolivia): The authority should control all activities in the international area relating to exploration, exploitation, marketing, distribution of benefits, protection of human life, environmental protection and scientific research. It could license States or firms, under strict controls.

John R. Stevenson (United States): All States must have non-discriminatory access to sea-bed resources. The authority should control only exploration and exploitation. Consumers must be protected from "artificial price increases" of sea-bed minerals. The Conference could not succeed if it was too ambitious.

Mohammed J. Gallali (Libya): The authority should be insulated from big-Power politics. It should control all economic and related activities in the area. A licensing system was unacceptable because it would allow the best parts of the sea-bed to fall under the control of a few States.

W.W. Vanderpuye (Ghana): The Committee should try to agree on the limits of the international area so that it could estimate the potential and profitability of the area. Only a comprehensive system which ensured the proper regulation of production and marketing could prevent harm to land-based mineral producers.

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Press Release SEA/100
31 July 1974

FIRST COMMITTEE OF LAW OF SEA CONFERENCE HEARS REPORT ON INFORMAL MEETINGS, CONSIDERS REPORT ON IMPACT OF SEA-BED MINING

(The following was received from a United Nations Information Officer attending the Conference in Caracas.)

A possible "turning point" in the discussion of a central issue involved in establishing a new legal order for the international sea-bed area--who should exploit the area--was reported yesterday morning, 30 July, in Caracas, to the First Committee (sea-bed regime and machinery) of the Third United Nations Conference on the Law of the Sea.

Christopher W. Pinto (Sri Lanka), Chairman of the informal meetings at which the Committee has been examining this matter over the past two weeks, stated that, with the introduction of a new proposal by the "Group of 77" developing countries, the Committee was at "the threshold of a real negotiation and a possible break-through". The proposal, which Mr. Pinto read out, provides that all exploitation of the international area would be conducted directly by the future world sea-bed authority, but it would also enable the authority to utilize outside enterprises for sea-bed operations under the authority's control.

Mr. Pinto reported that a smaller group of delegates was considering various issues concerning the future sea-bed regime and that the results of its work might be given to an informal meeting of the full Committee tomorrow, 1 August.

Also yesterday morning, the Committee heard a summary of a United Nations study on the economic implications of sea-bed mining, indicating that the production of minerals from the sea-bed "will not be unduly disruptive in world mineral markets" over the next decade, but that the situation could change after 1985 in the absence of regulation by a world sea-bed authority.

The report (document A/Conf.62/25), circulated in May, was introduced by Constantin A. Stavropoulos, who is Secretary-General Kurt Waldheim's Special Representative to the Conference. Several representatives participated in an exchange of questions and answers on this matter which was to continue when the Committee met again, in open session, at 3 p.m. yesterday.

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The draft article on the sea-bed regime, proposed by the developing countries and read out to the Committee yesterday morning, reads as follows:

"All activities of exploration of the area and of the exploitation of its resources and all other related activities including those of scientific research shall be conducted directly by the authority. The authority may, if it considers it appropriate, and within the limits it may determine, confer certain tasks to juridical or natural persons, through service contracts or association or through any other such means it may determine which ensure its direct and effective control at all times over such activities."

Mr. Pinto, whose interim report on the private meetings was received without discussion, also said that Jamaica had proposed a text providing that exploitation could be carried out either "(a) directly by the authority, or on its behalf, by States, groups of States or natural and juridical persons; or (b) under such legal arrangements as the authority may in any particular case approve". He indicated that the Committee still had before it two earlier texts providing for exploitation by States or enterprises under their authority or sponsorship.

With regard to the developing countries' proposal, Mr. Pinto said the "Group of 77" was preparing answers to questions raised about their draft, "dealing mainly with three subjects: (1) the basis for the underlying assumption of the financial viability of sea-bed operations conducted in accordance with the system implicit in the proposal; (2) the modalities of sea-bed operations under that system, and (3) the devices that would be utilized to ensure the authority's control at all times over such activities".

Mr. Stavropoulos, in presenting the Secretariat study on the economic implications of sea-bed mining, singled out cobalt as the mineral whose production from the sea was likely to have the greatest effect on the world market for that metal. Cobalt production from nodules on the deep sea-bed, he said, could amount to 30,000 tons by 1985, or at least half of projected world demand. Sea-bed production of manganese was also likely to depress prices, "thus reducing the export income of several developing countries". According to the study, there would be lesser impact on world markets of the two other metals obtained from nodule extraction--nickel and copper.

As to what a future sea-bed authority might do to lessen the damage caused by such production to land-based producers of the metals, Mr. Stavropoulos said a double approach might be required: long-term planning of nodule development, and compensation for the land-based mineral producers affected.

Raul M. Branco, a United Nations economist, answered delegations' questions. In response to Chile, he identified Zaire, Zambia, Cuba and Mexico as the cobalt-producers which would be hardest hit by sea-bed production. He added that if maganese recovery from nodules became economically feasible, Gabon, Brazil, India, Zaire, Ghana and Mexico would be most affected, although only Gabon obtained an important share of its foreign exchange from manganese.

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Asked by Venezuela and Yemen about other future deep-ocean sources of minerals, Mr. Branco mentioned hot brines and metallized muds, containing copper, nickel and zinc and located in the Red Sea and elsewhere.
He added that mining of undersea ocean ridges might be feasible by the year 2000.

Responding to a query by Jamaica, he said that if there was to be a 200-mile economic zone under national jurisdiction, it was difficult to see how oil production could come from the international area during the next decade. At the same time, nodule production from the economic zone might compete with that from the international area, making it desirable to consider possible revenue-sharing schemes.

Asked by Singapore how land-based producers could be protected without raising prices of metals bought by developing countries, he said long-term planning of nodule production could be combined with compensation for the affected producers. Such compensation might come not only from the revenues of sea-bed production but also from importers of those minerals, although that raised many political difficulties.

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Press Release SEA/101
31 July 1974

EXPERT QUESTIONED ON ECONOMIC ASPECTS OF SEA-BED MINING
IN FIRST COMMITTEE OF LAW OF SEA CONFERENCE

(The following was received from a United Nations Information Officer attending the Conference in Caracas.)

A United Nations economist answered questions yesterday afternoon, 30 July, in Caracas, on the economic effects likely to result from exploitation of minerals on the sea-bed, put to him by representatives in the First Committee (sea-bed regime and machinery) of the Third United Nations Conference on the Law of the Sea.

The Secretariat official, Raul M. Branco, answered queries by 13 delegations, based on material contained in a United Nations report entitled "Economic Implications of Sea-Bed Mineral Development in the International Area". The 92-page study was introduced yesterday morning by the Special Representative of the Secretary-General to the Conference, Constantin A. Stavropoulos.

Having completed the questioning of the Secretariat official, the Committee was to resume its informal, closed meetings today, aimed at working out details on an international regime and machinery for the sea-bed. No date has been set for the next formal meeting, but the Chairman, Paul Bamela Engo (Cameroon), said that an open meeting would be held to enable delegates to give their views on the economic impact of sea-bed mining -- the subject of yesterday's question and answer meetings.

Many of yesterday's questions dealt with the effects which recovery of minerals from manganese nodules lying on the deep ocean floor were likely to have on prices of those minerals and on their land-based producers, particularly in developing countries. The United Nations study predicts a price reduction for cobalt and possibly manganese over the next decade as a result of production from the sea, but estimates that there would be little or no effect of markets for two other sea-bed minerals -- copper and nickel.

(more)

Press Release SEA/101
31 July 1974

Answering questions by the United States and the United Kingdom about the effects of sea-bed production on developing countries as a whole as distributed from mineral-producers, Mr. Branco said "the loss to developing countries' exporters would tend to be greater than the gains to developing countries' importers of these metals", particularly during the first decade of sea-bed mining.

That was so, he explained, because developing countries imported very small amounts of cobalt and manganese, and the prices of those minerals played only a minor role in determining the prices of such products as jet-engine rotor blades which used the two metals. Lower prices resulting from sea-bed mining would thus lead to "a rather small drop in the total figures that developing countries must pay for their imports".

In response to another question by the United States, he acknowledged that certain developed countries, as the world's major producers of manganese, copper and nickel, "would certainly benefit" from any measures taken by the future sea-bed authority to regulate production of those minerals in order to avoid price declines. (Production control is one approach suggested by the United Nations study as a way by which the authority might shield land-based producers from the adverse consequences of sea-bed production; the other proposed approach is direct compensation of producers for their losses.)

To queries by Sri Lanka and France as to exactly how the sea-bed authority might counteract harmful price declines of sea-bed minerals, Mr. Branco replied that it could either pay compensation or take part in a general international agreement under which producers and consumers accepted a reduction in total supply or made use of buffer stocks. Other measures might be taken outside the authority, such as agreements with major importers of the metals to pay compensation from the net benefit they derived from declining prices.

In reply to the United Republic of Tanzania, he said that attempts to tackle short-term price fluctuations exclusively through the authority could create great problems and wipe out its resources in a few months. On the other hand, it could engage in long-term planning, projecting increases in demand and scheduling new sea-bed mining operations accordingly. He warned, however, as four major minerals were involved, no amount of planning could safeguard the interests of all developing countries which produced those materials.

He indicated, in reply to the Federal Republic of Germany, that there was not much likelihood that job declines in mineral-producing countries hurt by sea-bed production could be avoided by locating sea-bed mineral processing industries in those countries. He noted that Zaire and Gabon, the major

(more)

producers of cobalt and manganese, were far from the central Pacific, the likely source of most nodule production. Because chemical reagents were needed for the extraction, processing plants were likely to be situated in the United States and Japan.

Asked by Zambia whether the international sea-bed area would lack "economic viability" if the Conference agreed on broad limits of national jurisdiction over coastal areas, Mr. Branco replied that manganese nodules existed within 200 miles of some Pacific coasts, although they were "not the cream of the crop". He added: "If a 200-mile limit is adopted, some nodule resources might be exploited within national jurisdiction, thus escaping the possible control of the sea-bed authority."

* *** *

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5 August 1974

ORIGINAL: ENGLISH

FIRST COMMITTEE

DRAFT ARTICLES CONSIDERED BY THE COMMITTEE AT ITS
INFORMAL MEETINGS

(Articles I-21)

EXPLANATORY NOTE

This document contains the texts of draft articles which are the result of the Committee's reading of part I of annex I of the Report of Sub-Committee I of the Sea-Bed Committee, which deals with the status, scope and basic provisions of the régime, based on the Declaration of Principles, resolution 2749 (XXV). References to the Comparative Table (document A/AC.138/L.10), to the "first reading" or "second reading" by Working Group 1 of Sub-Committee I of the Sea-Bed Committee, and to the Introductory Note have been omitted, as being unnecessary at this stage. Several foot-notes which are no longer relevant have also been omitted, while in the remaining foot-notes, references to the "Working Group" have been replaced by references to the "Committee". Consequential and other minor editorial changes have been made.

Draft articles I-21 are presented at this stage without the Introductory Note which appeared at the beginning of the Report of Sub-Committee I of the Sea-Bed Committee, pending completion of the work of the First Committee on the other draft articles.

Wording taken from the Declaration of Principles continues to be underlined, while marginal notes refer to the corresponding paragraph of the Declaration. Draft article I is regarded by the Committee as having been subjected only to a first reading and hence is given a Roman numeral in accordance with the practice followed by Sub-Committee I of the Sea-Bed Committee.

The Committee decided not to deal, for the time being, with proposals for definition or interpretation of terms. Provision would continue to be made for an article on interpretation of terms (article "0") but the terms to be covered and their interpretation would be added at a later stage.

/[DRAFT]/ CONVENTION ON THE SEA-BED AND THE OCEAN FLOOR BEYOND THE LIMITS OF NATIONAL JURISDICTION/*

PART I: PRINCIPLES

Article I

LIMITS OF THE AREA 1/

(A)

1. (i) The limit of the sea-bed to which these articles apply shall be the outer limit of the continental shelf established within the 500-metre isobath.

(ii) In areas where the 500-metre isobath referred to in paragraph 1 of this draft is situated at a distance of less than 200 nautical miles measured from the baselines from which the territorial sea of the coastal State is measured, and in areas where there is no continental shelf, the limit of the sea-bed shall be a line every point on which is at a distance of not more than 200 nautical miles from the nearest point on the said baselines.

OR (B)

1. The Area shall comprise the sea-bed and the subsoil thereof seaward of the outer limit of the Coastal Sea-bed Area 2/ in which the coastal State by virtue of article ... /of the Convention .../ exercises sovereign rights for the purpose of exploring and exploiting the mineral resources of the coastal sea-bed area.

OR (C)

1. The Area shall comprise the sea-bed and ocean floor and subsoil thereof beyond the limits of national jurisdiction. 3/

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* The Committee has not considered headings, marginal notes, or the position of texts.

1/ The Committee noted the proposals submitted on the limits of the Area, as well as the fact that a final decision concerning those limits would depend on the results of discussions on the item as a whole in the Second Committee. The question of the limits of the Area was not fully considered by the Committee.

2/ This alternative envisages that the coastal State may establish the limit of its Coastal Sea-bed Area up to a distance of 200 nautical miles from the applicable baselines for measuring the breadth of the territorial sea.

3/ The term "national jurisdiction" is not intended to prejudge the nature and content of such jurisdiction.

OR (D)

1. The limit of the sea-bed to which these articles apply shall be the outer lower edge of the continental margin which adjoins the abyssal plains or when that edge is at a distance of less than 200 miles from the coast, up to that distance.

(A)

2. (Procedures for notification, record and publication of actual limits of national jurisdiction. In this connexion see also article XL, International Sea-Bed Boundary Review Commission.)

OR (B)

Omit this provision.

Article 2

COMMON HERITAGE OF MANKIND

(A)

Common heritage limits (D.1)

The Area and its resources are the common heritage of mankind.

OR (B)

The Area and its resources are the common heritage of mankind. This principle shall be implemented and interpreted in accordance with the provisions of these articles.

Article 3

ACTIVITIES REGARDING EXPLORATION AND EXPLOITATION, ETC.

(A)

Activities covered (D.4)

1. All activities in the Area, including scientific research and the exploration of the Area and the exploitation of its resources and other related activities shall be governed by the provisions of these articles and shall, unless otherwise provided in these articles, be subject to regulation by the Authority established pursuant to article ...

/...

OR (B)

The provisions of these articles shall govern the exploration of the Area and exploitation of its resources and other related activities which are specified herein. The Authority shall have the functions with regard to those activities which are conferred on it by these articles.

OR (C)

1. All activities in the Area shall be governed by the international régime established by these articles. The International Authority established under article ... shall enjoy in respect of these activities such powers as are conferred upon it by the terms of these articles.

Article 4

NO CLAIM OR EXERCISE OF SOVEREIGNTY, ETC.

(D.2 and 5) 1. No State shall claim or exercise sovereignty or sovereign rights over any part of the Area, nor shall any State or person, natural or juridical, appropriate any part thereof. No such claim or exercise of sovereignty or sovereign rights, nor such appropriation shall be recognized.

2. No State or person, natural or juridical, shall claim, acquire or exercise any rights /over/ /with respect to/ the resources of the Area except as hereinafter specified in these articles. Subject to the foregoing, no such claim, acquisition, or exercise of rights shall be recognized.

Article 5 4/

USE OF THE AREA BY ALL STATES WITHOUT DISCRIMINATION

Non-discrimination (D.5) The Area shall be open to use exclusively for peaceful purposes by all States, whether coastal or land-locked, without discrimination /in accordance with the provisions of these articles 5//

4/ See foot-note 6.

5/ It was suggested that a further sentence should be added at the end of the existing text, reading as follows: "All States, whether land-locked or coastal, shall have access to the Area in accordance with the provisions of these articles."

/...

Article 6

GENERAL CONDUCT IN THE AREA AND IN RELATION TO THE AREA

(A)

General conduct of States (D.6)

States shall act in and in relation to the Area in accordance with the provisions of these articles, the applicable principles and rules of international law including /those contained in/ the Charter of the United Nations /and taking into account/ the Declaration on Principles of International Law concerning Friendly Relations and Co-operation among States in accordance with the Charter of the United Nations, adopted by the General Assembly on 24 October 1970, in the interests of maintaining international peace and security and in the interests of peaceful coexistence and the promotion of international co-operation and mutual understanding.

(B)

All activities in the Area and in relation to the Area shall be in accordance with the provisions of these articles and the purposes and principles of the Charter of the United Nations.

Article 7 6/

BENEFIT OF MANKIND AS A WHOLE

General objective: benefit of mankind as a whole (D.7)

The exploration of the Area and the exploitation of its resources shall be carried out for the benefit of mankind as a whole, irrespective of the geographical location of States, whether land-locked or coastal, and taking into particular consideration the interests and needs of the developing countries.

Special interest groups

/2. Due regard shall be paid to the need to promote and protect the interests of /coastal States,/ land-locked and other geographically disadvantaged States in the development of sea-bed resources./

6/ It was suggested that there might be an amalgamation of articles 5 and 7, and perhaps article 8, along the following lines:

The Area shall be open to use exclusively for peaceful purposes by all States without discrimination. Scientific research, the exploration and exploitation of its resources shall be carried out for the benefit of mankind as a whole, irrespective of the geographical position of States, whether coastal or land-locked, and taking into particular consideration the interests and needs of the developing countries.

/...

Article 8

PRESERVATION OF THE AREA EXCLUSIVELY FOR PEACEFUL PURPOSES

Peaceful uses (D.8)

The Area shall be reserved exclusively for peaceful purposes, /, and every effort shall be made to exclude it from the arms race/ /and its use for military purposes shall be prohibited/.

/The Contracting Parties undertake to conclude further international agreements as soon as possible/ with a view to effective implementation of this article.

/The emplacement of nuclear weapons and of other weapons of mass destruction in the area is prohibited./

/Nuclear and thermonuclear weapon test explosions are prohibited in the Area./

Proposal to replace third and fourth paragraphs:

/The activities of all nuclear submarines in the Area and in the sea-bed area of other States shall be prohibited. The emplacement of nuclear weapons and all other weapons in the Area and in the sea-bed area of other States shall be prohibited./

Article 9

WHO MAY EXPLOIT THE AREA

(A)

All exploration and exploitation activities in the Area shall be conducted by a Contracting Party or group of Contracting Parties or natural or juridical persons under its or their authority or sponsorship, subject to regulation by the Authority and in accordance with the rules regarding exploration and exploitation set out in these articles.

OR (B)

All activities of exploration of the Area and of the exploitation of its resources and all other related activities including those of scientific research shall be conducted directly by the Authority.

The Authority may, if it considers it appropriate, and within the limits it may determine, confer certain tasks to juridical or natural persons, through service contracts, or association or through any other such means it may determine which ensure its direct and effective control at all times over such activities.

/...

OR (C)

1. All activities of exploration and exploitation in the Area shall be conducted in accordance with legal arrangements with the Authority pursuant to this convention, regulations included in this convention and those promulgated by the Authority pursuant to this convention.

2. The Authority shall enter into legal arrangements for exploration and exploitation with Contracting Parties, groups of Contracting Parties and natural or juridical persons sponsored by such Parties without discrimination. Such Parties or persons shall comply with this convention, regulations included in this convention and those promulgated by the Authority pursuant to this convention.

OR (D)

All exploration and exploitation activities in the Area shall be conducted by a Contracting Party or group of Contracting Parties or natural or juridical persons under its or their authority or sponsorship, subject to regulation 7/ by the Authority and in accordance with the rules regarding exploration and exploitation set out in these articles. The Authority may decide, within the limits of its financial and technological resources, to conduct such activities.

NOTE (1) The Committee will have to consider whether to set out here, as is done in some proposals, the general rules regarding resource activities in the Area. These could include, *inter alia*, according to the type of administration adopted as regards exploration and exploitation, rules on: notice to mariners and other safety procedures, areas to be allotted, work requirements, work plans, inspection, service contracts, licensing, joint ventures, fees payable, revocation of service contracts, revocation of licences and integrity of investments. On the other hand, the Committee may decide to omit them from part I of the articles.

7/ The view was expressed that the word "regulation" in this context should be replaced by the word "supervision".

/...

Article 10

GENERAL NORMS REGARDING EXPLOITATION 8/ 9/

(A)

(D.9) 1. The exploration of the Area and the exploitation of its resources shall be carried out in an efficient manner so as to provide for orderly and safe development and maximum benefits to producers and consumers of raw materials and of products which are made from them. Such resources development shall ensure expanding opportunities in the use thereof and ensure the equitable sharing by States Parties in the benefits derived therefrom, taking into particular consideration the interests and needs of the developing countries, whether land-locked or coastal.

(B)

The exploration of the Area and the exploitation of its resources and other related activities shall be carried out in a safe, orderly and rational manner so as to ensure their conservation and optimum utilization and to regulate production in the Area so as to prevent the deterioration in the prices of minerals and raw materials from land and off-shore sources that may result from such exploitation and adversely affect the exports of developing countries, especially those who are producers of wasting and non-renewable materials. The mineral resources of the Area shall be considered as being complementary to resources produced from land and off-shore areas. The benefits derived from exploitation of the resources of the Area shall be distributed equitably among all States, irrespective of their geographical location, giving special consideration to the interests and needs of developing countries, whether coastal or land-locked.

/2. 10/ An amount equal to the proceeds of any tax levied by a State in connexion with activities relating to the exploitation of the Area, whether in respect of profits made, services rendered or the supply of equipment or materials, or in respect of salaries paid or interests disposed of, by persons physical or juridical under its jurisdiction, shall be paid by that State to the Authority with a view to its being shared among developing countries. When the proceeds envisaged are greatly reduced because the State itself undertakes the exploitation or agrees to fiscal exemptions, a compensatory amount will be paid by this State to the Authority./

8/ One representative was of the view that the concepts dealt with in this article could more appropriately be included among the purposes of the machinery.

9/ With reference to this article, the representative of the USSR referred to the explanatory note to article 9 of the provisional draft articles submitted by the USSR, reproduced in section 11 of the Comparative Table.

10/ This provision would apply to either (A) or (B). It would become the second paragraph of (A) if (B) was not adopted. In any case, it does not prejudge the legal nature of the body or bodies legally entitled to exploit the resources of the Area.

/...

NOTE 1: The view was expressed in respect of this article that there is a need to take into account, in the regulations under the machinery, provisions allowing the Authority and States Parties to pursue measures designed to facilitate the stabilization of commodity prices on a global basis, as, for example, through international commodity agreements.

NOTE 2: The Committee may wish to consider whether to set out here, as is done, for example, in the United States draft, article 5 (1), the basic principles of benefit sharing, or to deal with this subject in a subsequent chapter of the articles.

Article 11

SCIENTIFIC RESEARCH

(A)

(D.10) 1. Every State, whether coastal or land-locked, has the right to undertake scientific research in the Area /ocean space/, provided due regard is paid to the rights and interests of other States, and of the Authority, concerning legitimate activities in the Area.

2. Every State shall:

(i) Encourage scientific research in the Area;

(ii) Promote international co-operation in scientific research, in particular:

(a) By participation in international programmes and by encouraging co-operation in scientific research by personnel of different countries;

(b) Through effective publication of research programmes and dissemination of the results of research through international channels;

(c) Through measures to strengthen research capabilities of developing countries, including the participation of their nationals in research programmes.

3. No such research activities shall form the legal basis for any claim with respect to any part of the Area or its resources.

OR (B)

1. Neither these articles, nor any rights granted pursuant thereto shall affect the freedom of scientific research in the Area. Each Contracting

Party agrees to encourage, and to obviate interference with, scientific research in the Area. Contracting Parties shall promote international co-operation in scientific research concerning the Area exclusively for peaceful purposes:

(a) By participation in international programmes and by encouraging co-operation in scientific research by personnel of different countries;

(b) Through effective publication of research programmes and dissemination of the results of research through international channels;

(c) Through measures to strengthen research capabilities of developing countries, including the participation of their nationals in research programmes.

2. No such research activities shall form the legal basis for any claim with respect to any part of the area or its resources.

OR (C)

Scientific research in the Area shall be carried out exclusively for peaceful purposes, for the benefit of mankind as a whole, irrespective of the geographical location of States, whether coastal or land-locked, and taking into particular consideration the interests and needs of developing countries.

Without prejudice to the scientific research activities carried out by the Authority itself, it shall grant authorization on a non-discriminatory basis for such activities to any person, natural or juridical, provided that there are the necessary guarantees of technical competence, responsibility for any damage that may be caused to the marine environment and compliance with the applicable regulations adopted in this regard by the Authority.

States shall promote international co-operation in scientific research in the Area, in particular through:

(a) International programmes directed toward the training of nationals of developing countries in all aspects of marine science and technology;

(b) Technical assistance to developing countries;

(c) Employment of qualified personnel from developing countries in all aspects of the activitiee carried out in the Area;

(d) Notification to the Authority of research programmes, and dissemination of their results by the same channel.

Article 12

TRANSFER OF TECHNOLOGY

(A)

Contracting Parties shall co-operate in promoting the transfer of technology and know-how relating to the exploration of the Area and the exploitation of its resources to developing countries and to other countries in need of such technology or know-how.

Opportunities shall be given for the training of personnel of those countries in all aspects of marine technology, particularly by participation, as far as possible, in the exploration of the Area and the exploitation of its resources.

OR (B)

States shall promote, through the Authority:

(a) Programmes for the promotion of transfer of technology to developing countries with regard to the exploration of the Area and the exploitation of its resources, including, *inter alia*, facilitating the access of developing countries to patented and non-patented technology, under just and reasonable conditions;

(b) The elaboration of techniques adapted to the production and trade structures of developing countries;

(c) Measures directed towards the acceleration of domestic technology of developing countries and the opening of opportunities to personnel from developing countries for training in marine science and technology and their full participation in activities in the Area.

OR (C)

Contracting Parties shall take necessary measures for promoting the transfer of technology and scientific knowledge relating to the exploration of the Area and the exploitation and utilization of its resources, so that all States benefit therefrom on an equitable and non-discriminatory basis.

Contracting Parties undertake to establish and to carry out concrete programmes, within the framework of the over-all policy of the United Nations in this field, for transferring scientific knowledge and technology, including patented technology, to the developing countries.

The Authority shall establish permanent means for the acquisition, dissemination and transfer of scientific knowledge and technology, as well as for training of personnel from developing countries in marine science and technology, so as to ensure their full participation in activities in the Area.

/...

OR (D) 11/

Revenues derived from sea-bed exploration and exploitation shall be used, through or in co-operation with, other international or regional organizations, to promote efficient, safe and economic exploitatiom of mineral resources of the sea-bed; to promote research on means to protect the marine environment; to advance other international efforts designed to promote safe and efficient use of the marine environment; to promote development knowledge of the Area; and to provide technical assistance to Contracting Parties or their nationals for these purposes, without discrimination.

Article 13

PROTECTION OF THE MARINE ENVIRONMENT

(D.11) With respect to /all/ activities in the Area, appropriate measures shall be taken for the adoption and implementation of international rules, standards and procedures for, inter alia:

(a) The prevention of pollution and contamination, and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment, particular attention being paid to the need for protection from activities such as drilling, dredging, excavation, disposal of waste, construction and operation or maintenance of installations and pipelines and other devices related to exploration of the area and exploitation of its resources;

(b) The protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment.

Article 14

PROTECTION OF HUMAN LIFE 12/

With respect to /all/ activities in the Area, appropriate measures shall be taken for the adoption and implementation of international rules, standards and procedures for the protection of human life.

11/ This alternative text is derived from article 5, paragraph 2, of the United States draft and is integrally related to that treaty, which asserts that States shall share with the Authority a portion of the revenues derived from the exploration and exploitation of sea-bed resources under their jurisdiction beyond the 200-metre isobath. Text (D) should be read in the context of this treaty proposal as it appears in article 5 of the United States draft and related articles.

12/ This article is drafted on the understanding that the rules, standards and procedures to be implemented include, so far as concerns States that are parties thereto and to the extent that they remain in force, those rules, standards and procedures that are in force at the date of entry into force of these articles.

/...

Article 15

DUE REGARD TO THE RIGHTS ETC. OF COASTAL STATES

(A)

Rights of coastal States (D.12)

1. /All/ activities /of exploration and exploitation/ /in the Area/ /in the regions of the Area adjacent to its limits/ shall be conducted with due regard to the rights and legitimate interests of coastal States in the region of such activities, as well as of all other States, which may be affected by such activities. Consultations /, including a system of prior notification,/ shall be maintained with the States concerned, with a view to avoiding infringement of such rights and interests. /Such activities of exploration and exploitation shall be conducted with the concurrence of the coastal State or States concerned./

OR

1. All activities of exploration and exploitation in the region adjacent to the boundary between the Area and the areas under State jurisdiction shall be conducted with due regard to the rights and legitimate interests of both the coastal State and the Authority. 13/

13/ It was proposed that if this text were adopted, the words "AND THE AUTHORITY" should be added at the end of the title of the article.

/...

Emergency measures (D.13 (b))

2. Neither these articles nor any rights granted or exercised pursuant thereto shall affect the right of coastal States to take such measures as may be necessary to prevent, mitigate or eliminate grave and imminent danger to their coastline or related interests from pollution or threat thereof or from other hazardous occurrences resulting from or caused by any activities in the Area.

OR

2. (a) Any State facing grave and imminent danger from pollution or threat of pollution, following upon a hazardous incident or acts related to such an incident in the Area, which may reasonably be expected to result in major harmful consequences for that State, may take such measures as may be necessary to prevent, mitigate or eliminate such danger subject to the provisions of this Convention.

2. (b) Measures taken in accordance with this subparagraph (a) shall be proportionate to the damage which threatens the State concerned and shall not go beyond what is reasonably necessary to achieve the objective referred to in subparagraph (a).

Resources near limits of national jurisdiction

3. Resources of the Area which lie across limits of national jurisdiction shall not be explored or exploited, except in agreement with the coastal State or States concerned. Where such resources are located near the limits of national jurisdiction, their exploration and exploitation shall be carried out in consultation with the coastal State or States concerned, and where possible through such State or States.

OR (B) 14/

1. Coastal States and the Authority shall co-operate closely in respect of all activities conducted in a zone under their respective jurisdiction adjacent to the boundary of the Area, not exceeding ... miles in breadth. /Legal effect shall be given to such co-operation by the adoption of a non-discriminatory convention to be elaborated for this purpose./

2. Coastal States shall transfer to the Authority a portion of the financial benefits obtained from the exploitation of the natural resources of maritime areas adjacent to the limits of the Area. /A special convention shall be negotiated on this subject./ 15/

OR (C)

Omit this provision.

14/ In connexion with some of the provisions of this draft the view was expressed that texts not covered by the Declaration of Principles and which might be at variance with it should not be proposed.

15/ It was proposed that if this text were adopted, the words "AND OBLIGATIONS" should be added after the word "RIGHTS" in the title of the article.

/...

Article 16

LEGAL STATUS OF WATER SUPERJACENT TO THE AREA, ETC.

(A)

/Except as provided in these articles, nothing herein/

Status of water column and air space (D.13 (a)) rights under existing international law.

/Neither these articles nor any rights granted or exercised pursuant thereto/ shall affect the legal status of the waters superjacent to the Area /as high seas/ or that of the air space above those waters.

/2. /Except as provided in these articles./ The use of the Area for the purpose of the exploration of the Area and the exploitation of its resources shall not conflict with freedom of navigation, fishing, scientific research, laying and maintenance of submarine cables and pipelines and other freedoms of the high seas./

(B)

Omit this provision.

Article 17

ACCOMMODATION OF ACTIVITIES IN THE MARINE ENVIRONMENT AND IN THE AREA

Activities in the Area

1. All activities in the marine environment shall /be conducted with reasonable regard for/ /not result in any unjustifiable interference with/ the exploration of the Area and the exploitation of its resources.

Other marine activities

2. The exploration of the Area and the exploitation of its resources shall /be conducted with reasonable regard for/ /not result in any unjustifiable interference with/ other activities in the marine environment.

NOTE: The Committee may wish to consider whether to include here or elsewhere in these articles a more detailed treatment of "non-interference rules" relating to such matters as prevention of interference with recognized sea-lanes and restrictions on resource exploitation in areas with a high pollution risk; see, for example, the USSR draft, articles 4, 10, 12, the United States draft, article 21, the Maltese draft, article 72, and other relevant texts.

/...

Article 18

RESPONSIBILITY TO ENSURE OBSERVANCE OF THE INTERNATIONAL REGIME AND LIABILITY FOR DAMAGES 16/

International responsibility (D.14)

/1./ Every State shall have the responsibility to ensure that activities in the Area, including those relating to /the exploration of the Area and the exploitation of/ its resources whether undertaken by governmental agencies, or non-governmental entities or persons under its jurisdiction, or acting on its behalf, shall be carried out in conformity with the provisions of these articles. The same responsibility applies to international organizations and their members for activities undertaken by such organizations or on their behalf. Damage caused by such activities shall entail liability, 17/ /on the part of the State or international organization concerned, in respect of activities which it undertakes itself or authorizes./ /A State Party to these articles shall be responsible for any damage caused to another State Party to these articles as a result of its activities on the sea-bed./

/2. A group of States acting together shall be jointly and severally responsible under these articles./

/3. Each Contracting Party shall:

(i) Take appropriate measures to ensure that those conducting activities under its authority or sponsorship comply with these articles;

(ii) Make it an offence for those conducting activities under its authority or sponsorship in the Area to violate the provisions of these articles; such offences shall be punishable in accordance with administrative or judicial procedures established by the authorizing or sponsoring party;

(iii) Be responsible for maintaining public order on manned installations and equipment operated by those authorized or sponsored by it;

16/ Although the Committee carried out a third reading of this article, it was agreed that the scope and complexity of the subject-matter were such that it would be necessary for the Committee to give further detailed consideration to the issues involved at a later stage. The view was expressed that the matter needed to be examined in the light of article 9, Who may exploit the Area".

17/ The Committee may wish to consider whether to include reference here to the question of limits of liability as well as to other liability questions.

(iv) Be responsible for damages caused by activities which it authorizes or sponsors to any other Contracting Party or its nationals;

(v) Be responsible for carrying out all measures necessary for the restoration or any damaged property or area to its condition immediately prior to such damage./

/4. Every /Contracting Party/ /State/ shall take appropriate measures to ensure that the responsibility provided for in paragraph 1 of this article shall apply mutatis mutandis to international organizations of which it is a member./

Article 19

ACCESS TO AND FROM THE AREA

Land-locked States /and other geographically disadvantaged States/ shall have /the right of/ /free/ access to and from the Area 18/ /in order to enable them to derive benefits, in accordance with the provisions of this Convention, from the Area and its resources/. 19/ 20/

Article 20

ARCHAEOLOGICAL AND HISTORICAL OBJECTS

(A)

1. Particular regard being paid to the preferential rights of /the State of country of/ /the State of cultural/ /the State of historical and archaeological/ origin, 21/ all objects of an archaeological and historical nature found in the Area shall be preserved /or disposed of by the Authority for the benefit of the international community as a whole./

18/ One delegation expressed the view that it might be useful to insert the words "all parts of" before the words "the Area".

19/ The view was expressed that the modalities of participation by States and other juridical persons or the Authority in activities in the Area, as well as benefits to be derived therefrom, should be dealt with in the appropriate provisions of this convention, and not under this article.

20/ The view was expressed that the formulation of this article could not be construed as discriminating in favour of land-locked States in terms of access to the Area.

21/ One delegation expressed the view that the first part of this paragraph, up to the word "origin" should be omitted.

/2. The recovery and disposal of wrecks and their contents more than /fifty/ years old found in the Area shall be subject to regulation by the Authority without prejudice to the rights of the owner thereof./

OR (B)

Omit this provision.

Article 21

SETTLEMENT OF DISPUTES 22/

All disputes arising out of the interpretation or application of these articles shall be settled in accordance with the provisions of article ... .

NOTE: An article of this kind, which does no more than foresee more detailed provision for settlement of disputes, may be all that is required under part I of these articles. Any further detailed consideration which the Committee may wish to give to this subject may take as a starting-point paragraph 15 of the Declaration of Principles. 23/

* * * *

Article 0

/INTERPRETATION/ /DEFINITION/

A definition article may be required when the negotiation is completed.

22/ Although the Committee carried out a third reading of this article, it was agreed that the subject of settlement of disputes should be considered further at a later stage.

23/ The view was expressed that article 21 was acceptable only if later coupled with procedures for the compulsory settlement of disputes.

* * * * *

NOTE: During the discussion of article 9 the following proposal was made by one delegation and it was agreed to reproduce the text of the proposal at the end of these draft articles since it contained some elements relating to various issues before the Committee:

1. All activities of exploration and exploitation shall be conducted pursuant to regulations promulgated by the Authority and no such exploration or exploitation shall be carried out except under and in conformity with such regulations and the provisions of this convention.

2. Regulations promulgated pursuant to paragraph 1 of this article shall include adequate provisions for:

(a) the orderly and rational exploration and exploitation of the Area and its resources;

(b) the securing of adequate measures of control by the Authority over all phases of the exploration, exploitation and marketing of the resources in order to secure the objectives of the common heritage of mankind;

(c) the widest and most equitable participation on a non-discriminatory basis, in the activities necessary for the exploration and exploitation of the Area and its resources including the provision of goods and services;

(d) the securing of the maximum benefits for mankind as a whole from the exploration and exploitation of the Area and its resources ensuring at the same time that such benefits are equitably shared having special regard to the interests and needs of developing countries, coastal and land-locked;

(e) the assurance to consuming countries, on a non-discriminatory basis, of adequate supplies at reasonable prices of the products arising from the exploration and exploitation of the Area and its resources, due regard being paid to the availability on fair and equitable terms of similar or competitive land-based products.

3. Regulations pursuant to this article shall be made on the recommendation of the Council and approved by the Assembly by a two-thirds majority present and voting, provided that such majority shall include at least a majority of the total membership of the Assembly.

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ON THE LAW OF THE SEA

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A/CONF.62/C.1/L.3/Corr.2
6 August 1974

ORIGINAL: ENGLISH

First Committee

DRAFT ARTICLES CONSIDERED BY THE COMMITTEE AT ITS INFORMAL MEETINGS

(Articles I-21)

Corrigendum

Page 4, article 4, paragraph 2

Fourth line: *for* exercise of rights *read* exercise of such rights

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UNITED NATIONS

THIRD CONFERENCE ON THE LAW OF THE SEA

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A/CONF.62/C.1/L.7
16 August 1974

ORIGINAL: ENGLISH

FIRST COMMITTEE

Text prepared by the Group of 77 and circulated in accordance with the decision taken by the Committee at its informal meeting on 16 August 1974

BASIC CONDITIONS

1. The area and its resources being the common heritage of mankind, the title to the Area and its resources and all other rights in the resources are vested in the Authority on behalf of mankind as a whole. These resources are not subject to alienation.

2. Title to the minerals and all other products derived from the resources shall not pass from the Authority except in accordance with the rules and regulations laid down by the Authority and the terms and conditions of the relevant contracts, joint ventures or any other such form of association entered into by it.

3. The Authority shall from time to time determine the part or parts of the Area in which activities relating to exploration and exploitation may be conducted.

4. All contracts, joint ventures or any other such form of association entered into by the Authority relating to the exploration of the Area and the exploitation of its resources and other related activities shall ensure the direct and effective control of the Authority at all times, through appropriate institutional arrangements.

5. The Authority may, if it considers it appropriate, enter into contracts relating to one or more stages of operations with any person, natural or juridical. These stages of operations may include the following: scientific research, general survey, exploration, evaluation, feasibility study and construction of facilities, exploitation, processing, transportation and marketing.

6. (a) The Authority shall establish appropriate procedures and prescribe qualifications on the basis of which persons natural or juridical may apply to the Authority for entering into contracts relating to one or more stages of operations.

(b) The selection from among applicants shall be made by the Authority on a competitive basis, taking into special account the need for the widest possible direct participation of developing countries, particularly the land-locked among them. The decision of the Authority in that regard shall be final and definitive.

C-1506

/...

7. Subject to the provisions of paragraph 6, a contractor who has fulfilled his contract regarding one or more stages of operations, as the case may be, to the satisfaction of the Authority shall have priority in the award of a contract for a further stage or stages of operations.

8. The rights and obligations arising out of a contract with the Authority shall not be transferred except with the consent of the Authority and in accordance with the rules and regulations laid down by it.

9. The Authority may, if it considers it appropriate, enter into a joint venture or any other such form of association with any person, natural or juridical, to undertake one or more stages of operations, provided, however, that the Authority shall have financial control through majority share and administrative control in such joint venture or other form of association.

10. The Authority shall ensure security of tenure to a contractor within the terms of the contract provided he does not violate the provisions of the Convention and the rules and regulations laid down by the Authority.

11. In case of a radical change in circumstances or "force majeure", the Authority may take appropriate measures, including revision, suspension or termination of the contract.

12. Any person, natural or juridical, entering into a contract, joint venture or any other such form of association with the Authority may be required to provide the funds, materials, equipment, skill and know-how necessary for the conduct of operations at any stage or stages, and to deposit a guarantee.

13. Any responsibility, liability or risk arising out of the conduct of operations shall lie only with the person, natural or juridical, entering into a contract with the Authority.

14. The share of the Authority in a contract, joint venture or any other such form of association may be, _inter alia_, in the form of the production or the proceeds from the resources.

15. (a) The Authority shall ensure that any person, natural or juridical, who enters into a contract, joint venture or any other such form of association with it undertakes to transfer to the Authority, on a continuous basis, technology, know-how and data relevant to the stage or stages of operations involved, during the life of such a contract, joint venture or any other such form of association.

(b) The Authority and any person, natural or juridical, who is a party to a contract, joint venture or any other such form of association, shall draw up a programme for the training of the personnel of the Authority.

/...

(c) The Authority shall further ensure that any person, natural or juridical, who enters into a contract, joint venture or any other such form of association with it, undertakes to provide at all levels training for personnel from developing countries, particularly the land-locked among them, and employment, to the maximum extent possible, to qualified personnel from such countries.

16. The Authority shall have the right to take at any time the necessary measures in order to apply the provisions contained in this Convention, particularly those relating to regulation of production.

17. The applicable law shall be solely the provisions of this Convention, the rules and regulations laid down by the Authority, and the terms and conditions of the relevant contracts, joint ventures and any other such form of association entered into by the Authority.

FIRST COMMITTEE
Informal

C.1/CRP.4
ENGLISH
26 July 1974

Text submitted by the Group of 77

Article 9

All activities of exploration of the Area and of the exploitation of its resources and all other related activities including those of scientific research shall be conducted directly by the Authority.

The Authority may, if it considers it appropriate, and within the limits it may determine, confer certain tasks to juridical or natural persons, through service contracts, or association or through any other such means it may determine which ensure its direct and effective control at all times over such activities.

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THIRD CONFERENCE ON THE LAW OF THE SEA

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16 August 1974

ORIGINAL: ENGLISH AND FRENCH

FIRST COMMITTEE

Belgium, Denmark, France, Germany, Federal Republic of, Italy, Luxembourg, Netherlands, United Kingdom of Great Britain and Northern Ireland: working document. Annex to the Law of the Sea Convention: conditions of exploration and exploitation

(Circulated in accordance with the decision taken by the Committee at its informal meeting on 16 August 1974)

In the view of the delegations co-sponsoring this working paper it is essential for conditions of exploration and exploitation to be included in any Law of the Sea Convention.

While this paper does not necessarily represent the final views of its co-sponsors, either as to substance or as to placement of the conditions, it is an illustration of the kind of conditions that would need to be included in the Convention. It is not a comprehensive and detailed set of conditions and is merely intended as an aid to the Committee's work on this subject.

I. Definition of activities

(i) Prospecting, evaluation and exploitation in the International Sea-bed Area of the resources referred to in article VI shall be subject to the conditions set out in this annex.

(ii) Prospecting means a general survey of a large area with a view to collecting data on the basis of which a determination can be made as to specific areas meriting evaluation. Prospecting may include all work involving geophysical and geochemical surveys and sea-bed sampling, excluding drilling deeper than 50 metres.

(iii) Evaluation means work, following prospecting, involving the use of considerable technical and financial means in order to confirm the existence, to evaluate the consistency and to demonstrate the exploitability of the resources of a specific area.

(iv) Exploitation means the extraction of resources for commercial and industrial purposes from a specific area.

II. Prospecting

(i) Prospecting shall be open in the international Sea-bed Area, other than in areas in respect of which contracts have been awarded in accordance with article III, subject to a detailed declaration being made to the Authority by the entity wishing to carry out prospecting.

(ii) The declaration shall indicate the area in which it is planned to carry out prospecting. The declaration shall be effective for two years and may be renewed. It shall not give any exclusive right in respect of the area.

(iii) The declaration shall cease to be effective as regards any part of the prospecting area concerned which becomes an area in respect of which a contract has been awarded.

(iv) The entity shall inform the Authority of the results of the prospecting undertaken. The results shall be held confidential by the Authority.

III. Award of contracts

(i) The Authority shall award contracts, in accordance with the procedure set out in paragraph (iii) below, giving an entity or group of entities the exclusive right to undertake the evaluation and exploitation (as defined in article I) of resources in a specific area.

(ii) In the case of a group of entities, they shall designate one of them who will represent them with respect to the Authority and who will exercise powers and accept responsibility on behalf of the group.

(iii) The Authority 1/ shall award contracts pursuant to the procedure set out below.

An application for a contract in respect of the evaluation and exploitation of a category, or categories, of resources in a specific area may be submitted to the Authority, except as regards an area in respect of which a contract has already been awarded with respect to the category, or categories, of resources referred to in the application.

The application shall include all relevant data, including results of prospecting for the resources in question in the particular area carried out by or on behalf of the applicant.

Such data contained in the application received by the Authority shall be held confidential. On receipt of the application the Authority shall award a contract provisionally to the applicant, provided the limitation specified in article IV is not exceeded. The award of such a contract shall be publicized immediately after it has been made. Provided that no competing application is received within one month after such publication the award of the contract shall become definitive.

1/ An organ of the Authority to be agreed upon.

/...

In the event that competing applications are received, the Authority shall reconcile such applications on the basis of the following objective criteria (to be determined). 1/

IV. Maximum number of contracts

An applicant may not hold more than six contracts at any one time in respect of each category of resources.

V. Assignment of contracts

In the case of an assignment the terms and conditions of the contract of the assignor shall continue to apply to the assignee.

VI. Categories of resources

Contracts shall be awarded for one or both of the two following categories of resources:

(i) liquid and gaseous hydrocarbons, helium, carbon dioxide and geothermal energy.

(ii) any mineral substance, in particular polymetallic and phosphate nodules.

VII. Size of areas

Areas, delimited by meridians and parallels according to a grid system drawn up by the Authority, shall, before the relinquishment referred to in article IX, have a maximum surface of:

(i) 9,000 sq. kms. in the case of the resources referred to in article VI (i) and,

(ii) 60,000 sq. kms. in the case of the resources referred to in article VI (ii) above.

VIII. Duration

(i) Contracts shall have a duration of 30 years. They shall thereafter be renewed every 10 years if the contractor so requests, for a maximum period of 50 years.

(ii) An area in respect of which a contract has been awarded shall be freed of any exclusive right:

1/ Proposals on this subject will be submitted by the co-sponsors in due course.

/...

1. at the end of the contract period or of a renewal period, if no further renewal period is requested in accordance with paragraph (i)

2. in the event of renouncement of the whole of the area.

(iii) Parts of an area relinquished or renounced shall likewise be freed of any exclusive right.

IX. Relinquishment and renunciation

(i) The contractor shall relinquish one third of the area in respect of which it has been awarded a contract before beginning any exploitation.

(ii) The contractor may at any time renounce the whole or part of the area in respect of which it has been awarded a contract.

(iii) Relinquishment or renunciation shall be carried out on the basis of the grid system referred to in article VII.

(iv) The Authority, within a period of three months after relinquishment or renunciation, shall publicize the areas, or parts of areas, which have been relinquished or renounced.

X. Work requirement

(i) The applicant shall undertake:

- to spend ... each year prior to exploitation (levels of expenditure, on a graduated scale, to be worked out)

- to begin exploitation within a period not longer than 10 years after the award of the contract and

- not to interrupt exploitation for more than 3 years, except in the case of *force majeure*, proof of which shall be submitted to the Authority.

(ii) In the event of an infringement of the obligations provided for in paragraph (i) the Authority shall give written notice to the contractor specifying the infringement and giving the contractor a reasonable period, in any case not less than six months, to remedy the infringement. If the infringement is not remedied within the period specified then the Authority shall terminate the contract on giving six months written notice to the contractor. If the contractor challenges the ground of termination, termination shall only take place in accordance with a decision given by the tribunal established under article ... of the Convention.

/...

XI. Participation of nationals of countries without sea-bed exploration and exploitation capability

The applicant shall indicate in his application the steps to be taken in order to ensure the participation in the activities envisaged of nationals of countries without sea-bed exploration and exploitation capability, with a view to ensuring the training of such nationals.

XII. Non-interference with other activities

(i) The work undertaken and safety zones established round installations and devices pursuant to article XV (ii), and in general activities exercised within the framework of this annex, shall not impede in an unjustifiable way the exercise of other lawful activities.

(ii) If areas relating to different categories of resources totally or partially overlap, each contractor shall exercise its respective activity in such way as not to impede in an unjustifiable way the activity of any other contractor.

XIII. Regulatory arrangements

(i) The necessary measures shall be taken to:

(a) protect the installations and devices referred to in article XV (i)

(b) enforce technical rules, particularly with a view to the maximum exploitation of resources, compliance with security measures; and protection of the environment.

(ii) The Authority shall be notified of the measures taken in implementation of paragraph (i).

(iii) (Questions of private law).

(iv) The contracts awarded by the Authority shall contain provisions relating to the safety of human life, the protection of the environment and non-interference with legitimate uses of the sea.

XIV. Inspection and supervision information to be supplied to the Authority

(i) The Authority shall be entitled to carry out inspection and supervisory measures, in accordance with the terms of the contract, in order to ensure that work is undertaken in conformity with this Convention and its annexes.

(ii) The contractor shall place at the disposal of the Authority any information concerning resources it has collected during work carried out in an area.

/...

XV. Installations and devices and safety zones

(i) For the purpose of this annex "installations and devices" means:

(a) platforms and other fixed devices, as well as their attachments

(b) ships, marine installations and floating devices and

(c) underwater habitats and vehicles, either floating, standing on, or moving over, the sea-bed

which are used for the purposes of evaluation or exploitation.

(ii) A "safety zone" shall be established around the installations and devices referred to in paragraph (i) (a), up to a distance of 1,000 metres measured horizontally from each point of the external limit of such installations and devices.

XVI. Marking of installations and devices and publicity to be given to nautical information

(i) Marine marking of installations and devices and safety zones shall be established and maintained, in conformity with international rules.

(ii) Appropriate publicity shall be given to nautical information relating to evaluation and exploitation.

* * *

Financial arrangements

To be determined.

Settlement of disputes

To be determined.

* * *

UNITED NATIONS

THIRD CONFERENCE
ON THE LAW OF THE SEA

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A/CONF.62/C.1/L.9
19 August 1974

ORIGINAL: ENGLISH

FIRST COMMITTEE

Japan: working paper on conditions of exploration and exploitation

This working paper is intended to outline the preliminary position of the Japanese delegation on a number of essential points concerning conditions of exploration and exploitation which, in our view, should be included as an integral part in this Convention as an appendix or other appropriate form.

The Japanese delegation is aware of certain difficulties involved in drafting, in the Law of the Sea Conference, a complete set of rules for conditions of exploration and exploitation. The conditions contained herein are therefore not exhaustive.

Basic rules and regulations regarding the conditions of exploration and exploitation

I. Activities to be regulated

All activities of exploration and exploitation shall be carried out through either registration or contracts with the Authority in conformity with the provisions of this Convention and the rules and regulations contained herein (hereinafter referred to as the "Rules"). Such activities shall be divided into three phases:

(i) General survey

(ii) Development activities

(a) Evaluation

(b) Exploitation

II. Eligible entities

Only the following entities may register or conclude contracts with the Authority for the purpose of conducting general survey, evaluation and exploitation:

(a) Contracting Parties,

(b) group of Contracting Parties, and

/(c) natural or juridical persons of such a Party or Parties/

III. Registration for general survey

1. Definition of general survey

General survey is an activity carried out prior to evaluation for the purpose of locating and identifying potential mineral deposits. Such activities include bottom sampling by means of dredging and drilling up to the depth of /   / 1/ metres from the surface.

2. Procedure for registration

An eligible entity desiring to conduct general survey shall submit to the Authority a written statement which shall specify inter alia:

(a) mineral or minerals which are the object of general survey,

(b) the approximate location of the area in which the general survey is to be conducted,

(c) general description of the activities, and

(d) expected duration of the work.

3. Registration shall give the registering entity non-exclusive right to conduct general survey for a period of two years from the date of registration. The right shall be renewed for additional periods of two years upon notification to the Authority of the intention of renewal.

4. The registering Contracting Party or Parties may delegate its rights and obligations derived from the registration to its natural or juridical persons /or such persons of other Contracting Parties/.

The delegating States shall be responsible to ensure that the activities of such natural or juridical persons be carried out in conformity with the provisions set forth in this Convention, these Rules and the rules to be made by the Authority pursuant to this Convention.

IV. Contract for development

1. Definition of development

(i) "Evaluation" is activities which follow general survey and which have as their objective to ascertain the total quantity, grades, population or concentration of mineral deposits in a contract area, as well as environmental and other factors affecting remunerativeness of mining.

(ii) "Exploitation" is extraction of minerals for commercial purposes whether or not there is profit.

1/ The exact depth to be determined by the Authority on the basis of expert opinions and taking into account the need of protecting the marine environment.

/...

2. Contractors

(i) Evaluation and exploitation shall be conducted only under contracts between the Authority and the eligible entities.

(Such entities which have concluded contracts with the Authority shall hereinafter be referred to as "Contractors".)

(ii) The recipient Contracting Party or Parties may delegate the rights and obligations under the contract with the Authority to its natural or juridical persons /or such persons of other Contracting Parties/ (hereinafter referred to as "sub-contractors").

The delegating States shall be responsible to ensure that the activities of such natural or juridical persons be carried out in conformity with the provisions set forth in this Convention, these Rules and the rules to be made by the Authority pursuant to this Convention.

3. Categories of minerals

Contracts shall be concluded with respect to the following categories of minerals:

(i) manganese nodules,

(ii) other hard minerals found on the surface and subsoil of the Area, and

(iii) minerals in the subsoil of the Area in fluid or gaseous state such as oil and natural gas.

4. Nature of rights under development contracts

(i) The rights of a Contractor under a development contract shall be exclusive with respect to the category of mineral or minerals which is the object of the contract within the contract area.

(ii) The rights of a sub-contractor may be transferred, subject to notification to the Authority to any other natural or juridical person of the delegating Contracting Parties or group of delegating Contracting Parties.

5. Qualifications of proposers

An entity proposing to conclude a development contract with the Authority shall satisfy the following conditions:

(i) technical and financial competence to be determined by the rules to be adopted by the Authority pursuant to this Convention. The Authority may require of the proposing entity a guarantee as an evidence of its financial competence.

/...

(ii) (in the case of an exploitation contract)

The proposer must be conducting or have conducted evaluation activities under a contract.

6. Contract area

(i) The International Sea-Bed Area shall be divided into areas to be defined by co-ordinates of latitude and longitude. Each area shall have, to the extent possible, equal size and a serial number.

(ii) The size of a contract area shall be for

minerals of category (i)....... square km 1/
" " " (ii)....... square km
" " " (iii)....... square km

7. Procedure for award of contracts

(i) An eligible entity desiring to conclude a development contract shall submit a proposal of contract in a written form which shall specify, inter alia:

(a) the category of mineral to be developed,

(b) the serial number of the area to be covered,

(c) (where a Contracting Party intends to delegate its rights under the contract to its natural or juridical persons /or to those of other Contracting Parties/ the name and qualification of such persons).

(ii) Subject to the provisions of paragraphs 8 and 9 below, the Authority shall conclude a contract with the proposer when his proposal has been made in strict conformity with the provisions of these Rules and of the rules to be made by the Authority pursuant to this Convention. However, no contract of exploitation shall be awarded with respect to a mineral or minerals in the same category in a contract area for which a contract of evaluation has been awarded and is still in force.

8. Selection of contractor in case of competing proposals

(i) A proposal received shall be kept sealed by the Authority for /one/ month. At the end of that period, the proposal shall be opened. If no competing proposal is received and if the Authority is satisfied that the proposal concerned meets the conditions of these Rules and relevant rules to be made by the Authority pursuant to this Convention, the Authority shall conclude a contract with that entity within /three/ months.

1/ The size shall be determined by the Authority taking into account expert opinions. 60,000 square km is considered as an optimum size for the mineral of category (i).

/...

(ii) In cases where more than one proposal is submitted by the end of the period of /one/ month with respect to the same category of a mineral or minerals in the same contract area, there shall be consultations among the proposers concerned with a view to reconciling the competing proposals.

(iii) If no agreement is reached within /five/ months from the date of the opening, the Authority shall select the Contractor taking into account the following factors:

(a) number of the contracts awarded to the proposers so that fair and equitable opportunity be accorded to all prospective contractors,

(b) needs of mineral resources imports of the Contracting Parties in particular such needs of developing Contracting Parties,

(iv) If selection cannot be made in accordance with subparagraph (iii) above, there shall be an auction. The contract shall be awarded to the highest bidder.

9. <u>Procedure during the first phase of the establishment of the Authority of this Convention</u>

No contract shall be awarded by the Authority during the /three/ months after the establishment of the Authority.

10. <u>Duration and renewal of contract</u>

(i) Unless otherwise provided for in these Rules, the contract shall be valid:

(a) for an evaluation contract, /fifteen/ years and

(b) for an exploitation contract, /twenty/ years.

(ii) An exploitation contract shall be renewed for additional periods of /ten/ years at the request of the Contractor.

11. <u>Transition from evaluation to exploitation</u>

Upon attainment of commercial production 1/ the Contractor of an evaluation contract shall propose to the Authority to conclude a contract of exploitation. The Authority shall award the contract within /three/ weeks.

V. Obligations

1. <u>Compliance with these Rules and other standards</u>

(i) Entities conducting general survey, evaluation and exploitation shall comply with the terms and conditions of these Rules and the provisions of the rules to be adopted by the Authority pursuant to this Convention.

1/ To be defined in terms of the quantity of ores to be mined per year.

/...

(ii) These entities shall also comply with other international standards relating to:

(a) operational standards

(b) navigational safety

(c) preservation of marine environment

(d) installations and devices

2. Relinquishment

Upon attainment of commercial production, the Contractor shall renounce /one half/ of the contract area. The relinquishment shall be made in such a way as not to prevent full utilization of the mineral resources of the renounced portion.

3. Work requirements

(i) During the evaluation stage the Contractor shall expend such amounts as are specified in the rules to be adopted by the Authority.

(ii) The amount shall be determined at a level which will discourage the freezing of contract area for speculative or other purposes.

VI. Participation of nationals of developing countries

(i) Promotion of the employment of qualified personnel from developing countries

(ii) Training of personnel of developing countries including the establishment of training centres.

VII. Financial arrangement

(To be elaborated)

VIII. Measures to ensure compliance

1. Inspection

(i) Objective of inspection

Inspection may be conducted by the Authority with a view to ascertaining compliance with the obligations under article V of these Rules.

The Authority may also conduct inspection for the purpose of verifying the exact quantity of minerals produced by the Contractor.

In case the rights of Contracting Parties under the development contract are delegated under article IV, such Parties shall be responsible for inspection.

/...

(ii) Modalities of inspection

Inspection shall be carried out by any of the following means:

(a) study of the reports of the Contractor including work plans

(b) on-the-spot inspection of mining sites.

2. Suspension and termination of contracts

(i) In conformity with the provisions of articles .... on settlement of disputes of this Convention, the Authority may suspend or terminate the contract if the Contractor is found to have violated the terms and conditions of the contract, these Rules and the rules to be adopted by the Authority pursuant to this Convention.

(ii) Force majeure

(To be elaborated)

3. Compensation of damage

(i) Liability

Entities shall be liable for damage caused by their activities of general survey, evaluation and exploitation to other users of the marine environment. In case a Contracting Party delegated its rights and obligations to natural or juridical persons in accordance with the provisions of articles III and IV, such natural or juridical persons shall be liable for damage.

(ii) Pollution damage

If damage is caused by pollution arising from the activities of entities conducting general survey, evaluation and exploitation, such entities shall be absolutely liable for such damage. However, in the case of delegation of the rights and obligations under articles III and IV, the operator shall be absolutely liable for such damage.

(iii) Insurance

(To be elaborated)

IX. Settlement of disputes

(To be elaborated)

UNITED NATIONS

THIRD CONFERENCE ON THE LAW OF THE SEA

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23 August 1974

ORIGINAL: ENGLISH

FIRST COMMITTEE

STATEMENT OF ACTIVITIES

Prepared by the Rapporteur

Note: The following paragraphs, and their attachments, give an account of the activities of the First Committee. The objective is to provide a document of record and reference which will enable the Committee to continue without delay consideration of the subject-matter before it at the next session of the Conference.

I. ESTABLISHMENT OF THE COMMITTEE

The First Committee was one of the three Committees of the whole established at the first session of the Conference to deal with the subjects covered by the three Sub-Committees of the Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor beyond the Limits of National Jurisdiction.

The members of the Bureau are:

Chairman	Mr. P. B. Engo - United Republic of Cameroon
Vice-Chairmen	Mr. S. M. Thompson Flores - Brazil
	Mr. Harry Wünsche - German Democratic Republic
	Mr. T. Iguchi - Japan
Rapporteur	Mr. H. C. Mott - Australia

II. MANDATE OF THE COMMITTEE

By decision of the Conference on 2 July 1974 (A/CONF.62/29), upon the recommendation of the General Committee, the First Committee has the task of considering the following items from the list of subjects and issues:

Item 1. International régime for the sea-bed and ocean floor beyond national jurisdiction

1.1 Nature and characteristics
1.2 International machinery: structure, functions, powers
1.3 Economic implications
1.4 Equitable sharing of benefits bearing in mind the special interests and needs of the developing countries whether coastal or land-locked
1.5 Definition and limits of the area
1.6 Use exclusively for peaceful purposes

Item 23. Archaeological and historical treasures on the sea-bed and ocean floor beyond the limits of national jurisdiction

The Conference also agreed that the following understanding reached in the Sea-Bed Committee on 27 August 1971 should be carried forward in respect of the Committees of the Conference:

"While each sub-committee will have the right to discuss and record its conclusions on the question of limits so far as it is relevant to the subjects allocated to it, the main Committee will not reach a decision on the final recommendation with regard to limits until the recommendations of Sub-Committee II on the precise definition of the area have been received, which should constitute basic proposals for the consideration of the main Committee."

III. DOCUMENTATION

By operative paragraph 6 of resolution 3067 (XXVIII), the General Assembly referred to the Conference the reports of the Sea-Bed Committee and all other relevant documentation of the General Assembly and the Committee. The First Committee thus has before it all the documentation from Sub-Committee I of the Sea-Bed Committee, including in particular the texts illustrating the areas of agreement and disagreement on items 1 and 2 of the Sub-Committee's programme of work (A/9021, vol. II).

Documents presented in the Committee during the second session of the Conference are listed in annex 1.

IV. WORK OF THE COMMITTEE

During the second session of the Conference in Caracas from 20 June to 29 August, the First Committee worked through formal and informal meetings. It held 17 formal meetings and 23 informal meetings.

At a meeting on 10 July, the Committee accepted a proposal by the Chairman that it should start work with a brief general discussion to enable representatives to comment on issues of fundamental importance, so as to facilitate efforts to reach agreement on the major issues over which wide differences of view existed. The Chairman proposed that at the end of this discussion the formal committee should be converted into an informal body of the whole, to examine the preparatory material sent forward from the

Sea-Bed Committee with a view to eliminating brackets and alternatives and thus to build up areas of agreement. The Committee agreed to the Chairman's proposal that Mr. C. W. Pinto of Sri Lanka should be Chairman of its informal meetings.

Sixty-six delegations spoke during the general discussion from 11 to 17 July. An index of the summary records of the Committee, including the list of those who spoke in the discussion is at annex 2.

Subsequently, at a further series of meetings, the Committee discussed the economic implications of mining in the deep sea-bed. As a basis for this discussion, a representative of UNCTAD and the Special Representative of the Secretary-General presented reports to the Committee on the subject; as a further aid to discussion the Chairman of the Committee issued a note (A/CONF.62/C.1/L.2) listing these reports and incorporating summaries and conclusions of them. During the discussion of this question 38 delegations made statements and raised questions which were answered by representatives of the Secretariats of the United Nations and UNCTAD. The statements of those representatives who took part in the discussion are also listed in annex 2. A working paper was tabled on the subject of the economic effects of deep sea-bed exploitation (A/CONF.62/C.1/L.5).

As an aid to understanding of the subject of economic implications, the Chairman of the Committee arranged two informal seminars on 31 July and 1 August 1974. For the information of the Committee the Chairman summarized the discussions in the seminars at the 13th meeting of the Committee (A/CONF.62/C.1/SR.13). In addition, at the Committee's 14th meeting the Chairman summarized further discussion which had taken place in the Committee (A/CONF.62/C.1/SR.14). His summaries contained personal views and were not binding on any delegation.

/A further sentence will relate to action in regard to the proposal made for a follow-up study in accordance with General Assembly resolution 2750 A (XXV)/

Three documents were tabled and introduced on the subject of Conditions of exploration and exploitation (A/CONF.62/C.1/L.6, 7 and 8).

At its 14th meeting on 19 August, the First Committee established a Working Group to pursue negotiations on articles 1-21 relating to principles of the régime, as contained in document A/CONF.62/C.1/L.3, and particularly on article 9 thereof, and on the subject of conditions of exploration and exploitation. The Committee agreed that the Working Group should be limited in number but open-ended so that any State could participate in its activities and entrusted the Chairman of the Committee with the duty of conducting consultations to establish the membership of the group. The Committee also agreed that Mr. C. W. Pinto of Sri Lanka should be Chairman of the Working Group and that he should report as appropriate to the Committee.

As a result of his consultations, the Chairman of the Committee said at its 16th meeting on 21 August that general agreement had been reached that the Working Group should consist of 50 States, made up of nine representatives of each of the five geographical groups plus five representatives of sponsors of individual proposals before the Committee. He announced the composition of the Working Group as follows:

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(a) African Group: Algeria, Egypt, Ghana, Lesotho, Madagascar, Mali, Morocco, Nigeria and the United Republic of Tanzania.

(b) Asian Group: Afghanistan (alternating with Nepal), China, India, Iran, Kuwait, Pakistan, Philippines (alternating with Indonesia), Singapore and Yugoslavia.

(c) Eastern European Group: Bulgaria, Byelorussian Soviet Socialist Republic, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania, Ukrainian Soviet Socialist Republic and Union of Soviet Socialist Republics.

(d) Latin American countries: Bolivia, Brazil, Chile, Honduras, Jamaica, Mexico, Peru, Trinidad and Tobago and Venezuela.

(e) Western European and Others Group: Austria, Canada, Germany, Federal Republic of, Italy, Netherlands, Norway, Sweden, Switzerland and United Kingdom of Great Britain and Northern Ireland.

(f) Sponsors of proposals before the Committee: Australia, Colombia, France, Japan and the United States of America.

A number of delegations stated views in regard to the establishment and functioning of the Working Group. The Chairman made a number of comments in response to these remarks. The statements of the delegations concerned and the comments of the Chairman are in the summary records of the 14th, 15th and 16th meetings of the Committee (A/CONF.62/C.1/SR.14-16).

V. WORK OF THE INFORMAL COMMITTEE

During the session the Chairman of the informal Committee reported to the Committee on progress made. By decisions of the Committee his statements appears <u>in extenso</u> in the records of the 9th, 11th and 14th meetings. His reports contained personal views and were not binding on any delegation.

The informal Committee reviewed draft articles 1-21 relating to principles of the régime, as set forward by the Sea-Bed Committee and contained in its report (A/9021, vol. II). The results of its work on those articles are before the Committee in document A/CONF.62/C.1/L.3. During consideration of the draft articles, it was agreed that there should be an article on definitions and that the terms to be dealt with and their interpretation would be decided at a later stage.

Upon completion of consideration of the draft articles, the Chairman suggested three issues which should be the subject of detailed study:

(a) the system of exploration and exploitation: who may explore and exploit the area?

(b) the conditions of exploration and exploitation;

(c) the economic implications of sea-bed mining.

It was agreed that, although the issues would be considered in that order, representatives could make relevant reference to other issues.

Discussion of the system of exploration and exploitation (the first issue), proceeded on the basis of the four alternative texts of draft article 9 prepared by the Working Group of Sub-Committee I of the Sea-Bed Committee. During the discussion, several new proposals were made. A new text was introduced to replace alternatives (B) and (C) of article 9; this new text is alternative (B) in document A/CONF.62/C.1/L.3. Another new proposal was introduced to replace the former alternative (C). Alternatives (A) and (D) of the original text remained unchanged. In addition, one delegation proposed a new text of two articles. The first of those was later considered to have been absorbed into the revised alternative (B) mentioned above; the second is reproduced at the end of document A/CONF.62/C.1/L.3.

During its consideration of the conditions of exploration and exploitation (the second issue), the informal Committee received three working papers which were subsequently tabled in the Committee as documents A/CONF.62/C.1/L.6, A/CONF.62/C.1/L.7 and A/CONF.62/C.1/L.8 (see annex 2).

The informal Committee did not discuss the economic implications of sea-bed mining (the third issue) because this subject was taken up at the level of the Committee (see part IV of the statement of activities above).

VI. WORK OF THE WORKING GROUP

/After the Chairman of the Working Group has reported to the Committee, a paragraph will be inserted/

VII. FUTURE WORK

The First Committee made useful progress at this session of the Conference towards completion of the mandate assigned to it by the Conference. It recommends that the opportunity should be provided for it to continue this work at a further session, with a view to completing the drafting of articles dealing with the international régime and machinery for exploration of the sea-bed beyond the limits of national jurisdiction and the exploitation of its resources.

When it resumes work the Committee will have before it, in accordance with General Assembly resolution 3067 (XXVIII), all reports of the Sea-Bed Committee and all other relevant documentation of the General Assembly and the Committee, and all of the documents presented at the second session as listed in annex 1.

U N I T E D   N A T I O N S

Press Section
Office of Public Information
United Nations, N. Y.

(FOR USE OF INFORMATION MEDIA -- NOT AN OFFICIAL RECORD)

Press Release SEA/145
28 August 1974

FIRST COMMITTEE OF CONFERENCE ON SEA LAW ENDS WORK FOR YEAR

(The following was received from a United Nations Information Officer attending the Conference in Caracas.)

The First Committee (sea-bed regime and machinery) of the Third United Nations Conference on the Law of the Sea completed its work for the session yesterday afternoon (27 August) in Caracas.

Before concluding, the Committee heard a statement by the Chairman of its newly created Working Group, Christopher W. Pinto (Sri Lanka), outlining the main issues on which negotiations had taken place in that Group during the past week concerning the future legal regime for the sea-bed and particularly the problems of who shall exploit the sea-bed and how.

In connexion with the Group's work, Mr. Pinto remarked: "In my opinion, a good deal of progress has been made, and a sound foundation laid for further work."

In a statement assessing the Committee's work over the past two months, its Chairman, Paul Bamela Engo (United Republic of Cameroon), declared that the "Central issue" before the Committee -- what entities will be able to exploit the sea-bed -- "is more ripe for negotiations now than it ever was".

The Committee took note of a statement on its activities during the session, prepared by its Rapporteur, H. C. Mott (Australia). The Committee Secretary, Jean-Pierre Levy, informed it that in accordance with a continuing mandate under General Assembly resolution 2750 A (XXV) of 1970, the Secretariat would prepare for the next session of the Conference next year, a brief follow-up study on the economic implications of sea-bed mining, taking account of the discussions held on that matter.

Report on Working Group by Chairman

In his oral report on the first six meetings of the Working Group since it began work on Wednesday, 21 August, Mr. PINTO, Chairman of the Group, said it had started by discussing draft article 9, on who may exploit the sea-bed, and particularly the proposed text for that article presented by the "Group of 77" developing countries (for details of proposal, see Press Release SEA/100 issued on 31 July).

(more)

Reviewing the issues raised during that discussion, Mr. Pinto first said it might be necessary to make specific reference to States and enterprises among the entities with which the proposed world authority could contract for sea-bed exploration and exploitation, so as to take account of the apprehensions of "States in which the juridical concept of the private company has been rejected".

Other issues which might have to be considered, he continued, were whether rights to participate in exploitation should be conferred only on States Parties to the future sea convention or on all States, and how to ensure compliance with the convention by States that were not parties to it.

He then turned to the question of how much discretionary power the authority should have and the limits that should be imposed on it by the future sea convention.

Noting the "uncertainty and a lack of confidence in the minds of those to whom access to sea-bed minerals is vitally necessary for economic growth and stability", he said it might be necessary to allay those apprehensions by including wording that would require the authority to exploit the area in accordance with the convention, with "no possibility for inaction on the part of the authority".

It might also be desirable, he said, to demonstrate that the authority would not have the same wide range of discretion as a State; the inclusion of basic conditions that would limit or orient the discretionary power of the authority would be welcome to some States. It might also be necessary "to make explicit the non-discriminatory nature of the system of selection" employed by the authority when it made contracts with outside entities for sea-bed activities.

There were other possibilities for limiting the authority's discretion, by requiring that contracts be awarded to entities within a State only with the concurrence of that State, and by specifying the number of contracts that might be awarded to a single country, he said.

Finally, in regard to the exercise of control by the authority over its contractors, he mentioned the view that such control over the affairs of a private company could "easily degenerate into interference", and he suggested that it was important to discuss the means of control, including visits and inspectors.

Concluding Remarks of Committee Chairman

The Committee CHAIRMAN, in his concluding statement, recalled "the grave gulfs of divergent opinions" and the "monumental difficulties" which had faced the Committee at the start of its work.

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The Committee, he believed, had "set in motion the processes of negotiations" and had "continued to remove obstacles". It had done "some housework, tidying up the misgivings" expressed on some of the 21 draft articles dealing with the future sea-bed regime, an activity which "exposes more than ever the main issues which must be negotiated".

The fact had been underlined, he went on, that the Committee could not advance its work before resolving the central issue of who shall exploit the sea-bed and the "off-shoot" issue of the conditions under which sea-bed activities should be carried out. There had been a consensus on the need for measures to ensure that adverse economic effects of sea-bed mining on the developing countries were minimized or eradicated, where possible.

"The major choice for us as a generation was between exploitation by the new international authority and the de facto monopoly of a few technologically developed countries under a licensing system", he stated. There had been "some movement" on the part of supporters of the first of those approaches, but "there is room for more movement here, especially on the part of some of the technologically developed nations".

He went on to say that "realistic negotiations have commenced". In view of the nature and complexity of the issues, the diversity of interests, the size of the Conference and the revolutionary ideas being discussed, "that is definitely progress". However, "we do not have, as a Committee, much to show as the results of negotiations".

He would encourage informal consultations between now and the next session, to which "we must come back in a negotiating mood", he declared.

"We can no longer tolerate a world dominated by a privileged few to the detriment of all others", the Chairman remarked. "The guarantee of equitable distribution of resources and benefits to all is what must preoccupy our endeavours, not the quest for new power or the strengthening of that which is already held", he stated.

The representatives of India, Egypt and Guinea commented on the work done during the session and stressed the importance of the draft article submitted by the "Group of 77" on who shall exploit the sea-bed.

P. C. RAO (India) expressed hope that all concerned would reciprocate the efforts of the developing countries to achieve agreement.

HUSSEIN A. K. HASSOUNA (Egypt) said the Conference must prevent sea-bed resources from becoming the object of "sheer greed and uncontrolled competition".

AMADOU B. KEITA (Guinea) said the developing countries' proposal sought to protect "resources which belong to everybody".

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CONFERENCE ON THE LAW OF THE SEA
Second Session, Caracas, Venezuela
STATEMENT BY C. W. PINTO (SRI LANKA)
Committee I, 11 July 1974

Mr. Chairman,

When we first met many years ago now, in New York, you had already won the respect and admiration of your colleagues through your outstanding qualities as a lawyer and diplomat. Those qualities have been proved again and again during your Chairmanship of the Committee on Friendly Relations and Cooperation among States, and your Chairmanship of Sub-Committee I of the Committee on the Peaceful use of the Seabed and Ocean Floor beyond the limits of National Jurisdiction.

Although the fearless champion of the young and small countries, you have, in your capacity as a Chairman, always dealt fairly and impartially with every country, large and small, and regardless of ideological persuasion and political and economic power. Over the years we have come to know you as a leader of unerring judgement and an eloquent advocate of the cause not only of the people of your own country, but of people everywhere struggling bravely to shape a better world for themselves. Your direction of the work of Sub-Committee I of the Committee on the Peaceful Uses of the Seabed and Ocean Floor beyond the limits of National Jurisdiction enabled it to make substantial progress and has brought us to a point where we are - at least in sight - of our goal of a new treaty on the Seabed beyond national jurisdiction. On behalf of my Delegation, I pledge to you and to the other members of the Bureau our fullest support and cooperation as you resume guidance of the work of this Committee of the Conference.

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In accordance with your wishes, Mr. Chairman, my Delegation would like to make a statement concerning what we believe to be the principal issues before this Committee, They fall roughly into two groups: 1) those relating to the fundamental principles of the international regime and 2) those relating to the structure and functions of the international authority.

Of the issues relating to the principles of the regime, we may first mention the limits of the area of the seabed beyond national jurisdiction, the subject of Article I of the text attached to the Report of Sub-Committee I of the Seabed Committee. The question of these limits was not fully discussed in the working Group, and it was felt that a final decision concerning those limits would depend on the results of discussions on this item, as a whole, and of the limits of national jurisdiction over the seabed in particular in what is now Committee II of this Conference. However, we may note three basic approaches reflected under Article I: the first, which will set the limits of the Area seaward of the limit of national jurisdiction established at the 500 meter isobath or 100 nautical miles from the coastal States baselines; a second, which would adopt as the limit of the Area the seaward limit of a Coastal Seabed Area of a breadth to be specified; and a third, which would have the Area commence at the lower edge of the continental margin or, if the edge were closer than 200 miles of the coast, then from a distance of 200 miles of the coast. It is, perhaps, too soon to say whether earlier serious objections to what was felt to excessive claims of coastal State national jurisdiction may be modified in an overall political compromise, but it seems evident that the possibilities for such compromise would be greatly enhanced if agreement could be reached

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on two related matters: viz. 1) the extent to which and the conditions upon which landlocked States and States which consider themselves geographically disadvantaged might be permitted to explore and exploit the area within exclusive coastal State jurisdiction; and 2) whether a coastal State whose continental margin extends beyond a numerically specified outer limit of jurisdiction might be willing to consider sharing with the international community, as represented perhaps by the proposed international seabed authority, the resources and other benefits of the area between that specified outer limit and the edge of the continental margin.

A second problem relates to the activities to be governed by the articles we are attempting to draft. Differences of approach on this matter are reflected, for example, under Articles 3, 7, 13, 14 and 15, and there would appear to be three such basic approaches: <u>first</u>, that <u>all</u> activities of whatever nature and scope (and by implication, therefore, activities of all kinds and not merely those related to commercial mineral exploitation) should be covered; <u>second</u>, that only exploration and exploitation of the resources of the Area and other related activities should be covered. A <u>third</u> approach may be viewed as a refinement of the second, in that while it limits the application of the Articles to resource exploration and exploitation, it would in terms be more precise in specifying "<u>industrial</u> exploration and exploitation" as the regulated activity, thus by implication emphasizing that scientific research unconnected with these activities should be free from such regulation.

A third and related problem concerns scientific research itself,

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dealt with under Article 11. The divergence of views on this matter was already foreshadowed in our observations on the activities to be regulated under the regime: thus, while some States advocate freedom of scientific research, others take the position that scientific research must be subject to certain controls not only in the interests of the security of States, in particular coastal States, but also in order to ensure the observance of certain environmental safeguards and the collection and dissemination of data collected through such investigations, data which are regarded by some as part of the benefits derived from the common heritage of mankind.

While it is perhaps too early to predict the course of negotiations, it may be worth noting that States which do not favour controls for scientific research have on occasion advocated, and I quote: "maximum freedom for scientific research". In this phrase perhaps lies the germ of a possible compromise. For my Delegation believes that among those who favour regulation of scientific research, few - if any - would wish to burden research scientists, those who work tirelessly to roll back the frontiers of human knowledge, with any but the minimum of controls. Between those who advocate "maximum freedom" and those who insist on minimal control, a good deal of common ground may be found, and even possibly a means or resolving many of the differences connected with the second and third problems we have noted. Agreement on an interpretation of the term "scientific research" could also help. Without attempting to draft at this stage we may suggest that "scientific research" covers that detailed observation and analytical activity which has as its <u>sole</u> objective a better understanding of the nature and characteristics of the Area and its resources and the physical

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environmental factors affecting them.

A fourth problem concerning the principles has also been foreshadowed earlier in our statement: viz. access to and from the Area for landlocked States and those States which consider themselves geographically disadvantaged. A State may, for example, have to traverse areas of the sea falling within the territorial jurisdiction of other States in order to reach the Area. The right of such a State to unimpeded access to the Area should be enshrined in the Articles which should specify that the excercise of this right would be the subject of negotiation and agreement between the States concerned. There is a problem of definition too. The term "geographically disadvantaged State" has given rise to considerable controversy: there would appear to be few States in the world who could not, with some justification, claim to be "geographically disadvantaged in some respect. Strictly applied, it could imply that the only country not so disadvantaged would be an island with a gradually sloping continental or insular shelf extending in all directions to a distance of 200 miles, and which has no neighbour in any direction for at least a distance of 400 miles. We do not say this, Mr. Chairman, in any way to make light of the difficulties that this group of countries undoubtedly has, but to draw attention to the problem of definition that needs to be solved. We need to recognize the limits of this problem: the difficulties of these countries must be acknowledged; at the same time, those countries must themselves realize that a transit State, while having continuous open access to the sea, might be much less well-endowed from the point of view of natural resources than they are and that, consequently, the transit State might seek to use its geographical advantage to redress what it may well regard as a "geological" disadvantage.

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This balance and mutuality might be ensured through first granting the right, and then providing that the modalities of the exercise of that right are to be worked out in direct bilateral negotiations.

I would now like to refer to perhaps the most important matter and one that lies at the very heart of our work: viz. the system under which the seabed area beyond national jurisdiction may be explored and exploited for the benefit of mankind as a whole. As a first step we may consider some very simple facts: 1) The sea-bed and ocean floor beyond the limits of national jurisdiction, as well as the resources of that Area, are the common heritage of mankind. Consequently, the area and its resources must be explored and exploited in such a way that the benefits derived must be made available to mankind as a whole, particular consideration being given to the interests and needs of the developing countries. 2) The technology and financial resources needed to exploit the area and its resources, and even to make the fullest use of the data and raw materials deriving from such activities, is today in the possession of a very few,in a handful of States. In many cases those who possess the technology are not State enterprises, and cannot, in view of the prevailing system of government, be compelled to contribute their knowledge, their funds, their efforts and their risk, for the good of the international community. They have to be attracted into the position of agents of the international community. The knowledge, funds and equipment they possess, and which the community needs, have been built up through painstaking and protracted effort of individuals, who may be expected to retain a proprietary interest in their achievement. The

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attraction we shall have to offer to them will be money, but not only money, but a chance to grow, expand and develop. 3) Although the ocean floor may contain limitless wealth, what we know of here and now, is the presence on the surface of certain areas of nodules containing a large amount of manganese, and relatively small amounts of such useful metals as copper, nickel and cobalt. It is the exploitation of these "manganese nodules" that we shall have, for the most part, to plan for at the present time. 4) The investment required for the commercial exploitation of the nodules could, we are told, be of the order of two thousand million Bolivares in any given case.

These simple facts, Mr. Chairman, are like the numbers marked on the rooms of this building - so large and clear that they are no longer obvious - and they add up to a very difficult problem indeed: The nodules are out there, and they belong to everyone. The tools we need to reach them, recover them, process them, obtain from them what we need, and use and dispose of the product to the greatest benefit of mankind as a whole, they remain for the time being in the effective control of a few private individuals and possibly State enterprises. How can we put these tools to work for the benefit of the international community? What system can we devise to attract, entice or compel these persons or entities to use their tools, fashioned with care, possessed in pride of personal achievement and intended to be used for personal profit, for the good of mankind as a whole and to do so subject to public controls designed to ensure that the peoples of all countries receive their due share of the benefits, that the resources themselves are exploited in a safe and rational manner, with-

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out damage to the environment and that individual States are secure against any adverse economic effects of such exploitation.

Three basic systems have thus far been suggested, and all three of them appear to have in common the establishment of a new intergovernmental organization with certain functions with respect to the area and its resources. One system conceives of the new organization as an administrative authority empowered to issue licences for the commercial exploitation of resources of the area to establish general rules for safe and orderly exploitation. On one view, these licences may be issued to the exploiting entity direct, whether it be a State or private entity; and in the case of a private entity, some would require "sponsorship" or an undertaking of residual responsibility by a State. This system under which the exploiting entity could have the widest latitude and be subject to minimal control by the international community as represented by the organization, is reflected in proposals for the establishment of an Operations Commission, a Permanent Board, or an Exploitation Commission of the organization. Under these proposals the organization would not itself engage in exploration and exploitation, would be precluded from doing so.

Another system contemplates an organization of wider powers, including not only the power to issue licences, but also to explore and exploit the resources of the seabed through its own funds, equipment and personnel, it being acknowledge, however, that the time is as yet far off when the organization would be in a position to exercise that power and engage in commercial competition with private or State entities in the field. This system is reflected in proposals to establish a Management

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and Development Commission, an International Seabed Operations Organization and an Exploration and Production Agency of the organization.

The third system contemplates establishment of an Enterprise with a monopoly of seabed exploration and exploitation as an arm of the new organization. The Enterprise would have the sole right to explore and exploit the area and its resources, but would - at least - in its initial phase do so through collaboration with qualified State agencies or other entities under arrangements that would ensure control and supervision by the Enterprise at all relevant stages of a particular project.

On examination, one may be tempted to think these systems very different indeed, according to the extent to which the organization itself may engage in exploration and exploitation. And yet, on reflection, the similarities in essentials are striking indeed. All three would appear to contemplate that the seabed will be explored and exploited in fact by entities which currently possess the required technology and financial capacity, and that this will be done under arrangements in writing, whether called a contract or a licence, or by any other name, which sets forth inter alia conditions that are designed a) to secure revenues and other benefits for distribution to the international community and b) to assure safe and rational exploitation c) to protect the environment and, perhaps, d) to minimize any adverse economic effects caused by fluctuation of prices of raw materials recovered through seabed exploitation.

In our view, Mr. Chairman, stripped of matters of detail, there is one essential respect in which the proposals differ from one another:

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the degree to which the new organization, through its appropriate organ, will control the activities of the entity actually carrying out exploration or exploitation. This is, in our opinion, the central issue: To what extent should the organization penetrate the actual operation of a particular project? Or to give the question a slightly different twist, to what degree should the organization establish and exercise control over an entity in the interests of obtaining the maximum benefit for, and maximum protection of the interests of, mankind as a whole. This is a matter on which it would be necessary for us to focus - sooner rather than later - in our deliberations, to try to get to the heart of our differences and decide how they might best be reconciled.

I would like now to consider briefly a different group of issues viz., those concerning the structure and functions of the organs of the new organization. All proposals before the Seabed Committee and before this Conference envisage that the new organization will have, at least, four main organs: 1) a plenary organ in which all States parties to the constituent instrument will be members; 2) an executive organ of restricted membership; 3) an operational arm and, 4) a Secretariat. Several differences exist in regard to the powers and functions to be assigned to the plenary organ, or Assembly, and the executive organ which we may - for convenience - tentatively call the "Council". These are reflected in the alternative formulations under Articles 34 and 36 respectively. In our view, the basic difference of approach here is the location of executive power. On one view, all power should be concentrated in the Assembly where representation over the widest political range would ensure that decisions

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will be taking that have the support of the majority of the membership. On this view, the assembly should be called upon to decide on every important issue, even some of essentially technical or operational significance. The Council would carry out the day-to-day business of the organization within relatively closely drawn policy lines laid down by the Assembly, and subject to its overall supervision.

On another view, while the Assembly would be the residual repository of political authority, it would only approve broad policy lines. The Council, on the other hand, would have wide executive powers and considerable latitude in its conduct of the business of the organization. On this relatively decentralized approach, one or more technical commissions composed of representatives of members or individual experts would be given responsibility for performing certain technical and scientific functions of the organization, or for advising the Council on matters within their competence.

The composition of the Council would appear to be another central issue with which we have to deal. On the first view, if the Council could be constituted in such a way as to reflect accurately the political alignments and their relative numerical strengths within the Assembly, current apprehensions that the Council would be dominated by special interests acting in the name of technological and operational efficiency, would fall away. On the other hand, it is necessary to take into account the fact that those who for the time being control the technology and financial resources required for seabead exploitation would, with some justification claim to play a special role in the executive organ. To achieve an internal balance among these considerations in in constituting the Council, and at the same time, bring about a balance as between the powers and functions of the Council on the one hand and the powers and functions of the Assembly on the other, will be one of our major tasks.

Among the powers and functions proposed for the Assembly of the organization there is one that is likely to require considerable further study and elaboration. It is numbered 32 and entitled: "Safeguarding the interests and needs of mineral producing countries". Under one of the alternative formulations of this power, the Assembly would be required to consider and make recommendations for safeguarding the interests and needs of developing countries whose economies are largely dependent on mineral resources within their jurisdiction in order to prevent the occurrence of adverse effects to those economies resulting from production of such minerals from seabed resources. An alternative formulation contemplates the establishment of a Planning Commission as a permenent organ of the organization, charged with making recommendations aimed at preventing fluctuation in the prices of raw materials produced by developing countries, caused as a result of marketing of minerals from the seabed. This matter should be the subject of further detailed consideration on the basis of the excellent study prepared by the Secretariat and circulated as document 25 of this Conference with a view to providing under the Articles for other methods of protection for such countries, as for example, the establishment of international commodity arrangements for the stabilization of prices, and inclusion of specific covenants on production control in any arrangements for seabed

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exploitation entered into between the organization and an entity carrying out seabed mineral exploitation.

Mr. Chairman, I dealt earlier with the operational arm of the organization called variously the "Enterprise" the "Operations Commission", the "Exploitation Commission", the "Permanent Board" and so on, and I would like before concluding, to refer briefly to the very important question of a system for the settlement of disputes, disputes between Member States, between a State and the organization, between the organization and an entity engaged in operations on the seabed, between one or more such entities and between a State and such an entity which is not its national. It is clear that agreement on a system for settling disputes of a technical or legal character would greatly facilitate our negotiations. It could in particular, help to resolve difficult problems arising out of differing views as to the degree of discretionary authority to be given to the organization in its dealings with entities engaged in seabed exploitation, and could, consequently, affect the nature of the basic operational rules to govern seabed exploitation.

A proposal before the Committee contemplates the establishment of a permanent Tribunal, to be the "principal judicial organ" of the organization, with compulsory jurisdiction to hear specified categories of cases, and to make binding decisions. Among the advantages of such a system are a reasonable guarantee of the technical expertise necessary for a proper balanced assessment of the facts, and that over a period of time a body of law and practice would be built up which would develop and clarify the law, and offer the prospect of reasonable and just settlements. But there are a variety of systems for achieving the same end and time taken in an effort to agree on one or other of them could be well spent.

Statement in Committee I by Alternate Deputy Representative of Canada, D.G. Crosby, July 11, 1974

First of all Mr. Chairman, I would like to express the pleasure of my delegation that you are the Chairman of this Committee, and that you are in effect continuing to carry on the work performed with such distinction in the past.

We are quite in accord with the modus operandi you have devised for the initial stage of work in this Committee - the allocation of a period of time during which all delegations have the opportunity to make general statements. There are many countries here represented who have not as yet had an opportunity to express their views with respect to matters dealt with in this Committee, and we are confident that the new ideas thus brought forward will be of great help. At the same time, those of us who have had this opportunity in the past, in the Seabed Committee, welcome this occasion to review what we consider to be major problem areas to which we should bend our efforts.

Mr. Chairman, the Canadian Delegation would like to renew its commitment to the establishment of a strong International Authority, an Authority that can ensure that the development of the seabed resources of the deep ocean areas is conducted in a fashion consistent with the premise that these resources constitute part of the common heritage of all mankind. Of course, we are not by any means alone in this respect, and we cannot help but feel that it was difficulties of a semantic nature, in particular difficulties in terminology, that contributed largely to some of the problems that arose during the course of work in the Seabed Committee. Thus, today it is our intention to avoid, as much as possible, the use of technical jargon, and we will also avoid the use of titles for bodies of the Authority that could be envisaged as performing or undertaking specific areas of responsibility.

With respect to the type of body that would undertake making the mineral resources of the International Area available for development, ideas expressed in the past have appeared to embrace a very wide spectrum of possibilities. We would wonder, however, if many of those apparent differences are really as marked as might seem at first glance. One would gather that a consensus is developing that whatever title or label is utilised for this body, it will no doubt enter on behalf of the Authority into contracts of one sort or another with competent entities for the exploration and development of these resources, especially since the Authority will not be in a position to 'go it alone' at the outset. First, it will be necessary for it to acquire sufficient technical expertise and financial resources, and this could involve some considerable time. It does not really matter how one refers to these contracts, whether they are called permits, licenses, agreements, joint-ventures, and so on, it is the substantive content that is important. It would appear, and this is quite natural, that there are various interpretations with respect to the definitions of such terms. In fact, such differences of opinion might even exist within delegations.

The general expectation would seem to be that at an early stage some benefits should flow to the Authority from whatever activities may be undertaken related to deep ocean floor resources. The cash flow will probably be relatively limited at first. It would seem equally widely accepted that the system of making these resources available for development should give rise to substantial returns to the Authority. On the other hand, there is the corollary that operators will need assurance of a reasonable return on their investments of expertise, time and capital. It is difficult to envisage deep sea resource ventures being undertaken under the auspices of the International Authority if such assurance is not forthcoming.

A primary problem area, then, is the nature of the legal contracts to be consummated between the Authority and the operators actually carrying out the work. However, working out the details, one might say the regulatory requirements, in this respect may not be as important at this point in time as agreement that the Authority will indeed be entering into contractual arrangements with competent entities. One can envisage that such requirements, for example financial terms, could well vary from case to case, dependent upon prevailing conditions and circumstances. Thus, it is difficult at this stage to foresee all the possibilities as regards regulatory requirements governing contractual arrangements for making these resources available for development.

However, there is one field in which we could perhaps come more quickly to grips with respect to regulatory requirements, and that is as regards the supervision and control of actual exploration and development activities. Regardless of what entity is carrying out work in this vulnerable marine environment, whether it be an operator or even a body of the Authority itself, or some joint-venture arrangement, all parties carrying out such activities should fulfill precisely the same regulatory requirements designed to ensure the safety of personnel, the prevention of pollution, and the optimum recovery of the resources. The formulation of this type of regulations is another primary problem area.

It might be thought that in order to do this sort of job effectively there would have to be an inspection entity within the Authority staffed with a very large number of experts. However, one can visualize a highly effective body with a limited number of skilled technical personnel but with the financial capacity to call upon the services of appropriate consultants to deal with specific problems or conduct special studies, as may be necessary from time to time, thus eliminating the necessity of a large bureaucratic structure.

We come now to the primary problem of access to the International Area for the purpose of carrying out exploration and development programmes. What procedures should be followed in making areas available for resource development purposes? We of the Canadian Delegation make no pretense of having the answers, but one thing that would appear desirable from the resource management standpoint is the reservation of portions of the International Area by the Authority, including a proportion of whatever areas are made available to developers under contractual arrangements. In the latter case, areas made available for exploration could be relatively large, with a proportion returned to the Authority when the production stage is reached. This could then be reserved by the Authority for disposition or utilisation as it might see fit. A procedure of this nature would help prevent monopolization of the areas of greatest potential, and it would allow an opportunity for access to high-potential areas by later entrants, including the Authority itself. Moreover, one could envisage sufficiently realistic work and/or financial requirements that would help ensure the exclusion of those parties who might be interested only in the speculative aspects of such ventures.

Certainly, a further primary problem area involves the mineral resources produced. Quite naturally, much concern has been expressed with regard to the possibility that nodule production could interfere with and indeed seriously affect the world production and marketing patterns of certain metals. Also quite naturally, Canada shares this concern - we are first in world nickel production and third in world copper production. Admittedly, present opinions on this subject differ greatly. There are those who believe that world patterns may not be altered appreciably as concerns one or another of the minerals that will be produced from the deep ocean floor. There are others who feel that adverse effects may be very great indeed, and that certain countries in particular could have their economies seriously disrupted. It is difficult to envisage completely unregulated production. Even if world-wide effects were minimal this would be small comfort for those individual countries affected the most. We have yet to find solutions to this complex problem, but hopefully we can muster sufficient talent and imagination to reach an accord as to its resolution.

These, Mr. Chairman, are some of the primary problem areas facing us, as my delegation sees them, and I might now summarize these very briefly, and in a slightly different order, as: firstly, the problem of access to the International Area for the purpose of exploration and development of the seabed resources, that is, how best to make portions of the International Area available for mineral resource development; secondly, the complex problem of envisaging the type or types of contractual arrangements that should be consummated between the International Authority and competent entities that would carry out exploration and development work, that is, what might be termed the regulatory requirements governing the disposition of seabed resource rights in the International Area; thirdly, the problem of formulating regulatory requirements governing the actual carrying out of the exploration and development activities, so as to ensure safety of personnel, prevention of pollution, and optimum recovery of the subject resources; and finally, the very complicated problem area involving the mineral production itself, in the case of nodules, the possible effects of the resultant metals on world production and marketing patterns.

Obviously, our Committee has much work to do, but we feel confident that good progress will be made in the informal meetings under expert chairmanship that we have agreed will begin once this initial stage is completed. Those of us who took part in the proceedings of the Seabed Committee recall with gratitude the outstanding leadership contributed by the distinguished delegate from Sri Lanka, Mr. Pinto, and we are very happy to see that he is with us once again in this type of role, guiding our efforts in this critical task.

Mr. Chairman, whatever methods of procedure may be adopted in the future, we are confident that with the able leadership we have, we will be proceeding along appropriate lines. Finally, Mr. Chairman, my delegation wishes to assure you once again of our full cooperation in furthering the progress of this Committee.

Statement made by Ambassador Sugihara
in the First Committee
on 15 July, 1974

Mr. President,

1. I should first of all like to join other distinguished delegates who preceded me in expressing the sense of deep appreciation and pleasure on the part of my delegation in seeing you at the chair of this important Committee. I am convinced that your authority and dynamism amply demonstrated during the Seabed Committee will guide this Committee to a successful conclusion of our work.

Mr. Chairman,

2. As a member of the Seabed Committee, my delegation had the opportunity to express its views on various issues of the work of this Committee. Today I shall limit myself to outlining briefly the views of my delegation on some of the issues which it considers essential to the overall solution of the questions of the international seabed. There are three points which I should like to make.

1st, How to maximize the benefits of the common heritage of mankind?

2nd, How to ensure the equitable participation in such benefits?

3rd, How to actually conduct operational activities?

Mr. Chairman,

Mr. Chairman,

3. The resources of the seabed and ocean floor beyond the limits of national jurisdiction offer an immense potential for the welfare of the mankind. There is a consensus that such resources are the common heritage of mankind to be used for the benefit of mankind as a whole. The concern of the Conference must then be how to maximize the potential benefits to be derived from such common heritage. This consideration signifies in the first place that the resources of the deep seabed must be exploited in a most efficient and economic way. In our view, the most efficient system of exploitation is the so-called licensing system under which the international organization to be established should issue licences to Contracting States which may authorize natural or juridical persons, irrespective of their nationalities, to explore and exploit mineral resources of the part of the deep seabed area specified by the licences. We believe that this system has advantages over the alternative one under which the international organization will conduct exploitation directly or through joint venture ~~of~~ or in association with private entities. The licensing system can make full use of the efficiency which characterizes private entities. It is free from those disadvantages inherent in bureaucracy which are unfavorable to ~~the~~ maximizing the benefits of mankind, because the seabed

production

production must after all be commercially viable in order to survive as economic activities.

Moreover, a licensing system has a merit of keeping the international organization within a reasonable bounds in organizational and budgetary terms. This advantage can easily be realized if we recall that the expenses of Specialized Agencies are in the order of tens or hundreds of millions of dollars per year. On the other hand, the system in which the proposed Enterprise monopolizes the power to exploit will inevitably lead to a large and expensive organization. Such situation is not compatible with the objective of maximizing benefits, and will not serve the best interests of the international community as a whole.

Mr. Chairman,

The conservation of resources is another way to maximize the benefits of the common heritage of mankind.

We know that the resources of the deep seabed are the last frontier to be opened up to meet the increasing need of the international community. If we developed these resources rationally the deep seabed could prove to be a stable source of precious minerals for a long time to come. We therefore owe it to our posterity that these resources will not be wasted. My delegation believes that appropriate provisions should be incorporated in the convention in order

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not to repeat the unfortunate experiences of some land-based mines which had to be abandoned after miners were permitted to exploit the choicest parts of such mines. One of the solutions to this question would be an over-all sub-division of the international area on a permanent basis in the form of a pre-determined chessboard or grid with an equal size for all blocks. This system could prevent individual seabed exploiters from mining only those areas of the seabed with the highest potentials.

Mr. Chairman,

4. I have just referred to the need for maximizing the benefits of the common heritage of mankind. However, it would be against the concept of the common heritage of mankind if such benefits were to be monopolized by one State or small number of States. This consideration leads to the next point which I should like to make, namely, the need for the fair and equitable participation in the benefits of seabed exploitation.

There are two aspects in the participation of benefits. First, there must be an equitable revenue sharing. My delegation supports the proposal that the revenues derived from the exploitation of mineral resources in the deep seabed should be equitably distributed among developing States, in

particular,

particular, land-locked and other geographically disadvantaged States.

Fair and equitable participation should be ensured not only in financial revenues but also in exploitation activities. Technical and managerial competence thus acquired will be of a great asset to the economic development of all interested States.

However, individual States will not be able to obtain such competences through an international entity such as the proposed Enterprise which will in all probability be managed by experts recruited from developed States. We believe that such competences can be obtained by individual States only if they engage in exploitation activities either directly or through joint ventures with technologically advanced States or their companies. To ensure the latter method, namely a joint venture system, we tentatively advocate that a State should be allowed to apply only for a limited number of licences in a specified period of time.

Technical resources necessary for exploitation can also be acquired through the participation in the exploitation activities of nationals of technologically disadvantaged countries, or in international programmes of technical co-operation designed to train them.

- Mr. Chairman,

Mr. Chairman,

5. In the Seabed Committee, we concentrated our efforts to elaborate provisions on the legal regime governing the seabed beyond national jurisdiction and the powers and functions of the international organization and the composition of respective organs. However in order to put into effect such provisions thus elaborated, we need further principles to be applied in actual operation activities. These principles may relate, for example, to the size of blocks to be exploited, the duration of the licence or the contractual arrangement to be entered into with the international organization, the phases of exploration and exploitation activities, the kinds of payments to be made to the organization, various obligations of miners and so on.. These questions are more fundamental than we are prepared to admit irrespective of the system of exploitation to be adopted. Without including to provisions on these principles, the Convention will fall short of perfection. Mr. Chairman, my delegation will obey your instruction and will not go into detailed discussion on these points at this stage. However, I believe that the Conference is most ideally equipped for elaborating these principles in view of the participation of competent delegates. We should not let pass this valuable opportunity to elaborate at least the basic principles regarding the actual conduct of exploration and exploitation activities.

Mr. Chairman,

Mr. Chairman,

6. These are the comments on which we believe our particular attention is required. However they are not exhaustive of our concerns. For example, determination of the limits of the international area of the seabed is one of the most important issues. While this Committee is competent to discuss this matter, we do believe that its discussion should be deferred to a later stage when the Second Committee comes to a conclusion on this point.

Mr. Chairman,

7. The work of this Committee involves many complex problems which are closely linked not only in respect of each other but also with the issues being discussed in other Committee. Reflecting these circumstances many square brackets and alternatives were used in the document which the Working Group of the Seabed Committee produced. This method of work which we adopted in the Seabed Committee was justified since it reflected clearly the divergent views and policies of delegations which took part in the deliberations. It helped us to grasp clearly the problems of the issues involved. This is still true in this Committee with respect to many issues which are yet to be clearly defined.

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On the other hand, we realize that some of the brackets and alternatives in the document of the working group of the Seabed Committee are the product of our over-cautious tactical considerations. As the first step of our informal consultation which will follow this debate, these minor alternatives and square brackets could be removed.

My delegation like many others came to Caracas with the expectation that the deliberations during the session will produce substantial results. If each delegation showed the spirit of compromise, it would not be difficult to achieve what you, Mr. Chairman rightly expected of us. My delegation is prepared to play a proper part in bringing about meaningful results.

Thank you, Mr. Chairman.

GERMANY, EAST

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Statement of the GDR-Delegation in the General Debate of the First Committee

Mr. Chairman,

Permit me to extend to you on behalf of the Delegation of the German Democratic Republic, our cordial congratulations on your election as Chairman of the First Committee. Your election at the same time honours your merits in the Sea-bed Committee, in particular in the elaboration of draft articles regarding the regime of the international sea-bed.

We are convinced that under your chairmanship the First Committee will succeed, on the basis of mutual understanding and a well-balanced consideration of the interests of all States, in finding regulations that will serve the strengthening of peace and the benefit of all peoples.

Mr. Chairman,

The GDR-Delegation holds the view that regarding the status of the sea-bed and its subsoil and the structure of an international sea-bed organization, the exploration and utilization of the sea-bed and its subsoil should be carried out in accordance with the basic principles of international law and only in the interests of all peoples and exclusively for peaceful purposes. In particular, all endeavours must be made to exclude this area from the arms race. Pursuant to the Treaty on the Prohibition of the Emplacement of Nuclear Weapons and other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and in the Subsoil thereof of 11 February 1971, and implementing the obligations of the States parties to the treaty, the contracting parties should make all efforts to conclude relevant international agreements as soon as possible.

We are of the opinion that the competence of the sea-bed organization for the exploration and utilization of the mineral resources of the sea-bed and its subsoil refer to that part of the sea-bed and the subsoil thereof which lies beyond the economic zone and the continental shelf of the coastal States.

Although resolution 2749 of the Twenty-fifth Session of the United Nations General Assembly states in its preamble that the existing legal regime for the high seas does not yet contain specific rules for the exploration of the sea-bed and the exploitation of its mineral resources, it follows already from the basic principles of international law that the regime of the international sea-bed must not affect the legal system of the superjacent water and air column, which is a constituent part of the high sea.

According to the principles of international law, each State has the sovereign right to share in the exploration and utilization of the sea-bed and its subsoil. This must not be a matter of a few states only or even of national or transnational monopolies. The question rather is that the mineral resources of the sea-bed and its subsoil should be used by all States on an equal footing and without discrimination. This applies especially to those States which today do not yet have the necessary technical prerequisites for exploration and utilization. The provisions that the sea-bed shall be used for the benefit of mankind as a whole, with special consideration to be paid to the needs of the developing countries, would contribute towards overcoming the differences existing in the economic and scientific-technological levels - one of the gravest inheritances of colonialism.

But also those States which have no direct access to the international sea-bed area should share in the advantages of exploration and exploitation. According to the principle of sovereign equality, the land-locked States and geographically disadvantaged States have the same rights as the coastal States with regard to the exploration and utilization of the international sea-bed area. The geographical situation of a State can by no means be the pretext for a differentiation between the member-States of the sea-bed organization. This principle is also in line with resolution 2467 (XXII) of the United Nations General Assembly of 21 December 1968 which pointed out that the activities of States shall be carried out independent of their geographical situation.

Mr. Chairman,

In our opinion the concept of the common heritage of mankind can only be defined in connection with the basic principles of international law and the other principles of resolution 2749 of the General Assembly. In our view the following principles flow from the concept of the common heritage of mankind:

1. No State shall be allowed to acquire, claim or exercise sovereignty or sovereign rights over any part of the sea-bed or its subsoil.
2. A State shall only acquire rights of property over mineral raw materials which have been exploited/extracted.
3. All States shall have the same rights in the exploration and peaceful utilization of the sea-bed and its subsoil.
4. The interests of the developing countries, land-locked States and other geographically disadvantaged States shall be taken into due account.
5. States shall be responsible under international law for activities which are not in accordance with the norms of a future Convention on the Law of the Sea.
6. No State or group of States shall be allowed to derive one-sided advantages from an international legal regulation on the utilization of the resources of the sea-bed and its subsoil.
7. The traditional uses of the high seas, such as free navigation, free overflight, the right of each State to lay cables and pipelines in the high seas, and scientific research must not be restricted.

Mr. Chairman,

The German Democratic Republic supports the establishment of an international sea-bed organization. Here our delegation proceeds from the idea that the main function of this organization should be to coordinate the activities of States in this area, to make the scientific results of these activities accessible to all States, to organize the international exchange of experience and transfer of technology and, in particular, to assist and support the developing countries in the preparation and implementation of relevant research and exploitation activities. Furthermore, the organization should be responsible for the equitable distribution of the mineral resources, taking into account especially the interests of the developing countries.

Mr. Chairman,

It follows from the character of a sea-bed organization, in which sovereign States exploit the mineral resources of the sea-bed and its subsoil on the basis of sovereign equality and mutual benefit, that all States which are contracting parties of the Convention on the Law of the Sea can become members of such an organization. The GDR also advocates that the national liberation movements recognized by regional organizations can participate in the work of this organization. As the international sea-bed area and its mineral resources are open to the peaceful utilization by all States and peoples, there must not be any discriminating conditions for membership in this organization.

As regards the participation or cooperation of other intergovernmental organizations in the matters the sea-bed organization is dealing with, such cooperation should be regulated on the basis of coordination agreements between these organizations and the sea-bed organization, agreements to be concluded in terms of international law. This is customary in international practice, in particular in the United Nations System, and has proved successful in the work of intergovernmental organizations.

Mr. Chairman,

In the deliberations of the Sea-bed Committee a number of proposals on the structure of the sea-bed organization has already been made. In principle, we agree with the establishment of a general assembly, a council and a secretariat. In our opinion, the general assembly should deal, among other things, with the fundamental questions of the exploitation of the resources of the sea-bed and its subsoil, the general rules regarding the prevention of pollution in the sea area in connection with the exploration and exploitation of the mineral resources, and with all questions connected with the implementation of the statute of the sea-bed organization, and to give recommendations thereon. In the council to be established full consideration should be given to the principle of the sovereign equality of States, the equitable geographical representation and to the interests of all States and groups of States.

The council should be competent, among others, for coordinating the activities of States in the exploration and exploitation of the mineral resources of the sea-bed and its subsoil, for making available scientific knowledge - including the organization of exchanges of experience -, for preparing draft conventions on problems of exploration and exploitation and the budget estimates, and for submitting reports to the general assembly on its activities. At the same time, the council should be granted the right to conclude agreements with the United Nations Organization, other intergovernmental organizations and with States, on behalf of the sea-bed organization and after due deliberation in the general assembly. It should further be considered whether to attach a commission to the council which will deal, above all, with the granting of licences for exploitation and prepare the respective decisions of the council.

As regards licence contracts, they should be concluded in terms of international law between the sea-bed organization and one or several States. The following questions should, above all, be regulated in licence contracts:

1. The delimitation of that part of the sea-bed and its subsoil that may be explored and exploited [illegible] economic purposes;
2. The maximum amount of minerals to be exploited;
3. The duration of exploitation and exploration for economic purposes;
4. The modalities and the ceiling for payments by the exploiting State which can be made either in cash or in kind (by deliveries of raw materials);
5. The participation of scientists, engineers etc. from developing countries in research and in the extraction of raw materials, for the purpose of qualification;
6. The responsibility, in terms of international law, for damages (e.g. pollution of the seas) arising in connection with exploration and exploitation for economic purposes.

Legal and natural persons should be allowed to share in the exploration and exploitation of the mineral resources of the sea-bed and its subsoil only on behalf of and under the full responsibility of the State or group of States, which has concluded the licence contract with the sea-bed organization.

In our opinion, the advantages of such a procedure are

- that in a relatively short period comprehensive estimates could be made of the mineral resources to be found on the sea-bed and in its subsoil;
- that the exploitation rights of States for minerals of the sea-bed and its subsoil shall be limited as to their duration, area and amounts;
- that the interests of all States, above all those of the developing countries, would be taken into account by revenue sharing and qualification of specialists;
- that by respective regulations in the licence contracts the sea-bed organization would be able to influence the amounts extracted and the distribution of revenues;
- that when licence contracts are concluded exclusively with States, whose responsibility under international law would be expressly stated, it will be possible to prevent that licences are used by national or transnational monopolies to achieve maximum profits.

Mr. Chairman,

You may be assured that the Delegation of the German Democratic Republic will be prepared to participate actively and constructively in finding solutions based on the agreement of all States participating. The Delegation of the GDR will present its concrete comments on the various questions under discussion in the course of the conference.

Thank you, Mr. Chairman!

STATEMENT

by

Elisabeth Mann Borgese

International Ocean Institute

Before the

Third U.N. Conference on the Law of the Sea

First Committee

Caracas, July 12, 1974.

00336

Mr. Chairman:

It is with a feeling of deep gratitude and in full awareness of the novelty of the situation that I, as the representative of a nongovernmental organization, take the word in this Committee.

The International Ocean Institute was established two years ago in cooperation with the Royal University of Malta and the United Nations Development Programme. It is governed by an international Board of Trustees of which the President of this Conference, Ambassador Amerasinghe of Sri Lanka, has graciously accepted, in a personal capacity, to be the Chairman. The Institute's work is conducted by an international Planning Council, a number of whose members are present here as Delegates and of which I have the honor to be the Chairman.

The work of our Institute continues that of the Pacem in Maribus Project which was initiated in 1968 by the Center for the Study of Democratic Institutions. From the outset this work has been impressed by the concept of the ecological unity of the world ocean system, the implications of technological advance, and the growing interactions of all uses of ocean space and the exploitation of its resources. Our work has convinced us of the need for a new and systemic approach to ocean affairs.

Mr. Chairman, it is in this context and on the basis of thisexperience, and with reference to General Assembly Resolution 2749 (XXV), containing the Declaration of Principles, and to the terms of reference of thie Committee, that I should like to discuss today one point that seems to me fundamental: namely, the necessity, in our opinion, of enlarging the concept of a sea-bed authority to that of an ocean-space authority.

From the statements we have heard during this Conference it appears that we are moving toward a consensus in favor of the establishment of an economic zone or patrimonial sea. I do not wish to discuss here the attributes of this zone. let me take it for granted and merely assume that jurisdiction over, and management of, the economic resources of the zone will be attributed to the coastal State. This is indeed a big innovation. The mandate of this Conference, on the other hand, to establish an international regime for the seabed beyond national jurisdiction -- which now includes the economic zone -- remains unaltered. It is my contention that the establishment of an economic zone, especially in conjunction with other arrangements concerning jurisdictional limits supported by many delegations, basically transforms the concept of the international seabed regime.

The common heritage of mankind to which we refer today simply is not the same as it was when the Declaration of Principles was adopted in 1970. Then it comprised more than three-quarters of ocean space having a very considerable economic potential, from exploitation of hydrocarbons to that of hard minerals, and as a consequence it would have had a financial basis for significant distribution of financial benefits to poorer nations. The size and resources of the area would also have made possible reasonably effective international measures for the control of marine pollution and independent research leading to effective scientific and technological transfers.

The seabed regime of which we speak today has none of these attributes. Its area, in the concept of some delegations, covers the abyssal ocean floor only. It is a single-function regime governing only the mining of manganese nodules, at least for the next few decades.

According to UN Document A/AC 138/87, even long-term prospects for oil on the continental rise are small, but then, the rise too, may fall under national jurisdiction. And there are no prospects, in the foreseeable future, for commercially exploitable minerals other than manganese nodules in the international area.

Add to this that not more than half a dozen countries and not more than a dozen companies have the capability to engage in nodule mining and that the revenue to be obtained from nodule exploitation may be expected to vary between 50 and 200 million dollars a year over the next ten years: a revenue not much larger than would be required to cover the operating costs of the future authority and certainly insufficient to effect any significant distribution of financial benefits.

Such a situation does not need, cannot afford, and will not tolerate a complex and costly machinery, about the structure of which, furthermore, the technologically less developed nations would have very little to say. It is an open secret that the companies of the nodule mining countries have been and are now negotiating the terms of their cooperation in the exploitation of nodules. It is not likely that they will come up with a machinery providing for the effective participation of the developing nations in decision-making and management.] At best such machinery would be of marginal utility as far as the interests of the great majority of the international community are concerned and would be totally incapable of fulfilling effectively those functions of scientific and technological transfer which are desired by many countries. In other words, the sea-bed regime about which we are talking today could in no way embody the Principles adopted in 1970 and would be incapable of filling the jurisdictional and managerial vacuum in the oceans which must be filled in the interests both of coastal States and of the international community as a whole.

Mr. Chairman. Should this be a reason for pessimism? For retreating from the Declaration of Principles whose adoption in 1970 was a mile stone in the history of the United Nations?

Not at all. On the contrary. We should stand firmly on the ground which has been conquered with so much toil, and enlarge it in accordance with the requirements of dhanged circumstances.

If the international ahthority governing the area beyond the limits of the economic zone is to be economically viable, if it is to be useful to the international community, if the developing nations are to have their share in decision-making and management as well as in financial benefits, then we must pass from the concept of a single-purpose seabed regime to that of a multi-purpose ocean-space regime and machinery. Only in such a comprehensive regime, where all nations can participate in activities, can there be give and take, and a harmonization of interests -- which is much harder to obtain in a regime where, as a starting point, ~~very few nations control everything and the majority has no capacity whatso ever.~~

imbalances of technology and knowledge are very great.

There are other cogent reasons which make this enlargement of the seabed regime concept the mandatory and logical consequence of the adoption of the economic zone.

In contrast to the continental shelf area over which national jurisdiction was extended by the second conference on the law of the sea, the economic zone is developing as a multi-functional zone. Especially in the technologically more advanced countries new forms of coastal management are evolving to coordinate and harmonize all uses of national ocean space, to integrate ocean-based ecology and economy with land-based ecology and economy, creating new forms of cooperation between local, regional, and national government, and between scientific, industrial, and administrative organs.

Mr. Chairman, if this is the form of "coastal management" that is now developing for ~~a~~ large and productive sectors of ocean space under national jurisdiction, it would be meaningless to face it with an array of fragmented organizations and competences in international ocean space. The two sectors, national and international, simply would not "knit." Sectoral and overlapping competences as well as competence gaps would render the international sector totally ineffective -- once again undermining confidence in the feasibility of international organization and cooperation.

Mr. Chairman. The second part of my statement deals with the functions and the structure the international sector should have, in our opinion, if it is to interlink effectively with the coastal management system regulating the interaction of all uses of national ocean space and resources; and the new forms of interaction between local, national, regional, and international, governmental and nongovernmental entities required by this development. I would be glad to submit it on a future occasion in some suitable form. I thank you.

The extension of the concept of common heritage from just the seabed to all of ocean space does not mean that the excellent preparatory work of the Seabed Committee should be wasted -- all of it could be incorporated in a new context. Under such an approach, the remaining difficulties could more easily be handled.

PRESS
DEPARTMENT OF STATE

July 24, 1974

No. 313

ADDRESS BY
AMBASSADOR JOHN R. STEVENSON
SPECIAL REPRESENTATIVE OF THE PRESIDENT,
U.S. REPRESENTATIVE TO
THE LAW OF THE SEA CONFERENCE
BEFORE COMMITTEE I
OF THE LAW OF THE SEA CONFERENCE
CARACAS, VENEZUELA
JULY 17, 1974

Mr. Chairman, may I say at the outset what great satisfaction my Delegation has in seeing you in the chair. We appreciate very much, as all delegations do, the contributions that you and your colleagues at the podium have made and continue to make to the success of our work. Your leadership, wisdom and political skills have in many ways enabled us to reach an advanced stage of work.

As you correctly pointed out in your statement to this committee on the 10th of July, the past work of the preparatory committee has given many of us a sense of false comfort for we have thought that the preparation of a single, large and complex document was in and of itself an achievement. You told us that our task was to begin to negotiate. Indeed, you demanded it of us. Mr. Chairman, we all owe you a great debt for your persistence because it is now obvious after more than fifty statements in this committee that you have served as the catalyst for the commencement of negotiations for which we have all waited so many years. We have listened with great care to the statements of all delegations who have spoken before us and it is now clear beyond any doubt that serious negotiations are occurring. Mr. Chairman, our analysis of the statements made in the last week of our work leads us to certain very specific conclusions about the nature and scope of the problems before us in Caracas and I will turn directly to them.

The central issue in the negotiation is the extent of control by the authority over commercial development of the resources of the international seabed area. In a very real sense the question of who will control is resolved. The authority will have the control and will exercise it through its principal organs and their subsidiary organs. The authority should contain four principal organs, an assembly, a council, an operational arm, and a dispute settlement body. The United States, in the latter part of the Geneva Session of the Seabed Committee last year, proposed the creation of a comprehensive Law of the Sea Tribunal for disputes arising out of the interpretation or application of the Law of the Sea Convention. We would anticipate that the dispute settlement machinery in the authority would be a more specialized organ. Each of these principal organs will have to be given different types of powers. Broad policy guidance will come from the Assembly, executive decision making will be in the Council, with particular reference to

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the implementation of the general system of exploration and exploitation. The operational arm will manage the day-to-day affairs of the authority and the dispute settlement procedures will help preserve the integrity of this treaty we are here to negotiate. It will be necessary to provide for some checks and balances among the organs of the authority to ensure against any abuse of power. This approach may help find a common middle path to agreement on the structure of the authority and many of its powers and functions.

The questions we face are: How much control and subject to what safeguards? And over what activities? These are clearly not easy questions but our impression of the statements of various speakers is that the question of control is made somewhat more difficult by thinking of it in terms of control versus no control. We believe a better approach would be to recognize that certain controls are essential in the authority -- these controls in a broad sense are the rights of the authority and these rights should be accompanied by corresponding duties.

Our first task is to identify the common denominators -- what types of controls do most delegations seek to repose in the authority. We have identified seven major categories which appear to command widespread support:

- First, the right of the authority to prevent degradation of the marine environment from seabed exploration and exploitation;

- Second, the right to ensure that sufficient and reliable information and data are given to the authority so as to allow it independently to satisfy itself that it is receiving all benefits and income to which the treaty entitles it;

- Third, the right to impose requirements which prevent any state or person who does not have the bona fide intention of exploring and exploiting from obtaining or keeping any mining rights in the area;

- Fourth, the right to require that mining be carried out safely;

- Fifth, the right to establish the procedures and mechanisms which will ensure that those provisions of our treaty which promote programs for the transfer of technology to the developing countries and provide for the training of developing country personnel be faithfully executed;

- Sixth, the right to ensure that the resources of the area are not monopolized by a few countries or private entities so as to preclude developing countries from participation in the exploitation of the resources of the area when they have the technology and financial capacity to do so; and

- Seventh, the right to participate in the benefits of resource development.

Mr. Chairman, my Delegation can pledge its full support to work to achieve these kinds of controls. In some cases, we believe the controls should be carefully spelled out in the treaty itself. In others, we would want to include the controls by way of a mandate to regulate in the future, provided we can agree in the treaty on standards for the regulatory machinery and a just procedure for rule making which will inspire the confidence of all states.

We have also listened with care to the statements of other delegations concerning the duties or obligations of the authority. Here again, we have found basically five common denominators:

- First, developing and developed countries alike have spoken out clearly for the need to ensure that no state is subject to discrimination in the exercise of its rights, nor can any state be deprived of a right of access to the resources, if it meets the obligations imposed by the treaty -- this being one of the fundamental principles of the common heritage concept;

- Second, virtually all countries have recognized the duty to provide stable conditions of investment which will promote the development of the resources. There is widespread recognition that we all depend on the creativity and initiative of a pioneering few to achieve realizable benefits for all from the extraction of the resources;

- Third, it has been wisely said by many delegations that the authority should not encumber those who extract the resources with needless regulatory interference and administrative burdens which reduce economic efficiency and thus the benefits, including the revenues, which will be available for sharing;

- Fourth, many delegations have noted the need to protect the property including proprietary data and trade secrets of those on whom we depend for the extraction of the resources;

- Fifth, the authority must provide facilities and institutions for the knowledge and technology which will be transferred to developing countries. Effective transfer of technology, which many have stressed, requires careful planning and the creation of new institutions of learning. In this area the authority will make one of its most significant contributions to the benefit of all mankind.

Mr. Chairman, we are gratified that most delegations have referred in their statements to the need for negotiations on the fundamental terms, conditions and safeguards for exploration and exploitation. Indeed, one delegation suggested that this committee change its perspective quickly and begin at once to examine these fundamental matters in the hopes that by doing so we will find common ground which may reduce the differences between what appear to be widely disparate conceptual approaches. We share this belief. It was our view in the working group last summer, and it remains our view today, that the differences between the two competing conceptual approaches to the question, "Who may exploit the area," are not as serious as previous debate would have indicated and that a close study of the basic conditions of exploitation founded on what now appear to be widely supported common denominators will help us find the path to agreement.

Regretfully, Mr. Chairman, it appears that in one major area no sign of a rapprochement is yet on the horizon. A few major producers and exporters of nickel and copper have brought to our attention their belief that a problem will accrue to them from seabed nickel and copper production -- the two metals of principal commercial interest in nodules. The Secretary General has, at the request of the Seabed Committee, done several useful studies of the question, including a study now before us, A/Conf. 62/25. Mr. Chairman, my Delegation is pleased that at an appropriate time this summer the committee will have an opportunity to study this report more fully. We believe in light of recent international experience that it will be most useful for all countries, whether developed or developing, who are consumers of these materials in either raw or manufactured form to analyze together their interests.

Mr. Chairman, a better understanding of this problem, and the extent to which it has already influenced the work of this committee may help us over the few hurdles ahead of us. Several nátions have made proposals in connection with economic implications which call for production and price controls or which limit access to the resources of the area. Still other proposals have been made which, while they do not appear to be directly related to economic implications, may be motivated by a desire to ensure that the authority will be able to regulate production effectively. Mr. Chairman, several of these proposals can be seriously disruptive in the negotiation because they are not only capable of being used to maintain or increase prices, but also can be used to deprive states of access to the resources. In addition, if used they may well decrease the benefits available from the sea, including the benefits to consumers everywhere, from the availability of a new supply of nickel and copper and the products made from those metals. The U.N. economic studies have shown that the increases in copper demand will greatly exceed the rate of development in seabed production. Similar conclusions, to a lesser extent, hold for nickel, but in any case nickel is largely a developed country export. The effect on manganese is speculative and only one company that we know of has any plan to produce any manganese at all from nodules. The cobalt production of one or two developing countries may be affected. In these cases appropriate measures will have to be considered. Let us move with extreme care and not try to solve problems which in reality may be quite small and manageable with remedies more dangerous than the illness we seek to cure.

Mr. Chairman, all countries, not only the rich, but rich and poor alike, are justifiably concerned by any price increase in essential commodities. Higher prices for resources used for development are a serious matter today, causing widespread hunger and starvation in many poor countries.

We believe, Mr. Chairman, that seabed metal production should be treated on the same basis as land production. Together, the two sources will account for the global supply and meet the global demand for these metals. To draw up special restrictions for one source and not the other is equivalent to agreement by treaty to discriminate against all states who may be seabed producers. This is neither a fair nor rational approach to the disposition of the common heritage of mankind.

Mr. Chairman, my Delegation places special emphasis on the decision-making procedures which will be used by the authority for dealing with the multitude of problems that will face the authority in its quest for control over the resources of the area. As I mentioned earlier, we believe that in order to protect the interests of all states decision making should be dispersed throughout the organs of the authority to avoid any single organ's dominance over the machinery. In respect of the basic resource policies of the authority we wish to assure a special procedure which we call rule making. The authority will have to deal with a host of unpredictable developments. In these areas, which include environmental protection, mining safety, resource conservation, adjustments to regulatory provisions which ensure diligence in exploration and deter speculation, to name only a few, we think the authority should make rules by a procedure similar to the one used by the International Civil Aviation Organization. Rules should be drafted by a specialized subsidiary organ, and after council approval, forwarded to all states for review. If after a fixed time period, say 90 days, less than one-third of the members of the authority have objected, the rules would become binding. This approach, we believe, will give maximum opportunity for expert review in the authority and in governments and avoids the risk of undue influence by one or another of the organs of the authority.

Mr. Chairman, the authority has not yet been created. We are here to create it. This is an exciting and important experiment in international cooperation. We are each prepared to agree to controls over valuable resources by an inter-governmental organization. This is a unique adventure. But it cannot succeed if we are too ambitious. We are asking all nations to have trust in an unknown body. Let us build into this treaty as many necessary procedural protections as we can to ensure that those who are wary of our efforts will be satisfied with our work product. To that end, Mr. Chairman, my Delegation wishes to stress the following points which we regard as most important in these negotiations:

(1) The resource system we choose for the treaty must ensure nondiscriminatory access to the resources of the area for all states. If the authority has the power to restrict the number of areas available for commercial development and to select among applicants, my government would not be satisfied that our access was secure and free of potential discrimination.

(2) The mandate of the authority should only include control of activities in the area which are directly related to the exploration and

exploitation of seabed resources.

(3) The treaty should provide an appropriate system of checks and balances among the organs of the authority.

(4) A carefully defined system of rule making should be elaborated in the treaty to ensure a fair and thoughtful decision-making process.

(5) Provisions for the compulsory settlement of disputes and machinery for that purpose are essential.

(6) Voting arrangements in the council of the authority should be realistic.

(7) We should seek methods for accommodating the concerns of land-based producers who are developing countries if it is clear that seabed production harms their level of domestic production, but at the same time the consumers of goods made from raw materials found in the seabed must be protected from artificial price increases for such materials.

(8) The provisional application of the permanent regime and machinery.

Before closing, Mr. Chairman, my Delegation would like to take note of the remarks of one speaker who indicated that industrialized countries had supported a system for exploitation which would permit both licensing and direct exploitation by the authority simultaneously. He rejected such a parallel system. We support his rejection. We are here to find a single system for exploration and exploitation which will accommodate the interests and needs of all countries.

For our part, we approach the next two-week period with the hope that when the informal committee makes its report to this committee the third reading of the regime and machinery will be concluded except for those areas which we know cannot be easily solved and will in any case require your own firm guidance and personal attention in the weeks and months ahead. In August we look forward to a thorough and careful elaboration by the informal committee of the new aspects of our work -- the effort to study more closely the resource exploitation system, its basic conditions of operation. We will also have to deal with the unfinished business of economic implications. We are here to negotiate, Mr. Chairman, and we are convinced that the time to do so is now.

Thank you, Mr. Chairman.

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COMMITTEE I
August 8, 1974

STATEMENT BY LEIGH S. RATINER
ALTERNATE UNITED STATES REPRESENTATIVE

Mr. Chairman,

My delegation is very grateful to your good offices in providing this Committee ample opportunity to engage in serious and thoughtful discussion of the whole range of issues connected with the question of the economic aspects of deep seabed mineral exploitation. In our statement to Committee I on July 17, the Head of the United States delegation stressed that we should seek means of accommodating the concerns of developing country land-based producers if it becomes clear that seabed production harms their level of production but that consumers of these raw materials, and the products made from them, must also be protected from artificial price increases.

After many hours of discussing this problem in various forums of this Committee and careful study of the economic studies which have been submitted to us, one indisputable fact has emerged. None of us sitting in this room today can verify that seabed production will clearly reduce output or income of developing country producers of nickel, copper, cobalt and manganese from present levels.

In the working paper which my delegation submitted to the informal seminar, an expectation regarding the effects of seabed production on land-based producers was presented that is slightly different from that presented in the most recent report of the Secretary-General on this subject. Moreover, the conclusions of the Secretary-General's report are slightly different from those contained in the studies prepared by the UNCTAD Secretariat. Several delegations have expressed the view that our time was not well spent in analyzing the statistical variations in these reports or comparing many of their basic assumptions, that this was a subject better left to the economists and technicians. Mr. Chairman, the uncertainty surrounding economic estimates is a factor which must be taken into account in the political decision-making process of developing concrete treaty texts to resolve the questions of how to protect both developing country producers and consumers.

As the working paper which my delegation has prepared and which we now submit for the record in this Committee indicates, we doubt very seriously that seabed production will result in any decrease from the present levels of production or total revenues of land-based producers within the forecast period selected in the Secretary-General's report. Other studies and other delegations have insisted that the likelihood is much greater and they have presented several concrete suggestions for solution of the problem as they perceive it. Although there is widespread sympathy for the general philosophical perspective that has inspired these proposals, a perspective that finds its fundamental basis in the Declaration of Principles, there is also general recognition of the inherent difficulties in their successful implementation, as well as of the uncertainty of their effects on the wide range of economic interests involved in this negotiation.

Implementation of any of these schemes would require the availability of comprehensive data concerning market factors, data whose accuracy can never be verified with absolute precision. The Authority would need to predict the behavior of four global markets whose present combined value totals billions of dollars. It would need to contend with production variables in numerous producer countries and demand factors in over one hundred and fifty nations. Obviously, the margin of error in such data would be substantial, to say nothing of the problem of extrapolating economic trends into the future. For example, one of the most commonly discussed means of regulating seabed production would be to limit the amount of seabed area open for exploitation in any given year. At the time such a decision was made, the Authority would be basing its recommendation on projections concerning future markets three to ten years in advance, since it is approximately that period which is needed to bring a deep sea mining unit into full-scale operation. It would also have to project production not only from present producers but from potential new land-based producers. Given the difficulties which have been highlighted in recent weeks regarding market projections extended from the present to 1980 or 1985, we question whether even the most capable experts could guarantee a satisfactory data base for decisions of this nature.

Effective implementation of these schemes to protect land-based producers would also require the ability to take measures which influence the global markets for the four metals under consideration. Most of the proposals for dealing with possible harm to land-based producers have been restricted to controls over seabed production, production which will account for only a small segment of the world's total for most of these metals in the foreseeable future. Thus, as the United States working paper explains, limiting the level of mineral recovery from the seabed may not appreciably affect global markets. Moreover, production restrictions on seabed output will not provide the Authority with an effective tool for selectively protecting individual metal markets because of the joint product nature of seabed operations.

Finally, even were it possible to implement some of these proposals, we would still have found no acceptable means of protecting only developing country producers. As we have learned, producers from already developed countries account for a large share of total world output for these metals. Moreover, the implementation of any of these schemes could result in economic costs to consumers of all countries, both developed and developing far in excess of the good we are trying to do for the land-based producers.

A solution to the desires of developing country producers for the development of seabed exploitation in a manner which avoids disrupting their economies must be found, but such a solution must manifest a careful, considered balance among all economic interests, particularly the interests of consuming countries, in order to maximize the benefits of seabed exploitation to all mankind. Given the inadequacy of information available to us, it is clear that we are presently incapable of making decisions on what should be the exact nature of this balance. My delegation is convinced that no other delegation here would wish to agree to treaty articles which purport to determine in advance a solution to a problem on whose parameters we can only speculate. We must instead seek an accommodation which provides a mechanism for reviewing on a continual and current basis whether the problem does indeed exist, what are its true dimensions and what measures could most appropriately be enacted for its resolution in the light of conditions existing at the time.

In the August 3 edition of the New York Times there is a tragic story of a poor farmer in India and the dilemma he faces as a result of the increased prices he must now pay for petrochemical fertilizer. Mr. Chairman, the story speaks for itself. I will read a few paragraphs from it.

> Charan Singh Maan, one of the farmers of the Punjab, India's most productive state, is frightened.
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> He has sold his tractor, cut back purchases of fertilizer and watched the wheat production falter on his family's farm.
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> Mr. Maan stood the other day on the 25 acres he and his family share with his two brothers and their families, 19 persons in all. As a rented tractor plowed an acre of land on the farm, 40 miles west of Chandigarh on the road to Ludhiana, he explained that for the first time in years his family was avoiding the use of the initial dose of fertilizer.
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> "We give three doses," he said in English. "The first we give before sowing, the second on the crop and the third before it ripens."

But now, he went on, "we can't afford to give three."

"It will hurt the crop," he said, "of course it will hurt the crop. But what can a farmer do about it?"

"Less and less," the 55-year-old farmer said of his wheat crops. "The fertilizer costs so much. The water is not available. It's bad--very bad."

Farmers and state officials alike are plainly worried about the decline in food production, the cost and scarcity of fertilizer--in the last year it has more than doubled in price here--electricity cutbacks, sporadic rainfall, the depletion of land and the absence of incentives to keep the soil fertile.

Looking only at the monetary estimate does not tell the full story of the sacrifice. A penny denied to a struggling Indian farmer clearly has a larger impact than that same penny in the pocket of a land-based producer.

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FIRST COMMITTEE

United States: working paper on the economic effects of deep sea-bed exploitation

I. Introduction

Numerous studies have been prepared, including the reports of the United Nations Secretary-General and the UNCTAD secretariat, concerning the potential economic effects of manganese nodule exploitation on the markets for the metals involved and on the economies of developing country producers of the metals to be extracted from nodules. The analytical work contained in these studies is open to an inevitable criticism - it is highly speculative because we are studying the impact of an industry which does not yet exist on future markets whose magnitude is impossible to predict with absolute precision. Hence, it is understandable that there are often contradictory predictions on the extent to which developing country producers will be harmed by deep sea-bed production.

The following discussion is not presented as a critique of any individual studies concerning economic implications which have previously been submitted to the Law of the Sea Conference. 1/ Rather, we have attempted an explanation of what will be the most probable economic effects of deep sea-bed production and why the United States is of the view that certain solutions which have previously been proposed to the Conference may result in greater economic costs to all mankind than the benefits they are designed to achieve.

Only a small number of developing countries are major producers or exporters of nickel, copper, cobalt and manganese, the metals of chief commercial interest in manganese nodules. If world production of these four metals is considered as an aggregate, it is producers in industrialized countries which account for the greater

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1/ In certain areas, this working paper will draw upon the commentary contained in the most recent report of the Secretary-General, "Economic Implications of Sea-Bed Mineral Development in the International Area", document A/CONF.62/25, 22 May 1974. Unless otherwise noted, all figures used here are based on the Secretary-General's report.

share. The benefits to be derived from restrictions on sea-bed production will primarily flow to only six developed country producers - Australia, Canada, Japan, South Africa, the USSR and the United States - and six developing country producers - Chile, China, Peru, the Philippines, Zaire and Zambia. Restrictions on sea-bed production will result in more rapid price increases for these raw materials than would otherwise take place and will largely benefit only a few land-based producers. Inhibitions on sea-bed production may cause higher prices for a large number of developing countries with no land-based production. In relative terms, they will be considerably more harmed by higher prices than consumers in the industrialized world.

II. Assessment of Effects

A. Effects on Land-based Producers

The following discussion outlines the most probable impact of manganese nodule exploitation on land-based producers of individual metals and briefly interprets the significance of these conclusions.

Nickel

With respect to the economic effects of projected sea-bed production of nickel, the Secretary-General's report 1/ concluded the following:

> For nickel, a minimum six per cent per annum long-term growth rate is assumed. In 1972, the share of developing countries in world production of nickel was only 13 per cent, although this share is expanding rapidly. Production from nodules might amount to 18 per cent of the total world demand in 1985. This volume of production would depress prices somewhat, but the impact would be lessened by the good growth prospects for nickel, and by the fact that developing producers account for a small share of the total market. Nickel production from nodules might cause some high cost laterite projects under consideration to be abandoned, but it should not have a serious effect on land-based production as a whole.

In 1972, three countries - Canada, France (New Caledonia) and the USSR - accounted for 74 per cent of world mine production of nickel. Developing country producers, primarily Cuba and Indonesia, accounted for only 13 per cent of total mine output. Within the next decade, even with sea-bed production, nickel production from developing countries is expected to increase to almost three times its present size, and the Secretary-General's report estimates that this increase will lead to an 18-20 per cent share of the world's nickel production in 1985.

Given the Secretary-General's assumption that sea-bed production of nickel from nodules will account for approximately 18 per cent of world demand in 1985, land-based

1/ Report of the Secretary-General, A/CONF.62/25, pp. 8-9.

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sources of nickel will still have to increase by 70 per cent in order to meet world demand. Such a large increase in demand can be expected to result in increased prices. Thus, a number of high cost land deposits which were previously marginal may become economically feasible. We can anticipate that even with full-scale sea-bed production many new nickel deposits may be opened in developing countries. In fact, a rough computation, based on the Secretary-General's estimate that developing country producers' share of the market will increase from 13 per cent to 20 per cent, would imply that about 50 per cent of the increase in land capacity would come from developing countries.

A very strong growth rate (approximately 6 per cent) is projected for world nickel demand, and this projected increase in demand will mean that sea-bed nickel output may gradually augment world supply without displacing any land-based production. Given that demand is projected to increase at a 6 per cent annual rate, there will in all likelihood be a corresponding increase in prices over current levels, even with sea-bed production. Thus, with increased output and increased prices, the total revenue obtained by land-based producers will also be greater than current levels. Sea-bed nickel production may help to limit somewhat this expected price increase, but its effect will be less pronounced if we assume that demand for nickel is elastic, as is done in the Secretary-General's report. Any expansion in the total production of nickel thus would not have a large impact on prices and would result in an increase in total revenues accruing to the industry as a whole.

Copper

The Secretary-General's report 1/ concluded the following with respect to the impact of sea-bed copper production on world markets:

> The world market for copper is huge compared to that for nickel, being about 14 times the size of the nickel market in 1972. Copper prices rose dramatically from 1970-1974, reaching a record level of $US 1.10/lb in early 1974. Of the metals contained in nodules, copper production is the least concentrated among producers. It is expected that the demand for copper will show an annual percentage growth rate of 4-5 per cent to the end of the century. Production from nodules might supply about 1.3 per cent of world consumption in 1985 and would displace only 5.5 per cent of the net import requirements of developed countries by that time. Copper production from nodules is expected to have a minimum impact on a relatively large, growing and somewhat diffuse market.

1/ A/CONF.62/25, p. 9.

In 1972, developing country producers accounted for around 42 per cent of world mine production of copper. While there are over fifty countries which produce significant volumes of copper, three developed countries - the United States, USSR and Canada - contributed 46 per cent to the 1972 world production total.

The Secretary-General's report estimates that sea-bed production of copper in 1985 would account for only 1.3 per cent of total world demand. In contrast, land-based production of copper will virtually have to double by 1985, given the UNCTAD assumption that demand will increase at a rate of 4-5 per cent per year. Assuming that developing country producers will continue to provide the same proportion of total world copper output as they have in the past, the reasonable presumption is that their current revenues and export earnings from copper production will also double by that year.

It is difficult to predict what the precise effect ten years from now will be of an added supply of less than 2 per cent for an industry that may grow by 100 per cent. However, the implications of sea-bed production for world copper markets will be clearly insignificant.

Manganese

The Secretary-General's report 1/ draws the following conclusions with respect to the effect of sea-bed production on world markets of manganese:

> Manganese might be recovered from nodules in two forms, either as pure metal or as ore-equivalent. More than 90 per cent of the manganese produced is used in the form of ferromanganese in the manufacture of steel; thus the rate of growth in its consumption will tend to parallel that of steel production. On the other hand, the market for manganese metal is relatively small. Metal production from one operation of one million tons/year in 1985 might amount to twice the volume of projected demand. Therefore, manganese metal supply from nodules would depress prices. Depending on the form and volume of manganese recovery from nodules, the export earnings of developing country producers might drop significantly. However, with just one exception, developing countries are not dependent upon manganese exports to a great degree.

There is some dispute concerning whether there will be significant manganese recovery from sea-bed nodules. 2/ Evaluation of the conclusions reached in the Secretary-General's report requires some analysis of the uses of manganese and of the manganese market. More than 90 per cent of world manganese is used as a "scavenger",

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1/ A/CONF.62/25, p. 9.

2/ In this connexion, it should be noted that an "Intensive Consultation" on manganese ore was held in Geneva early in 1974. This Consultation, which was held under the auspices of UNCTAD, was attended by representatives of all countries interested in the production, consumption and marketing of manganese ore. Delegations may be interested in studying the outcome of this meeting, of which one decision was that no recommendation about manganese should be sent to the Law of the Sea Conference in Caracas.

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or remover of impurities, in the production of steel from iron ore. Manganese is added to the molten ore in the form of either manganese ore or ferromanganese, which is produced from manganese ore. The manganese combines with the impurities and is drawn off with the slag and discarded.

In contrast with manganese ore from land-based mines, manganese nodules contain metals other than manganese. Therefore, manganese from nodules cannot be used in steelmaking unless it is refined, since otherwise it would add impurities to the steel rather than removing them. Since the percentage content of manganese in nodules is lower than the percentage in land-based ores, there is also a higher proportion of waste rock which would have to be melted in the steelmaking furnace, thus adding substantially to fuel costs and processing time. The small likelihood that manganese from nodules can compete with manganese ore from land sources has been recognized by the companies which are preparing to mine the nodules. Only one United States company has indicated that it may produce any manganese from nodules, and this manganese would be in the form of a highly pure metal which would serve only a very small segment of the manganese market.

It therefore appears highly unlikely that the assumption by the Secretary-General of significant impact on land-based manganese producers from manganese nodule production will be realized. Even if new uses develop for pure manganese metal, it is by no means certain that the nodules would be a more economic source of such metal than the higher grade, purer manganese available from traditional sources.

Cobalt

The Secretary-General's report 1/ reached the following conclusions on the effect of sea-bed production on the prices of cobalt:

> Cobalt is a relatively expensive metal with a small market, and its value in world commodity trade is rather small. By 1985, production from nodules could account for about half the volume of world output while effecting a drop in price to about two thirds of current levels.

Projected production of cobalt from the sea-bed would account for such a large share of world demand by 1985 that some downward pressure on cobalt prices would be inevitable. Since cobalt can serve as a substitute for nickel in many of its uses, however, the price of nickel in the long-term can be expected to provide a lower limit on this potential decline.

Several developing countries - Zaire, Morocco, Cuba and Zambia - produce cobalt, but of these, only Zaire earns more than 1 per cent of its foreign exchange from this metal. Even at a significantly reduced price, present cobalt producers probably could continue to operate profitably, for cobalt is produced as a by-product, usually from copper or nickel recovery. Assuming, then, that land-based production of nickel and copper will increase dramatically in the next decade, the total revenues of individual cobalt producers accruing from the combined recovery of cobalt and copper or cobalt and nickel will probably continue to increase.

1/ A/CONF.62/25, p. 9.

It is also possible that new uses for cobalt, particularly as a partial substitute for nickel, will create additional demand if the price of cobalt declines. Although it is difficult to predict the precise magnitude of this phenomenon, the result would be an increase in total revenues from cobalt production accruing to the entire industry.

Summary

Table 1 below demonstrates that developed, as well as developing countries are major producers of the metals contained in manganese nodules and contains some order-of-magnitude estimates for the value of production, based on 1971 prices. This table demonstrates that by value, cobalt, manganese and nickel production are small in comparison with copper.

Many producers of one of the metals contained in nodules are also major producers of other metals. This is particularly true with respect to cobalt, which is produced as a by-product, usually of copper or nickel. Thus, if we can expect major expansions in productive capacity over the next decade for copper and nickel, the effect which decreased cobalt prices might have on Zaire, Zambia, Morocco and Cuba would be more than compensated by projected increased revenues from copper and nickel production.

Table 2 summarizes our estimates with respect to present (1971) production, future sea-bed production, future land-based production and future production for all sources. An implied assumption of the table is that the division of output between developing and developed countries will remain about the same as current levels.

The projected income of individual land-based producers of nickel, copper, manganese and cobalt from their combined production of these metals will increase significantly between the present and 1985, even with sea-bed production.

B. Positive Economic Implications

As explained in the preceding section, only a small number of developing countries are major producers of nickel, copper, cobalt and manganese (Chile, Zambia, Zaire, Peru, the Philippines and China), while a large share of total production for these minerals comes from developed countries (the United States, Canada, USSR, South Africa, Australia and Japan). Even fewer developing countries depend on production from one or more of these metals as a significant source of foreign exchange earnings. In contrast, all developing countries are consumers in varying degrees of the products made from these raw materials and in most cases they use valuable foreign exchange earnings to pay for importation of these goods.

An increase in the prices of raw materials will inevitably result in increased prices for the goods made from them, and the goods made from nickel, copper, cobalt and manganese are largely capital goods - the industrial equipment and machinery which is used in the manufacturing sector, such as wire, electrical equipment, stainless steel, steel with better shock resistance, heat resistant steel and permanent magnets. A country which is attempting to develop quickly must increase its stock of these and other capital goods at a much higher rate than is now found in industrialized countries. For nations with scarce resources, this means a lower rate of consumption than might

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otherwise prevail, and even a slight increase in the prices of goods necessary for development will mean a further intensification of the sacrifices to be made by consumers in developing countries or a reduction in economic growth. In relative terms, then, consumers in developing countries as a whole are more affected by increased prices for these goods than those in the industrialized world.

Consuming countries, including the developing countries, clearly stand to gain positive economic benefits from the exploitation of deep sea-bed resources, for the existence of a large alternative source of supply will serve to prevent the prices of these four metals from rising as quickly as they might otherwise. Cheaper prices for such commodities as wire, electrical equipment, stainless steel and permanent magnets will mean that some of the essential elements for economic growth are more readily available.

In addition to the benefits which the world's consumers will derive from sea-bed production, developing countries will gain positive financial benefits from the generation of revenues from sea-bed exploitation. Another positive economic effect may be the development of technology, especially with regard to mineral recovery, which could contribute markedly to the development or improvement of mineral extraction elsewhere.

III. Analysis of Economic Effects of Certain Proposals

Although the benefits to be derived from greater availabilities and lower prices resulting from sea-bed production will accrue to developing as well as developed country consumers, the major share of these benefits in absolute terms will of course be gained initially by the industrialized world. Moreover, the economic effects of sea-bed production for developing country producers of these four metals cannot be considered solely from the perspective of whether the level of their present earnings is jeopardized, for there is also the question of whether developing country producers will earn less than they would have earned in the absence of sea-bed production.

Several proposals have been submitted to the United Nations Sea-Bed Committee and the Conference which attempt to reconcile the interests of all peoples in minimizing prices to the consumer with the interests of developing country producers whose revenues may not increase as rapidly as a result of sea-bed production. Several of these proposals envision production or price controls on sea-bed exploitation. The policy issue of whether it is necessary to balance the interests of the international community in efficiency with its interests in protecting developing country producers will not be addressed by this economic working paper. However, the implications in economic terms of the various proposals for resolving this problem may not be as clear as they have been portrayed. The following discussion analyses some of the economic effects associated with the implementation of these proposals.

Restrictions on Sea-Bed Production

There are essentially two types of restrictions which can be imposed upon sea-bed production to limit production. The first includes controls which can be imposed on sea-bed miners who have already come into commercial production, such as controls in the rate of sea-bed production, high financial or other regulatory burdens, or

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requirements that miners limit their production of individual metal components from nodules. It is unlikely that producers would begin operations under a régime that erratically inhibited recovery operations, for such actions are tantamount to depriving producers of a return on their investment and could drive them to other sources outside the international régime. As has been generally agreed, the international régime must provide security of investment for potential miners to be effective and successful.

The second category of production restrictions relates to the potential for limiting the entry of new operations in sea-bed mining through burdensome financial and regulatory provisions or by limiting the amount of sea-bed area available for exploitation. The purpose of these measures would be to decrease supply from the sea-bed and increase market prices. However, there are several reasons why production restrictions on sea-bed output do not provide an effective mechanism for increasing the revenues of land-based producers.

First, restrictions of this nature would not offer a very precise tool for the purposes of controlling the effect of sea-bed production on land-based producers of one particular metal, since the impact of these controls would be experienced in all of the markets of the metallic components of nodules. Even selected controls on the rate of production of one metal would alter the internal cost structures of firms and possibly decrease sea-bed production of all other metals.

Moreover, restrictions of this nature cannot affect the short-term revenues of land-based producers, since these controls would have to be applied anywhere from three to ten years in advance of the problem. In other words, limiting new entries into sea-bed mining would not affect the output levels of existing sea-bed producers or the projected level of output for those miners who had received rights but not yet achieved full-scale recovery.

Second, there is reason to believe that demand for these raw materials is elastic, that is, a 1 per cent change in price produces a change in consumption of more than 1 per cent. Although restrictions on production resulting in decreased output from the sea-bed will cause market prices to rise and the quantity demanded to decrease, the decrease in quantity demanded will be larger in percentage terms than the increase in price. Putting it another way, it is necessary to restrict sea-bed output to a much larger extent to achieve a desired increase in land-based earnings when demand is elastic. A glance at Table 2 where the magnitude of potential sea-bed production is shown, indicates that in most instances, sea-bed production would not be so large a percentage of the total that its complete elimination could cause much of an increase in earnings for land-based producers.

Third, production controls are not selective in their effects. Whatever wealth is transferred from consumers to land-based producers will go to land-based producers in both developing and developed countries. Inspecting the value of output for all four metals from land-based production in Table 1 demonstrates that industrially developed countries produce the larger share of the present world supply of the four metals in question. If the present division of production continues, the major share of the increased earnings will go to producers in industrially developed countries.

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Finally, limitations on sea-bed production will not resolve the most critical problem for existing producers of these four metals - competition from the opening of new deposits on land.

Commodity Agreements

Another mechanism which has been suggested for regulating sea-bed production in order to control the world market prices of the metals produced from nodules is the establishment of international commodity agreements. Such agreements would no doubt be characterized by provisions such as floor prices, production quotas, etc. To be effective, they would require the participation of virtually all producers both land-based and sea-based, and their agreement on matters such as price ranges and market shares.

Based on past experience, it can be anticipated that the negotiation of commodity agreements for the four metals involved would be difficult. Assuming, however, that they could be negotiated, they would be difficult to operate, and would not necessarily be effective, because of the obvious conflicts of interest which would exist among producers, on the one hand, and between producers and consumers, on the other.

It is assumed, of course, that membership in any such agreements would include most of the countries with a major interest in the production, trade and consumption of the various metals. However, even under these circumstances, not only the decision-making process, but also the development and implementation of means of enforcing decisions would be problems of major proportions. Moreover, the joint product nature of sea-bed production makes it difficult to selectively manage, through commodity agreements as well as through production restrictions, the amount of recovery from the sea-bed of individual metallic components of nodules.

Finally, commodity agreements are incapable of being designed to aid just the land-based producers that are developing countries. Their very nature requires them to be based upon existing capacity and this would mean favouring the industrially advanced producers.

Compensation

The function of compensation is often to pay a supplement to a high cost producer in order to permit that producer to stay in operation when the market price is too low to enable him to operate profitably without the supplement. Since the higher cost producers are being subsidized in their operation, they have little incentive to reduce costs or improve the quality of their product. If the sea-bed segment of the industry, in this case, were required to provide a subsidy to land-based producers, additional costs would be imposed on sea-bed mining and consumers of sea-bed products and the effect would be similar to that of production restrictions. Thus, a compensation scheme for land-based production could lead to upward pressure on prices.

Compensation does have the advantage, however, that it can be selectively applied so that only developing country producers are eligible. In addition, compensation can be provided only to the extent that resources freed from mineral production are not employable in other productive activities. If such a system were adopted, it would be desirable to use it in a way that encourages internal adjustment in the countries affected.

IV. Conclusions

The following conclusions concerning the effects of production restrictions, commodity agreements and compensation can be drawn from the preceding analysis:

(1) All three schemes invariably cause prices to be higher than they would otherwise be;

(2) Restricting sea-bed production cannot effectively stabilize land-based producer revenues, much less increase them, due to the small segment of the market served by sea-bed production;

(3) Commodity agreements are extremely difficult to establish and have built-in impediments to their success;

(4) Except for compensation, these solutions cannot be selectively applied solely to benefit developing country producers.

In a summary of effects that are to be expected from these three types of restrictions on sea-bed production, one point is most important. To the extent there are beneficiaries of restricting sea-bed production, they will be land-based producers who are largely the industrially developed countries. Those suffering the greatest losses will be the world's consumers, including the peoples of the lesser developed economies who depend so heavily upon the capital goods made with these minerals for increasing their future standards of living.

TABLE 1 *

Approximate 1971 Value of Mineral Production

(millions of 1971 dollars)

	Cobalt	Copper	Manganese	Nickel	Total	Percent of World Output
I. TOTAL	$115	$6125	$223	$445	$6908	100%
II. Group of 77 Countries	88	2602	98	45	2833	40
III. Other Countries	27	3523	125	400	4075	60
Non-Group of 77						
U.S.A.	--	1522	--	9	1531	22
Canada	11	720	--	186	917	13
U.S.S.R.	8	680	76	80	844	12
Australia	2	195	11	22	230	3
South Africa	--	174	36	9	219	3
Japan	--	133	2	--	135	2
Poland	--	99	--	--	99	1
France	--	--	--	71	71	1
Rhodesia	--	--	--	9	9	0.1
Finland	6	--	--	--	6	0.1
Greece	--	--	--	9	9	0.1
Group of 77 Producers						
Chile	--	790	--	--	790	11
Zambia	10	718	--	--	728	10
Zaire	65	449	4	--	518	7
Peru	--	235	--	--	235	3
Philippines	--	230	--	--	230	3
China	--	110	12	--	122	2
Mexico	--	70	2	--	72	1
Cuba	8	--	--	27	35	0.5
Brazil	--	--	29	--	29	0.4
Gabon	--	--	20	--	20	0.3
India	--	--	20	--	20	0.3
Indonesia	--	--	--	18	18	0.3
Morocco	5	--	--	--	5	0.1
Ghana	--	--	7	--	7	0.1

* NOTE: see bottom of Table 2 for sources and comments.

TABLE 2 *

Approximate Value of Mineral Production

(millions of 1971 dollars)

	Cobalt	Copper	Manganese	Nickel	Total
Landbased					
Group of 77 Producers					
1971	88	2602	98	45	2833
1980	99	4036	110	131	4376
1985	106	5214	150	175	5645
Other Countries					
1971	27	3523	125	400	4075
1980	31	5346	200	486	6063
1985	34	6755	213	650	7654
Seabeds					
1971	0	0	0	0	0
1980	70	123	12	135	340
1985	120	158	33	181	492
TOTAL					
1971	115	6125	223	445	6908
1980	200	9505	322	752	10,779
1985	260	12,127	396	1006	13,789

* Countries are listed in rank order of the total value of the four metals in question. The countries listed produce at least 1% of the world production of one of the metals listed.

* Data is extrapolated from UNCTAD documents TD/B/449/Add 1; TD/B/484; TD/B/483; TD/113/Supp 4; UN document A/Conf.62/25; and U.S. Department of the Interior 1971 Minerals Yearbook.

UNITED NATIONS

THIRD CONFERENCE
ON THE LAW OF THE SEA

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FIRST COMMITTEE

United States of America: draft appendix to the law of the sea Treaty concerning mineral resource development in the international sea-bed area 1/

Article I. General

1. All commercial prospecting, evaluation and exploitation activities in the international sea-bed area which have as their principal or ultimate purpose the discovery, appraisal or exploitation of mineral deposits shall be conducted in accordance with this Convention, these regulations, supplementary regulations promulgated by the Authority in accordance with this Convention, and the terms and conditions of /legal arrangements/.

2. Any /legal arrangements/ entered into between the Authority and other entities as defined in article II must be drawn in strict accordance with this Convention, these regulations and supplementary regulations promulgated by the Authority in accordance with the provisions of this Convention. (Hereinafter, the term "this Convention" shall be deemed to include these regulations and supplementary regulations promulgated in accordance with the provisions of this Convention.) The Authority shall not have the right to require terms and conditions in /legal arrangements/ not found in this Convention.

Article II. Legal relationships

1. The Authority may enter into /legal arrangements/ concerning evaluation and exploitation with a Contracting Party, group of Contracting Parties or natural or juridical persons which obtain the sponsorship of a Contracting Party or group of Contracting Parties (hereinafter referred to as "Party or Person"). The Authority may not enter into /legal arrangements/ for such purposes with any other entity.

2. In those cases in which a Contracting Party elects to act as a Sponsoring Party rather than as the direct recipient of the rights granted pursuant to /legal arrangements/ the Sponsoring Party shall be responsible for the performance of any duties or obligations imposed by this Convention on natural or juridical persons which it sponsors.

1/ These articles are preliminary in nature and are intended to reflect concepts rather than final detailed provisions. It is expected that revisions and additions will be submitted by the United States.

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3. The /legal arrangements/ shall grant the right to mine. The right to mine shall include both the evaluation and the exploitation of mineral deposits.

4. It shall not be necessary to enter into /legal arrangements/ to engage in commercial prospecting, which shall be governed by the provisions of article III.

Article III. The right to conduct commercial prospecting

1. All States and persons natural or juridical shall have the right to conduct commercial prospecting in the international sea-bed area in accordance with the provisions of this Convention.

2. The term "commercial prospecting" shall, for the purpose of this Convention, mean the carrying out of geophysical and geochemical measurements, bottom sampling, dredging, drilling and other forms of subsurface entry with the intention of locating mineral deposits for the purpose of evaluation and exploitation.

3. Any State or person natural or juridical conducting commercial prospecting activities shall so inform the Authority. The Authority shall acknowledge receipt of this information by issuing a prospecting certificate.

4. The prospecting certificate shall be issued for a two-year period and shall be automatically reissued for additional two-year periods.

5. If the Tribunal finds, on complaint of the appropriate organ of the Authority or any Party or Person, that a prospector has conducted his activities in such a way as to result in a gross and persistent violation of this Convention, the Tribunal may prohibit that Party or Person from prospecting for a period of two years. At the expiration of such period, the prospector shall be entitled to engage in prospecting again without regard to the previous activities which gave rise to the prohibition.

6. Notwithstanding the provisions of paragraph 2 of this article, no State or person, natural or juridical, shall have the right to conduct drilling or any other form of excavation in the international sea-bed area deeper than 300 metres below the surface of the sea-bed for purposes of commercial prospecting, evaluation and exploitation unless such State or person obtains the right to mine pursuant to article IV.

Article IV. The right to mine

General conditions

1. Any Party or Person, as defined in article II, paragraph 1, shall be entitled to enter into /legal arrangements/ with the Authority, which shall grant the right to mine to such Party or Person (hereinafter referred to as the miner) when the following conditions have been met:

(a) The miner declares to the Authority that in his judgement exclusive rights to an area or areas are essential to the pursuit of further commercial activity. In the case of a miner who is a natural or juridical person, the declaration to the Authority shall be made by his Sponsoring Party.

(b) In the case of a miner who is a natural or juridical person, he shall submit to the Sponsoring Party all raw data which he has acquired from the international sea-bed area prior to the date of his application for a right to mine to the extent such data concern the physical and chemical properties of the area or areas and the resources for which he seeks an exclusive right to mine. The Sponsoring Party shall ensure that appropriate protection is provided for such data in order to protect the commercial value of such data to the miner.

(c) The miner shall describe the category of mineral or minerals for which he seeks the right to mine. The right to mine shall only extend to minerals within that category. The mineral or minerals shall be described as falling within one of the following two categories:

Category (i) Fluids or minerals extracted in a fluid state, such as oil, gas, helium, carbon dioxide, water, sulphur and saline minerals, steam, hot water or brine or geopressured fluids, metalliferous muds and any hard minerals found more than three metres beneath the surface of the sea-bed.

Category (ii) Hard minerals on the surface of the sea-bed or beneath the surface of the sea-bed not deeper than three metres including nodules.

(d) The Sponsoring Party, in the case of a natural or juridical person, shall ascertain the financial and technical competence of the miner and shall provide assurances to the Authority that the miner is financially and technically competent to engage in mining and comply with the conditions imposed by this Convention.

(e) The miner shall agree to comply with this Convention and any Tribunal orders or decisions.

(f) The Authority shall be entitled to receive an application fee not to exceed /US $50,000/ to defray the administrative expenses of the Authority.

2. Upon receipt by the Authority of the declarations, statements, assurances and application fee required pursuant to paragraph 1, the Authority shall enter into /legal arrangements/ granting the right to mine to the Party or Person requesting it in an area or areas to be designated by that Party or Person not to exceed, in the case of minerals described in paragraph 1 (c) (i) of this article, 300 square kilometres per area applied for. In the case of minerals described in paragraph 1 (c) (ii), the area or areas to be designated shall not exceed 30,000 square kilometres per area applied for.

3. The precise manner in which the area or areas is described shall be in conformity with supplementary regulations to be promulgated by the Authority in accordance with the terms of this Convention.

4. The right to mine shall be an exclusive right to mine in that no other Party or Person shall be granted any right to evaluate or exploit minerals in the same category and area unless the right to mine is forfeited in accordance with article V, paragraph 2, suspended in accordance with article VIII or transferred in accordance with article IX.

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Procedures

5. In the event any Party or Person applies for the right to mine the same category of minerals in the same or an overlapping area applied for by another Party or Person, the first such Party or Person to have so applied shall be granted the right to mine.

6. During the first day after this Convention comes into force, the following procedure for awarding applications for the right to mine shall be used in lieu of the procedure set forth in paragraph 5 of this article. All applications for a right to mine shall be held sealed and unopened by the Authority until the opening of business on the first working day after 24 hours have elapsed from the time this Convention comes into force measured in local time at the site of the Authority. At that time, the Authority shall publicly open and determine whether applications have been received for the same category of minerals in the same or overlapping areas. The Authority shall make public all such competing applications when they are opened and no subsequent applications shall be accepted for the same category of minerals in the same or overlapping areas. In the event any such competing applications have been received, the right to mine the area or areas in question shall be awarded by the Authority within 30 days to the highest bidder after a request is made to the competing applicants, or their Sponsoring Party, in the case of natural or juridical persons, for sealed bids. A bid shall consist of a commitment on the part of the bidder to transfer to the Authority a specified amount of money in a common convertible currency to be named by the Authority in its request for bids. Operations under /legal arrangements/ for the right to mine may commence upon full payment of the bid commitment.

7. The Authority may enter into other /legal arrangements/ with respect to the right to mine minerals in the other category in the same area or areas which have already been awarded to a miner. The Authority shall ensure that in such cases the /legal arrangements/ include a provision requiring non-interference by succeeding rights holders with the Party or Person first granted the right to mine in the area. The Authority shall promulgate supplementary regulations in accordance with the provisions of this Convention to ensure that holders of the right to mine do not unjustifiably interfere with other uses of the area.

Article V. The right to mine - evaluation and exploitation phases

1. The right to mine shall be conducted in two phases: (a) an evaluation phase which shall commence when the right to mine is granted and shall terminate when commercial production is achieved as defined in paragraph 3 of this article or at the end of 15 years, whichever occurs first, (b) an exploitation phase which shall commence when the evaluation phase is terminated and which shall terminate after 20 years. An additional period of 20 years shall be granted for exploitation under the original right to mine at the option of the miner but the right to mine shall be amended to be made subject to such regulations as are in force at that time.

2. The miner shall forfeit the right to mine at the end of the evaluation phase if he has not achieved commercial production as defined in paragraph 3 of this article.

3. Commercial production shall be deemed to have begun if for a period of six consecutive months the miner engages in activity of sustained large-scale recovery

operations which yield a sufficient quantity of material as to clearly indicate that the principal purpose is large-scale production rather than production intended for information gathering, analysis, equipment or plant testing.

4. In the event the appropriate organ of the Authority determines that commercial production has been achieved, it may require that the miner commence the exploitation phase. In the event of a dispute between the Authority and the miner concerning whether the miner has commenced commercial production, the evaluation phase shall continue until the dispute has been settled in accordance with dispute settlement procedures provided for in this Convention. Any other Party or Person who believes that a Party or Person holding a right to mine has commenced commercial production but has not entered into the exploitation phase of his right to mine may request the Authority to so determine and, in the event of disagreement with the Authority's determination, may resort to the dispute settlement procedures provided for under this Convention.

5. Any Party or Person which has obtained the right to mine shall, if the right is forfeited under paragraph 2 of this article, make available all data which it has acquired as defined in article IV, paragraph 1 (b) to the Authority. In the case of a natural or juridical person such data shall be submitted by the Sponsoring Party. The Authority shall make such data available to the public immediately upon receipt.

<u>Article VI. Requirements to ensure diligence during the evaluation phase</u>

1. In order to ensure that the miner carries out his evaluation work in a diligent manner, he shall be required to make periodic expenditures. The Authority shall promulgate supplementary regulations in accordance with the terms of this Convention, selecting specific levels of expenditure from the allowable range set out in paragraph 2 of this article. These expenditure requirements shall be applied in such a manner as to assure that they do not discriminate in form or in fact between different miners. The Authority, in selecting the specific amounts, shall be guided by the principle that these amounts should be at a level adequate on the one hand to ensure diligence and on the other to ensure that there is no discrimination against <u>bona fide</u> miners who have the intention of serious evaluation.

2. The Authority shall select a level from the following schedule* and shall require that the miner spend not less than the amount specified per annum per each area which he has been awarded. When the Authority selects a level within each category or time period, that level for that time period shall be applied to all miners without discrimination.

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* An automatic mechanism should be found for changing these figures with inflation.

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Paragraph 1 (c) (i) Minerals

Years	Amount per annum
1-5	$ 120,000-$ 200,000
6-10	300,000- 1,200,000
11-15	400,000- 1,200,000
TOTAL	$4,100,000-$13,000,000

Paragraph 1 (c) (ii) Minerals

Years	Amount per annum
1	$ 120,000-$ 200,000
2-5	300,000- 400,000
6-10	600,000- 1,500,000
11-15	750,000- 1,500,000
	$8,070,000-$16,800,000

3. With respect to paragraph 1 (c) (ii) minerals, expenditures for equipment purchase or off-site construction costs directly related to the area or areas for which the miner holds the right to mine shall apply toward fulfilment of these requirements.

4. Expenditures in excess of the required amount for any given year shall be credited to the requirement for the subsequent year or years.

5. In the case of a natural or juridical person, the Sponsoring Party shall be responsible for ensuring compliance with paragraphs 1 and 2 of this article.

Article VII. Additional requirements during the exploitation phase

1. The provisions of article VI shall not apply when the exploitation phase commences pursuant to article V.

2. The following additional terms and conditions shall apply during the entire period of the exploitation phase:

(a) payment to the Authority, in the case of a natural or juridical person by the Sponsoring Party, of such revenues as are established pursuant to article X;

(b) any Party or Person must submit, in the case of a natural or juridical person through the Sponsoring Party, all raw data which he has acquired from the international sea-bed area concerning the area for which he holds exclusive rights to the extent such data concern the physical and chemical properties of the area or areas and the resources either while he held a prospecting certificate or during the previous evaluation phase or if he did not hold a prospecting certificate, all such data which he may have acquired from others prior to obtaining the right to mine.

Such Party or Person shall also submit once each year during the exploitation phase all such data described above and all data concerning the amount of production achieved and [such other data as is directly relevant to the implementation of article X].

Article VIII. Suspension of the right to mine

1. The right to mine shall be suspended and no compensation shall be paid by the Authority to the miner if any of the following events occurs:

(a) The Tribunal finds on complaint of the Authority or any Party or affected Person that the Party or Person holding the right to mine has conducted his activities in such a way as to result in a gross and persistent violation of this Convention if such violations are directly related to his mining activities and were not caused by circumstances beyond his control.

(b) The Tribunal finds, on complaint of the Authority, that a Party or Person has wilfully failed to comply with a final or interlocutory decision of the Tribunal.

2. No final suspension of the right to mine may be implemented except after the miner has had a reasonable opportunity to exhaust the procedures provided for in thia Convention for the settlement of disputes which shall include de novo review of the facts and law in the matter by the Tribunal. If the miner holds the right to mine more than one area, suspension shall only apply to the area or areas which have given rise to the situation for which suspension is the penalty. Suspension or other penalties imposed pursuant to this article shall not prejudice the right of a Party or Person to obtain the right to mine in other areas in the future.

3. The period of suspension shall be proportionate to the nature of the violation.

4. The Tribunal may, in lieu of suspending the right to mine, impose monetary penalties proportionate to the nature of the violation and not to exceed______ per violation. The Tribunal may also impose monetary penalties proportionate to the nature of the violation and not to exceed______ per violation for violations which are not gross and persistent if such violations are directly related to his mining activities and were not caused by circumstances beyond his control.

5. Any Party or Person whose right to mine is suspended pursuant to this article shall make available all data which it has acquired as defined in article IV, paragraph 1 (b) and article VII, paragraph 2 (b) to the Authority. In the case of a natural or juridical person such data shall be submitted to the Authority by the Sponsoring Party. The Authority shall hold such data in secret.

Article IX. Transferability of the right to mine

1. The right to mine shall be freely transferable provided the transferee agrees to comply with all applicable provisions of this Convention and any Tribunal orders or decisions.

2. In the case of a transferee who is a natural or juridical person, such person must obtain the approval of the transferor's Sponsoring Party to the transfer unless the transferee elects to obtain the sponsorship of another Contracting Party or group of Contracting Parties in which case such new Sponsoring Party shall have previously certified to the Authority its willingness to assume the role of Sponsoring Party immediately upon the completion of the transfer of rights and certifies compliance with article IV, paragraph 1 (d).

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3. The right to mine may be transferred in whole or in part.

4. The rights of the transferee, whether transferred in whole or in part, shall be identical to the rights held by the transferor prior to the transfer.

Article X. Income of the authority - revenue commitments of Contracting Parties and Sponsoring States

Any Party or group of Parties holding the right to mine, or acting as Sponsoring Parties under the terms of article II, shall be required to make annual financial payments during the exploitation phase in a convertible currency according to /formula/.

Statement by Ambassador John R. Stevenson
Special Representative of the President and
Chairman of United States Delegation to the
Third United Nations Law of the Sea Conference,
before the Senate Foreign Relations Committee
Hearings on S.1988, "Emergency Marine Fisheries
Protection Act of 1974," September 5, 1974

Mr. Chairman:

I welcome this opportunity to appear before the Senate Foreign Relations Committee to report on the progress made at the first substantive session of the Third United Nations Conference on the Law of the Sea held in Caracas, Venezuela, from June 20 to August 29, 1974.

Before proceeding with this report, I would like to say how much we appreciated the attendance at the Conference of three members of this Committee, Senators Clifford Case, Edmund Muskie, and Claiborne Pell, as well as members of their and the Committee's staffs. We are deeply grateful for their willingness to attend the Conference and for the advice and assistance that they and other members of the Committee have given to our efforts to achieve an agreed constitution and supporting legal regime for two-thirds of this planet. It has been and will remain a fundamental part of our policy to work closely with the Congress and this Committee to achieve a Law of the Sea Treaty that fully protects the basic interests of the United States.

I want to emphasize at the outset that, while the results of the Caracas session were not all we hoped for, the session was not a failure.

A most significant result was the apparent agreement of most nations represented there that the interests of all will be best served by an acceptable and timely treaty.

To that end, the Conference has scheduled not only the next session in the spring in Geneva, but a return to Caracas for the signing of this agreement in the expectation that this will take place in accordance with the United Nations timetable. That timetable provides for conclusion of the treaty in 1975.

Further evidence of this desire to achieve promptly a widely-acceptable treaty was reflected in the adoption by consensus of the rules of procedure early in the session. These rules make several changes in normal procedures that are designed to promote widespread agreement.

The tone of the general debate and the informal meetings was moderate and serious and reflected wide agreement on the broad outlines of a comprehensive general agreement.

Finally, I am sure the members of the Senate who were with us will agree that the Delegates from all regions worked hard. Three or four simultaneous meetings were common and there were some night sessions. The number of papers worked on was enormous, but this time the object -- largely achieved -- was organizing and reducing the alternatives, not proliferating them.

Other accomplishments of the session were considerable. Among the most important are the following:

(a) The vast array of critical law of the sea issues and proposals within the mandate of Committee II--including among others the territorial sea, economic zone, straits, fisheries and the continental margin--was organized by the Committee into a comprehensive set of working papers containing precise treaty texts reflecting main trends on each precise issue. All states can now focus on each issue, and the alternative solutions, with relative ease.

A similar development occurred with respect to marine scientific research in Committee III. Committee I, dealing with the novel subject of a legal regime for exploiting the deep seabed, had previously agreed to alternative treaty texts in the preparatory Committee and further refined these texts at the Caracas session.

(b) The transition from a preparatory Committee of about 90 to a Conference of almost 150, including many newly independent states, was achieved without major new stumbling blocks and a minimum of delay.

(c) The inclusion in the treaty of a 12-mile territorial sea and a 200-mile economic zone was all but formally agreed, subject of course to acceptable resolution of other issues, including unimpeded transit of straits. Accordingly, expanded coastal state jurisdiction over living and non-living resources appears assured as part of the comprehensive treaty.

(d) With respect to the deep seabeds, the first steps have been taken into real negotiation of the basic questions of the system of exploitation and the conditions of exploitation.

(e) Traditional regional and political alignments of states are being replaced by informal groups whose membership is based on similarities of interest on a particular issue. This has greatly facilitated clarification of issues and is necessary for finding effective accommodations.

(f) The number and tempo of private meetings has increased considerably and moved beyond formal positions. This is essential to a successful negotiation.

Of course, by their very nature, the results of such meetings cannot be discussed publicly.

With few exceptions, the Conference papers now make it clear what the structure and general content of the Treaty will be. The alternatives to choose from, and the blanks to be filled in, and even the relative importance attached to different issues, are well known.

What was missing in Caracas was sufficient political will to make hard negotiating choices. A principal reason for this was the conviction that this would not be the last session. The absence prior to the completion of this session of organized alternate treaty texts on many issues also inhibited such decision making.

The next step is for Governments to make the political decisions necessary to resolve a small number of critical issues. In short, we must now move from the technical drafting and preliminary exploratory exchanges of views at this just completed session, which has laid bare both the outlines of agreement and the details of disagreement, to the highest political levels, involving heads of states themselves, to make accommodation on these critical issues possible.

The fundamental problem is that most states believe the major decisions must be put together in a single package. Every state has different priorities, and agreement on one issue is frequently conditioned on agreement on another. Thus, it might have been possible--and ight have been helpful to the Executive Branch in its efforts here today--to adopt a general declaration of principles in Caracas endorsing, among other things, a 12-mile territorial sea and a 200-mile economic zone. Our Delegation opposed such an idea, because it would have diverted us from negotiating the key details of an economic zone that can spell the difference between true agreement and the mere appearance of agreement, and because our willingness to support such concepts is also conditioned on satisfactory resolution of other issues, including unimpeded passage of straits. In choosing to concentrate on precise texts and alternatives, our Delegation believed we were in fact best promoting widespread agreement on schedule. However, we recognized that the absence of tangible symbols of agreement would place us in a politically difficult situation between sessions.

In his closing statement before the Caracas session, the President of the Conference, recognizing the problem, stated, "we should restrain ourselves in the face of the temptation to take unilateral action", and then urged states to prepare to reach agreement "without delay" since governments cannot be expected to exercise "infinite patience."

We regret that for a variety of reasons the Conference was unable to capitalize upon the initial, prevailing good will to produce a final treaty at the Caracas session. Nevertheless, the political parameters of an overall agreement were made much clearer at Caracas and we are at the stage where differences in approaches are embodied in specific treaty articles expressed as alternative formulations on almost all the major issues.

On July 11 at a Plenary session, we noted there was a growing consensus on the limits of national jurisdiction, which we expressed in the following terms: "A maximum outer limit of 12 miles for the territorial sea and of 200 miles for the economic zone...conditioned on a satisfactory overall treaty package and, more specifically, on provisions for unimpeded transit of international straits and a balance between coastal state rights and duties within the economic zone." To promote negotiations on the essential balance of coastal state rights and duties the United States submitted draft articles proposing the establishment of a 200-mile economic zone in the treaty. The U.S. draft articles consist of three sections: the economic zone, fishing, and the continental shelf.

The economic zone section provides for a 200-mile outer limit with coastal state sovereign and exclusive rights over resources, exclusive rights over drilling and economic installations, and other rights and duties regarding scientific research and pollution to be specified. There would be coastal state environmental duties with respect to installations and seabed activities. All states would enjoy freedom of navigation and other rights recognized by international law within the economic zone.

The fishing section gives the coastal state exclusive rights for the purpose of regulating fishing in the 200-mile economic zone, subject to a duty to conserve and to ensure full utilization of fishery stocks taking into account environmental and economic factors. In substance, there is no significant difference between the objectives of S.1988 and the United States proposal at the Conference. Fishing for anadromous species such as salmon beyond the 12-mile territorial sea would be prohibited except as authorized by the host state. Highly migratory species such as tuna would be regulated by the coastal state in the zone and by the flag state outside the zone, in both cases in accordance with regulations established by appropriate international or regional organizations. Membership in the organization would be mandatory and the coastal state would receive reasonable fees for the highly migratory fish caught in its zone by foreign vessels. The international organization in establishing equitable allocation regulations, would be obligated to ensure full utilization of the resource and to take into account the special interests of the coastal states within whose economic zones highly migratory fish are caught.

The continental shelf section provides for coastal state sovereign rights over exploration and exploitation of continental shelf resources. The continental shelf is defined as extending to the limit of the economic zone or beyond to a precisely defined outer limit of the continental margin. The coastal state would have a duty to respect the integrity of foreign investment on the shelf and to make payments from mineral resource exploitation for international community purposes, particularly for the economic benefit of developing countries. In our plenary statement we suggested that these payments should be at a modest and uniform rate. The revenue sharing area would begin seaward of 12 miles or 200 meters water depth, whichever is further seaward.

The draft articles on the economic zone place the United States in the mainstream of the predominant trends in the Conference, and we were pleased with the favorable reaction to our proposal. We were disappointed, however, at the support, particularly among a number of African countries, for an economic zone in which there would be plenary, coastal state jurisdiction, not only over resources, but over scientific research and vessel-source pollution as well and in all of these areas there would be no international standards except provisions for freedom of navigation and overflight and the right to lay submarine cables and pipelines. Many of the same countries are saying that if a pattern of unilateral action by individual countries emerges before a treaty is agreed, they would go further and opt for a full 200-mile territorial sea.

We believe that specifying the rights and duties of both coastal states and other states in the economic zone is the approach best designed to avoid the sterile debate over abstract concepts.

At the final meeting of the Second Committee on August 28, the Chairman, Ambassador Andres Aguilar of Venezuela, made a constructive and challenging statement summing up its work. On its own initiative, the Committee decided to have the statement circulated as an official Committee document. This occurred after initial opposition by the 200-mile territorial sea supporters, which was withdrawn in the face of other Delegations' willingness to proceed to a vote if necessary. Because of its great importance and the universal respect and admiration earned by Chairman Aguilar for his strong and effective leadership, I would like to quote briefly from that statement.

> "No decision on substantive issues has been taken at this session, nor has a single Article of the future Convention been adopted, but the States represented here know perfectly well which are at this time the positions that enjoy support and which are the ones that have not managed to make any headway.
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> "The paper that sums up the main trends does not pronounce on the degree of support which each of them had enlisted at the preparatory meetings and the Conference itself, but it is now easy for anyone who has followed our work

closely to discern the outline of the future Convention.

"So far each State has put forward in general terms the position which would ideally satisfy its own range of interests in the seas and oceans. Once these positions are established, we have before us the opportunity of negotiating based on an objective and realistic evaluation of the relative strength of the different opinions.

"It is not my intention in this statement to present a complete picture of the situation as I see it personally, but I can offer some general evaluations and comments.

"The idea of a territorial sea of 12 miles and an exclusive economic zone beyond the territorial sea up to a total maximum distance of 200 miles is, at least at this time, the keystone of the compromise solution favoured by the majority of the States participating in the Conference, as is apparent from the General debate in the Plenary meetings and the discussions held in our Committee.

"Acceptance of this idea is, of course, dependent on the satisfactory solution of other issues, especially the issue of passage through straits used for international navigation, the outermost limit of the continental shelf and the actual retention of this concept and, last but not least, the aspirations of the land-locked countries and other countries which, for one reason or another, consider themselves geographically disadvantaged.

"There are, in addition, other problems to be studied and solved in connection with this idea, for example, those relating to archipelagos and the regime of islands in general.

"It is also necessary to go further into the matter of the nature and characteristics of the concept of the exclusive economic zone, a subject on which important differences of opinion still persist.

"On all these subjects substantial progress has been made which lays the foundations for negotiation during the intersessional period and at the next session of the Conference."

Mr. Chairman, perhaps the most marked differences between the position of the United States and that of a majority of other states at the Conference emerged in the First Committee, which deals principally with the mining of manganese nodules in the deep seabed for the production of nickel, copper, cobalt and perhaps certain other metals. The basic differences relate to who will exploit the deep seabed resources and how this exploitation will take place. The United States took the position that access to the resources should be guaranteed on a non-discriminatory basis under reasonable conditions that provide the security of expectations needed to attract the investment for development of the resources. This would generate international revenues to be used for international community purposes, particularly for developing countries. A number of developing countries have supported a concept under which the international seabed authority would itself undertake exploration and exploitation, and which, under the new formula introduced by the developing countries at Caracas, would in addition have discretion to contract with States and private companies to operate under its direct and effective control and under basic conditions of exploitation set forth in the Convention itself.

During the last few weeks of the Conference real negotiations began on the basic conditions for exploitation when the First Committee agreed to establish a small, informal negotiating group. This group will resume its work at the next session of the Conference and we hope that negotiations in this context and during the intersessional period will lead to a narrowing of differences and a realistic approach that will promote access by industrialized consumer countries and the development of the mineral resources of the deep seabeds. The differences between what we call regulation and what others call control may be narrowed if we can agree on the conditions of exploitation, including measures to ensure that exploitation on a non-discriminatory basis will take place, and if agreement can be reached on protecting relevant interests in the decision-making process.

In the Third Committee of the Conference, there were mixed results on formulating treaty texts for protection of the marine environment and oceanographic scientific research. We were pleased that texts concerning the preservation of the marine environment were prepared on several points including basic obligations, particular obligations, global and regional cooperation and technical assistance. But basic political issues remain to be resolved on the jurisdiction of port and coastal states with respect to vessel-source pollution and on whether there will be different obligations for states depending upon their stage of economic development--the so-called double standard. We believe that the Caracas session broadened the basis of understanding of the complex problems involved in drafting new legal obligations to protect the marine environment, and there were indications that all states were analyzing their environmental policies in detail.

On the scientific research issue, the various proposals were reduced to four principal alternatives regarding scientific research within the areas of national jurisdiction. Some states advocated a regime requiring coastal state consent for all research. Others supported a modified consent regime. The United States supported a regime which places obligations on the state conducting the research to notify the coastal state, provide for its participation and ensure sharing of the data, and assistance in interpreting such data. Other states proposed complete freedom of scientific research.

We were encouraged by the fact that for the first time states appeared to be moving toward serious negotiations on this subject, including serious consideration of our proposal.

Mr. Chairman, we know there will be disputes with respect to the interpretation and application of the provisions of the Treaty. The willingness of the United States and many others to agree to a particular balance of the rights and duties of states and the International Authority is predicated upon reasonable confidence that the balance will be fairly maintained. Accordingly, the establishment of an impartial system of peaceful and compulsory third party dispute settlement is critical. We were encouraged to find at the Caracas session that there were states from all Regional Groups that support the need for comprehensive dispute settlement provisions. At the end of the session, the United States co-sponsored, with eight other states from different regions, a working paper containing alternative texts of draft treaty articles. This document was prepared, and is in general supported, by a broader informal Group chaired by the Representatives of Australia and El Salvador, for which Professor Louis Sohn of the Harvard Law School served as Rapporteur. We hope this document will facilitate the drafting of treaty articles on this important element of the Convention.

With your permission, Mr. Chairman, I will submit for the Record a copy of the Report transmitted by the Delegation to the Department of State on August 30, and copies of all draft articles sponsored or co-sponsored by the United States. The consolidated Treaty texts in Committee II and other documents will be transmitted to the Committee as soon as we receive them from the UN Secretariat.

Mr. Chairman, it is my firm conviction that a comprehensive treaty is obtainable by the end of 1975 as contemplated in last year's United Nations General Assembly Resolution. To do so, however, governments must begin serious negotiation the first day at Geneva, and to prepare for that, they must during the inter-sessional period appraise the alternatives, meet informally to explore possible accommodations that go beyond stated positions, and supply their delegates with instructions that permit a successful negotiation.

A mutlilateral convention of unparalleled complexity affecting some of our nation's most vital economic and strategic interests is within our reach. We cannot and will not sign just any Treaty; but in my judgment we would be terribly remiss in our responsibilities to the United States and to the international community as a whole if we were now to overlook broader and longer-range perspectives. In the year ahead we intend to work diligently and carefully for a Convention that will protect our interests in the broadest sense of that term. In this endeavor, Mr. Chairman, we trust that we shall have the guidance and support of the Congress and of your Committee.

Through our mutual cooperative efforts I am certain that we can take the necessary steps and develop constructive initiatives so that all will agree that the United States has done all it could to foster a successful outcome of the Third United Nations Conference on the Law of the Sea on schedule in 1975.

Thank you, Mr. Chairman.