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U.S. ANTARCTIC POLICY

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HEARING

BEFORE THE

SUBCOMMITTEE ON OCEANS AND INTERNATIONAL ENVIRONMENT

OF THE

COMMITTEE ON FOREIGN RELATIONS UNITED STATES SENATE

NINETY-FOURTH CONGRESS

FIRST SESSION

ON

U.S. POLICY WITH RESPECT TO MINERAL EXPLORATION AND EXPLOITATION IN THE ANTARCTIC

[Executive hearing held May 15, 1975; made public July 6, 1975]

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[NOTE.—Sections of this hearing were deleted in the interests of national security. Deleted portions are indicated by the notation [deleted].]

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U.S. ANTARCTIC POLICY

THURSDAY, MAY 15, 1975

UNITED STATES SENATE,
SUBCOMMITTEE ON OCEANS AND
INTERNATIONAL ENVIRONMENT
OF THE COMMITTEE ON FOREIGN RELATIONS,
Washington, D.C.

The subcommittee met at 2:30 p.m., in room S–116, U.S. Capitol Building, Senator Claiborne Pell (chairman of the subcommittee) presiding.

Present: Senators Pell and Case.

Also present: Mr. Keaney of the committee staff.

Senator PELL. The subcommittee will come to order.

OPENING STATEMENT

In a finite world of dwindling natural resources, it is not unrealistic to assume that activities designed to explore and exploit the economic potential of the Antarctic continent may commence in the not too distant future. The adoption of a recommendation at the 1972 meeting of the Antarctic Treaty Consultative Group to study the feasibility of such activities is evidence that certain members of the international community are, indeed, giving serious consideration to this possibility.

Historically, the economic development of Antarctica has been a particularly devisive and sensitive subject to those nations party to the Antarctic Treaty. At the time of its signing—1959—the issues of mineral exploitation and territorial sovereignty were purposely deferred to avoid conflict between those countries—Argentina, Chile, and Great Britain—which have overlapping territorial claims in the treaty area. Consequently, the renewed interest in the mineral exploration and exploitation of the Antarctic poses serious questions concerning the utility of the Antarctic Treaty to deal with this issue, and presents a grave threat to the continued existence of that agreement.

In addition to these problems, any attempts to establish a regime within the context of the Antarctic Treaty to govern the development of the resources of Antarctica, will give rise to charges throughout the international community that the United States is seeking to carve up that continent for the use of itself and a few other, primarily developed, nations.

As chairman of the Subcommittee on Oceans and International Environment, I would like to express my personal hope that any U.S. policy with respect to an agreement governing the future economic development of that continent would not only uphold and promote the aims and principles of the Antarctic Treaty, but would insure that the benefits derived from such activities would be shared with all the nations in the world community.

Today the subcommittee is meeting to hear State Department witnesses concerning the U.S. policy with respect to mineral exploration and exploitation in the Antarctic. Our witness is Dr. Ray, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs. Dr. Ray is also head of the U.S. Antarctic Policy Group which has been charged with the responsibility to formulate policy on this issue.

The purposes of this hearing are: (*a*) to determine the current U.S. policy on this subject; (*b*) to discuss the possible alternatives available to the U.S. on this issue; and (*c*) to review the consequences such policy will have on the Antarctic Treaty and its 10 years of successful cooperation.

SANITIZATION AND RELEASE OF TRANSCRIPT

While this is an executive session, I hope that when through we could sanitize and release as much as possible of the transcript. I think it would be of interest to clear the record in this regard.

I have not had a chance to go through your statement in detail yet, but I understand a good deal of it probably could be released.

Dr. RAY. We would want to check it with our legal people.

Senator PELL. I realize there will be questions about our negotiating position and things of that sort, but we would appreciate your doing that as quickly as possible because this question is of mounting importance, particularly in the scientific community.

I think the sooner it is shown that we are conscious of the problem and the Congress has a responsibility here, too, the better off we are.

So would you proceed right along?

Dr. RAY. Fine.

STATEMENT OF DIXY LEE RAY, ASSISTANT SECRETARY OF STATE, AND CHAIRMAN, ANTARCTIC POLICY GROUP, ACCOMPANIED BY STEVEN J. BURTON, OFFICE OF LEGAL ADVISER, DEPARTMENT OF STATE; PETER BERNHARDT, OFFICE OF THE LAW OF THE SEA NEGOTIATIONS, DEPARTMENT OF STATE; ADDISON RICHMOND AND THEODORE SELLIN, BUREAU FOR OCEANS, INTERNATIONAL ENVIRONMENT, AND SCIENTIFIC AFFAIRS, DEPARTMENT OF STATE

Senator PELL. You may not want to read the full statement. It will be printed in the record.

Dr. RAY. I will be happy to go through it if you like, or we could just——

Senator PELL. Maybe you could go through it briefly, not word for word, and it would be printed in full in the record. Then we have some points that we would like to develop.

Dr. RAY. Good, I will try to summarize, then. I think it would be useful to lay the groundwork to go into the history a little bit.

Senator PELL. I am delighted.

I need to be educated in this field.

Dr. RAY. I think it might help at least to read the first part, and I must tell you it was at my request we did go into a bit of a background.

As you know, I am quite new at this aspect of the Government's activities.

Senator PELL. When it comes to Antarctica, I am new, too.

Dr. RAY. We are in the same boat together.

ANTARCTIC POLICY GROUP

It might be useful to start here at the second paragraph—you already met my associates coming in—and refer to the Antarctic Policy Group [APG] which is an existing body to whom these questions go, and I might say that since I became Assistant Secretary the Antarctic Policy Group has met twice and we are meeting again tomorrow and on the next two consecutive Fridays in order to hear representatives from other departments and agencies and get their comments and their positions on this whole topic of resources.

The APG was established on April 10, 1965, to provide a more specific arrangement for the formulation of Antarctic policy than had existed previously. Originally the NSC's [National Security Council] Operations Coordinating Board [OCB] had the Antarctic policy oversight function, but was disbanded in 1961 when the Department of State assumed coordination of U.S. Antarctic operations.

The APG was created by then Acting Secretary of State George Ball, with the agreement of the Secretary of Defense, and the Director of the National Science Foundation [NSF]—the two other agencies with primary responsibilities for Antarctic affairs—and with the concurrence of the Secretary of Commerce and Interior.

The APG, from the start, consisted of the heads of the three lead agencies, State, DOD and NSF, with other interested agencies able to participate at the invitation of the chairman.

In his 1965 memorandum to the President informing him of the establishment of the APG, Acting Secretary Ball designated an Assistant Secretary of State to represent this Department and to chair the APG. He also stated that the APG will take appropriate steps to insure that the views of all U.S. agencies having an interest in Antarctic affairs are adequately reflected in the work of the group.

Congress is, in a way, responsible for this step since the creation of the APG was also a response to criticism from some Members of Congress that the arrangment existing after the abolition of the OCB was too informal for an area as important as Antarctica.

Presidential imprimatur was placed on the APG shortly after its inception when, on May 1, 1965, President Johnson announced the receipt of the first report of "his" Antarctic Policy Group established the month before "at his request."

Responsibility for Antarctica in the Department of State resided in the Bureau for International Organization Affairs (IO) until 1970. During that year, the Secretary designated the Director of the Bureau of International Scientific and Technological Affairs (SCI) to be his representative and Chairman of the APG. That same year an NSC study recommended, and the President decided that with the increasing importance of the scientific activity in Antarctica, the National Science Foundation should take on the bulk of the budget for the U.S. Antarctic program. The Office of Management and Budget approved the details in OMB Circular A–51, revised, of August 4, 1971.

With the reorganization of the old Office of International Scientific and Technological Affairs into the Bureau for Oceans and International Environment and Scientific Affairs (OES) and my appointment as Assistant Secretary for OES in January of this year, I have succeeded the former Director of SCI as chairman of the APG.

As you can see from the foregoing, the APG is not a subcommittee of the NSC, but an interagency policy-level committee chaired by the Department of State. It meets as circumstances require, on the call of the chairman or at the request of a member.

ANTARCTIC TREATY OF 1959

Now to turn to the subject of the hearing today—let me first state unequivocally that I am a firm advocate of the maintenance of solemn treaty commitments. One does not lightly tamper with, or espouse policies which threaten such a commitment.

This is certainly the case at present with the Antarctic Treaty of 1959, a treaty which evolved from a U.S. initiative and which is the cornerstone of our policy in the Antarctic.

This unique treaty embodies pioneering concepts in international cooperation, and reflects the willingness of nations to put aside contentious issues and to concentrate on protection of the Antarctic environment for the benefit of all.

Military activities in Antarctica, except logistical support for others, have been curbed by mutual agreement.

Senator PELL. There are no military activities?

Dr. RAY. Unless one calls the logistic support military. This is sometimes carried on by the military. It is not anything more than a support action.

Senator PELL. I see.

"Curbed" perhaps is not the right term. In that sense, it might be misinterpreted since military activities are expressly prohibited except for the logistical support for scientific expeditions.

Dr. RAY. Right.

Mr. BURTON. The language of the treaty is, "Antarctica shall be used for peaceful purposes only. There shall be prohibited any measures of a military nature, such as establishment of military bases and fortifications, the carrying out of military maneuvers, as well as testing any type of weapons." And there is a separate paragraph which makes the exception.

Senator PELL. I am well aware of the treaty. I will insert the text of the treaty in the record following Dr. Ray's statement.

Dr. RAY. Good.

HISTORY OF RESOURCE EXPLORATION AND EXPLOITATION QUESTION

Now the question of resource exploration, an issue which has lain dormant for years, is looming over the horizon. It is only in a cooperative spirit, of which the treaty is both a symbol and an instrument, that we can effectively deal with this potentially divisive matter.

The Antarctic Treaty does not refer to commercial activity in the treaty area. This silence is the reason that the treaty parties are consulting on the question of exploitation of Antarctic resources before the balance of interests of all treaty parties could be upset by dis-

covery of oil in commercially recoverable quantities and the development of the technology to extract it. It must be emphasized that deposits of neither oil nor natural gas have in fact been "discovered." But these hydrocarbons may exist under the Antarctic Shelf and could thereby occur in sufficient amount to attract recovery efforts.

It would be incumbent on the United States and its treaty partners to examine the problem with realism and in a spirit which does not do violence to the principles and purposes of the Antarctic Treaty.

Throughout the history of our involvement in Antarctica, the U.S. policy has consistently held that:

Antarctica shall be used for peaceful purposes only and shall not constitute a source of international discord;

U.S. rights and interests must be protected;

Freedom of exploration and scientific research should be guaranteed;

Activities in Antarctica should be guided by established, nonpreferential rules;

Orderly administration of the area should be established;

Free access to develop natural resources; and

Establish uniform and nonpreferential rules applicable to all countries and nations for any possible development of resources in the future.

In 1959, during preparatory talks for the treaty conference, it became clear that resource questions were so contentious that the subject would not be addressed at the conference. The treaty finally negotiated and signed on December 1, 1959, was silent on the question of resources. However, the possible resource potential of Antarctica was recognized and referred to during the Senate debate preceding treaty ratification.

In the first 10 years of the treaty's existence, and the five consultative meetings of the treaty signatories held during that period, the resources topic was conspicuously absent from agendas and discussion, primarily because [deleted] feared that any multilateral approach to resources management would be detrimental to their territorial claims in that area.

Although the United States was also loath to raise the subject, a 1970 review of the U.S. policy and program for Antarctica, designed primarily to rearrange the funding for the U.S. Antarctic program, did result in a Presidential policy statement touching on resources. A press release of October 13, 1970, stated that the President noted that U.S. policy in Antarctica included several objectives:

To maintain the Antarctic Treaty and insure that this continent will continue to be used only for peaceful purposes and shall not become an area or object of international discord.

To foster cooperative scientific research for the solution of worldwide and regional problems, including environmental monitoring and prediction and assessment of resources.

To protect the Antarctic environment and develop appropriate measures to insure the equitable and wise use of living and nonliving resources.

In the treaty forum, the issue was finally raised by the United Kingdom at the 1970 sixth consultative meeting, where it was agreed to place on the agenda for the seventh consultative (1972) the item "Antarctic Resources—Effects of Mineral Exploration."

Discussion at that meeting demonstrated that the issue was still highly charged and agreement was reached only to postpone discussion until the subsequent eighth consultative meeting, which convenes shortly (June 9–20 in Oslo, Norway), in order that governments would have time to give the subject careful consideration.

ADVISABLE COURSE OF ACTION CONCERNING RESOURCE ACTIVITIES

It is recognized that the resources question could go to the heart of the Antarctic Treaty's delicate juridical balance and directly affect the future of U.S. policy on the full range of Antarctic interests.

[Deleted.]

An internationally agreed approach for any commercial exploration and exploitation of Antarctic mineral resources is the advisable course of action.

Of course, we would not seek an agreement at any price, and there are a number of more specific objectives we would hope to achieve.

It is elementary that, if undertaken, commercial exploration and exploitation activities should be carried out in a manner that does not disrupt the implementation of the Antarctic Treaty or prejudice our position on territorial claims.

Resource activities must not become a cause for significant international discord. The sensitive Antarctic environment must be protected from harm caused by mineral resource activities.

Moreover, to say that the United States will seek an internationally agreed approach is a broad statement. We have refined this objective.

Nondiscriminatory guaranteed access by the United States and others for exploitation purposes to any part of the Antarctic Treaty area, except specially protected areas, is critical to avoid prejudicing our underlying juridical position.

An internationally agreed approach should also facilitate an increase in the global supply of minerals. While no decision has been made by any entity to commence mineral resource activities, and no government has decided to promote and encourage such activities, any system that might be seriously contemplated should provide stability of investment for those who would develop the area.

Effective means for protecting the unique environment is, of course, essential.

We have found it a most complex and difficult problem to structure a detailed position that would adequately achieve all of these objectives.

What would be a difficult problem in any case is compounded by the lack of basic data on the economics and environmental effects of mineral activities in Antarctica, and the early stage of knowledge as to positions of other treaty signatories.

We do not anticipate that the eighth consultative meeting this June will involve much more than an exchange of views and consultations on the general subject, particularly directed toward assessing the attitudes of others.

In recognition of the early stage of consultations, several nations have pressed for a moratorium of some kind. The United States has resisted any formal moves in this direction, but has adopted an interim policy of opposing actions by any nation with the purpose of com-

mercial exploitation and exploration of Antarctic mineral resources and urging other nations to join the United States in such an interim policy. Of course, this policy is kept under continuing review in light of changing circumstances.

This, then, is the present state of U.S. policy on Antarctic mineral resources.

It is the Department of State's conviction that international solutions are desired if U.S. interests are to be optimally protected in an international area such as Antarctica.

The Antarctic Treaty has been a model of international cooperation. The successful accommodation of conflicting juridical positions on territorial claims in Antarctica, demilitarization of the continent with onsite inspection, continued freedom of scientific research and international cooperative measures to protect the sensitive Antarctic environment have served U.S. interests well.

[Deleted.]

And, Senator, if I might add, that I think states as well as we are able to at the present time the position of the APG and the position of the Department of State with respect to our thinking about the Antarctic, the treaty itself, and as we approach this eighth consultative meeting to be held next month in Oslo.

Senator PELL. Right.

[The treaty referred to follows:]

THE ANTARCTIC TREATY*

Signed at Washington December 1, 1959; Ratification advised by the Senate August 10, 1960; Ratified by the President August 18, 1960; Ratification deposited at Washington August 18, 1960; Proclaimed by the President June 23, 1961; Entered into force June 23, 1961.

BY THE PRESIDENT OF THE UNITED STATES

A PROCLAMATION

Whereas the Antarctic Treaty was signed at Washington on December 1, 1959 by the respective plenipotentiaries of the United States of America, Argentina, Australia, Belgium, Chile, the French Republic, Japan, New Zealand, Norway, the Union of South Africa, the Union of Soviet Socialist Republics, and the United Kingdom of Great Britain and Northern Ireland;

WHEREAS the text of the said Treaty, in the English, * * * languages, is word for word as follows:

THE ANTARCTIC TREATY

The Governments of Argentina, Australia, Belgium, Chile, the French Republic, Japan, New Zealand, Norway, the Union of South Africa, the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland, and the United States of America,

Recognizing that it is in the interest of all mankind that Antarctica shall continue to be used exclusively for peaceful purposes and shall not become the scene or object of international discord;

Acknowledging the substantial contributions to scientific knowledge resulting from international cooperation in scientific investigation in Antarctica;

Convinced that the establishment of a firm foundation for the continuation and development of such cooperation on the basis of freedom of scientific investigation in Antarctica as applied during the International Geophysical Year accords with the interests of science and the progress of all mankind;

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*Citation: 12 UST 794; TIAS 4780.

States which are parties: Argentina, Australia, Belgium, Chile, Czechoslovakia, Denmark, France, German Democratic Rep. (with declaration), Japan, Netherland (including Surinam and Netherlands Antilles), New Zealand, Norway, Poland, Romania (with a statement), South Africa, Union of Soviet Socialist Republics, United Kingdom, United States.

Convinced also that a treaty ensuring the use of Antarctica for peaceful purposes only and the continuance of international harmony in Antarctica will further the purposes and principles embodied in the Charter of the United Nations; [1]

Have agreed as follows:

ARTICLE I

1. Antarctica shall be used for peaceful purposes only. There shall be prohibited, *inter alia*, any measures of a military nature, such as the establishment of military bases and fortifications, the carrying out of military maneuvers, as well as the testing of any type of weapons.

2. The present Treaty shall not prevent the use of military personnel or equipment for scientific research or for any other peaceful purpose.

ARTICLE II

Freedom of scientific investigation in Antarctica and cooperation toward that end, as applied during the International Geophysical Year, shall continue, subject to the provisions of the present Treaty.

ARTICLE III

1. In order to promote international cooperation in scientific investigation in Antarctica, as provided for in Article II of the present Treaty, the Contracting Parties agree that, to the greatest extent feasible and practicable:

(a) information regarding plans for scientific programs in Antarctica shall be exchanged to permit maximum economy and efficiency of operations;

(b) scientific personnel shall be exchanged in Antarctica between expeditions and stations;

(c) scientific observations and results from Antarctica shall be exchanged and made freely available.

2. In implementing this Article, every encouragement shall be given to the establishment of cooperative working relations with those Specialized Agencies of the United Nations and other international organizations having a scientific or technical interest in Antarctica.

ARTICLE IV

1. Nothing contained in the present Treaty shall be interpreted as:

(a) a renunciation by any Contracting Party of previously asserted rights of or claims to territorial sovereignty in Antarctica;

(b) a renunciation or diminution by any Contracting Party of any basis of claim to territorial sovereignty in Antarctica which it may have whether as a result of its activities or those of its nationals in Antarctica, or otherwise;

(c) prejudicing the position of any Contracting Party as regards its recognition or non-recognition of any other State's right of or claim or basis of claim to territorial sovereignty in Antarctica.

2. No acts or activities taking place while the present Treaty is in force shall constitute a basis for asserting, supporting or denying a claim to territorial sovereignty in Antarctica or create any rights of sovereignty in Antarctica. No new claim, or enlargement of an existing claim, to territorial sovereignty in Antarctica shall be asserted while the present Treaty is in force.

ARTICLE V

1. Any nuclear explosions in Antarctica and the disposal there of radioactive waste material shall be prohibited.

2. In the event of the conclusion of international agreements concerning the use of nuclear energy, including nuclear explosions and the disposal of radioactive waste material, to which all of the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX are parties, the rules established under such agreements shall apply in Antarctica.

ARTICLE VI

The provisions of the present Treaty shall apply to the area south of 60° South Latitude, including all ice shelves, but nothing in the present Treaty shall prejudice or in any way affect the rights, or the exercise of the rights, of any State under international law with regard to the high seas within that area.

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[1] TS 993; 59 Stat. 1031.

ARTICLE VII

1. In order to promote the objectives and ensure the observance of the provisions of the present Treaty, each Contracting Party whose representatives are entitled to participate in the meetings referred to in Article IX of the Treaty shall have the right to designate observers to carry out any inspection provided for by the present Article. Observers shall be nationals of the Contracting Parties which designate them. The names of observers shall be communicated to every other Contracting Party having the right to designate observers, and like notice shall be given of the termination of their appointment.

2. Each observer designated in accordance with the provisions of paragraph 1 of this Article shall have complete freedom of access at any time to any or all areas of Antarctica.

3. All areas of Antarctica, including all stations, installations and equipment within those areas, and all ships and aircraft at points of discharging or embarking cargoes or personnel in Antarctica, shall be open at all times to inspection by any observers designated in accordance with paragraph 1 of this Article.

4. Aerial observation may be carried out at any time over any or all areas of Antarctica by any of the Contracting Parties having the right to disignate observers.

5. Each Contracting Party shall, at the time when the present Treaty enters into force for it, inform the other Contracting Parties, and thereafter shall give them notice in advance, of

(a) all expeditions to and within Antarctica, on the part of its ships or nationals, and all expeditions to Antarctica organized in or proceeding from its territory;

(b) all stations in Antarctica occupied by its nationals; and

(c) any military personnel or equipment intended to be introduced by it into Antarctica subject to the conditions prescribed in paragraph 2 Article I of the present Treaty.

ARTICLE VIII

1. In order to facilitate the exercise of their functions under the present Treaty, and without prejudice to the respective positions of the Contracting Parties relating to jurisdiction over all other persons in Antarctica, observers designated under paragraph 1 of Article VII and scientific personnel exchanged under subparagraph 1(b) of Article III of the Treaty, and members of the staffs accompanying any such persons, shall be subject only to the jurisdiction of the Contracting Party of which they are nationals in respect of all acts or omissions occurring while they are in Antarctica for the purpose of exercising their functions.

2. Without prejudice to the provisions of paragraph 1 of this Article, and pending the adoption of measures in pursuance of subparagraph 1(e) of Article IX, the Contracting Parties concerned in any case of dispute with regard to the exercise of jurisdiction in Antartica shall immediately consult together with a view to reaching a mutually acceptable solution.

ARTICLE IX

1. Representatives of the Contracting Parties named in the preamble to the present Treaty shall meet at the City of Canberra within two months after the date of entry into force of the Treaty, and thereafter at suitable intervals and places, for the purpose of exchanging information, consulting together on matters of common interest pertaining to Antarctica, and formulating and considering, and recommending to their Governments, measures in furtherance of the principles and objectives of the Treaty, including measures regarding:

(a) use of Antarctica for peaceful purposes only;

(b) facilitation of scientific research in Antarctica;

(c) facilitation of international scientific cooperation in Antarctica;

(d) facilitation of the exercise of the rights of inspection provided for in Article VII of the Treaty;

(e) questions relating to the exercise of jurisdiction in Antarctica;

(f) preservation and conservation of living resources in Antarctica.

2. Each Contracting Party which has become a party to the present Treaty by accession under Article XIII shall be entitled to appoint representatives to participate in the meetings referred to in paragraph 1 of the present Article, during such time as that Contracting Party demonstrates its interest in Antarctica by conducting substantial scientific research activity there, such as the establishment of a scientific station or the dispatch of a scientific expedition.

3. Reports from the observers referred to in Article VII of the present Treaty shall be transmitted to the representatives of the Contracting Parties participating in the meetings referred to in paragraph 1 of the present Article.

4. The measures referred to in paragraph 1 of this Article shall become effective when approved by all the Contracting Parties whose representatives were entitled to participate in the meetings held to consider those measures.

5. Any or all of the rights established in the present Treaty may be exercised as from the date of entry into force of the Treaty whether or not any measures facilitating the exercise of such rights have been proposed, considered or approved as provided in this Article.

ARTICLE X

Each of the Contracting Parties undertakes to exert appropriate efforts, consistent with the Charter of the United Nations, to the end that no one engages in any activity in Antarctica contrary to the principles or purposes of the present Treaty.

ARTICLE XI

1. If any dispute arises between two or more of the Contracting Parties concerning the interpretation or application of the present Treaty, those Contracting Parties shall consult among themselves with a view to having the dispute resolved by negotiation, inquiry, mediation, conciliation, arbitration, judicial settlement or other peaceful means of their own choice.

2. Any dispute of this character not so resolved shall, with the consent, in each case, of all parties to the dispute, be referred to the International Court of Justice for settlement; but failure to reach agreement on reference to the International Court shall not absolve parties to the dispute from the responsibility of continuing to seek to resolve it by any of the various peaceful means referred to in paragraph 1 of this Article.

ARTICLE XII

1. (a) The present Treaty may be modified or amended at any time by unanimous agreement of the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX. Any such modification or amendment shall enter into force when the depositary Government has received notice from all such Contracting Parties that they have ratified it.

(b) Such modification or amendment shall thereafter enter into force as to any other Contracting Party when notice of ratification by it has been received by the depositary Government. Any such Contracting Party from which no notice of ratification is received within a period of two years from the date of entry into force of the modification or amendment in accordance with the provisions of subparagraph 1(a) of this Article shall be deemed to have withdrawn from the present Treaty on the date of the expiration of such period.

2. (a) If after the expiration of thirty years from the date of entry into force of the present Treaty, any of the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX so requests by a communication addressed to the depositary Government, a Conference of all the Contracting Parties shall be held as soon as practicable to review the operation of the Treaty.

(b) Any modification or amendment to the present Treaty which is approved at such a Conference by a majority of the Contracting Parties there represented, including a majority of those whose representatives are entitled to participate in the meetings provided for under Article IX, shall be communicated by the depositary Government to all the Contracting Parties immediately after the termination of the Conference and shall enter into force in accordance with the provisions of paragraph 1 of the present Article.

(c) If any such modification or amendment has not entered into force in accordance with the provisions of subparagraph 1(a) of this Article within a period of two years after the date of its communication to all the Contracting Parties, any Contracting Party may at any time after the expiration of that period give notice to the depositary Government of its withdrawal from the present Treaty; and such withdrawal shall take effect two years after the receipt of the notice by the depositary Government.

ARTICLE XIII

1. The present Treaty shall be subject to ratification by the signatory States. It shall be open for accession by any State which is a Member of the United Nations, or by any other State which may be invited to accede to the Treaty with the consent of all the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX of the Treaty.

2. Ratification of or accession to the present Treaty shall be effected by each State in accordance with its constitutional processes.

3. Instruments of ratification and instruments of accession shall be deposited with the Government of the United States of America, hereby designated as the depositary Government.

4. The depositary Government shall inform all signatory and acceding States of the date of each deposit of an instrument of ratification or accession, and the date of entry into force of the Treaty and of any modification or amendment thereto.

5. Upon the deposit of instruments of ratification by all the signatory States, the present Treaty shall enter into force for those States and for States which have deposited instruments of accession. Thereafter the Treaty shall enter into force for any acceding State upon the deposit of its instrument of accession.

6. The present Treaty shall be registered by the depositary Government pursuant to Article 102 of the Charter of the United Nations.

ARTICLE XIV

The present Treaty, done in the English, French, Russian, and Spanish languages, each version being equally authentic, shall be deposited in the archives of the Government of the United States of America, which shall transmit duly certified copies thereof to the Governments of the signatory and acceding States.

* * * * * * *

IN WITNESS WHEREOF, the undersigned Plenipotentiaries, duly authorized, have signed the present Treaty.

DONE at Washington this first day of December, one thousand nine hundred and fifty-nine.

Whereas the Senate of the United States of America by their resolution of August 10, 1960, two-thirds of the Senators present concurring therein, did advise and consent to the ratification of the said Treaty;

Whereas the said Treaty was duly ratified by the President of the United States of America on August 18, 1960, in pursuance of the aforesaid advice and consent of the Senate;

Whereas it is provided in Article XIII of the said Treaty that upon the deposit of instruments of ratification by all the signatory States, the said Treaty shall enter into force for those States and for States which have deposited instruments of accession;

Whereas instruments of ratification were deposited with the Government of the United States of America on May 31, 1960 by the United Kingdom of Great Britain and Northern Ireland; on June 21, 1960 by the Union of South Africa; on July 26, 1960 by Belgium; on August 4, 1960 by Japan; on August 18, 1960 by the United States of America; on August 24, 1960 by Norway; on September 16, 1960 by the French Republic; on November 1, 1960 by New Zealand; on November 2, 1960 by the Union of Soviet Socialist Republics; and on June 23, 1961 by Argentina, Australia, and Chile; and an instrument of accession was deposited with the Government of the United States of America on June 8, 1961 by the Polish People's Republic;

And whereas, pursuant to the aforesaid provision of Article XIII of the said Treaty, the Treaty entered into force on June 23, 1961;

Now, therefore, be it known that I, John F. Kennedy, President of the United States of America, do hereby proclaim and make public the Antarctic Treaty to the end that the same and every article and clause thereof shall be observed and fulfilled with good faith, on and after June 23, 1961 by the United States of America and by the citizens of the United States of America and all other persons subject to the jurisdiction thereof.

IN TESTIMONY WHEREOF, I have caused the Seal of the United States of America to be hereunto affixed.

DONE at the city of Washington this twenty-third day of June in the year of our Lord one thousand nine hundred sixty-one and of the Independence [SEAL] of the United States of America the one hundred eighty-fifth.

JOHN F. KENNEDY.

By the President:
DEAN RUSK
Secretary of State

GEOGRAPHIC DESK FOR ANTARCTICA

Senator PELL. First, touching for a moment on the mechanics of the way it is handled in the Department, the geographic desk for Antarctica would be your office?

Dr. RAY. If there were one.

Senator PELL. That was the original concept I had in the Bureau of Ocean Affairs. I felt the 30 percent of the world above water level was represented with a geographic desk and 70 percent was not, That was the concept of your Bureau. It seems very appropriate just as your Bureau has authority over the Arctic Ocean——

Dr. RAY. Yes.

U.S. DELEGATION TO OSLO

Senator PELL. When it comes to negotiating a treaty who will be the U.S. representative in Oslo?

Dr. RAY. We are at the present time working on putting together a delegation, and because of the interest in this resources question we are proposing to the Secretary that the delgation be rather larger than have been the delegations at the previous consultative meetings, to include representatives not only of our own legal department in the Department. The Office of the Legal Adviser in the Department of State, and representatives from the National Science Foundation, Department of Defense, and some representation from the group of agencies that are more particularly interested in resources, especially Commerce, Interior, Treasury, and those agencies that are particularly involved with environmental affairs, the Environmental Protection Agency (EPA), the Council on Environmental Quality (CEQ), and then, of course, the Federal Energy Agency (FEA).

Clearly not all of these departments and agencies could each have its own representative, so we must find some way of getting groups of representation from——

INVOLVEMENT OF PRIVATE INDUSTRY IN DELEGATION

Senator PELL. How about private industry?

Dr. RAY. Private industry, to the best of my knowledge, has not been involved in any of the official delegations in any of the consultative meetings.

Am I correct? It is entirely governmental.

Senator PELL. Would it or would it not be a good idea to involve the hard mineral and oil industries?

Dr. RAY. We have a legal position here and will ask one of the lawyers to comment. I would imagine government-to-government negotiation, that at most a private industry or nongovernmental person could be a consultant to the negotiation.

Senator PELL. He could be.

We could make him a delegate, if we wish, or include him in the delegation as a consultant, but there is no legal reason, although there may be tactical reasons, why we should not do it.

Mr. BURTON. There is no legal prohibition on doing it, of course. We do it in the Law of the Sea Conference. [Deleted.]

Senator PELL. We had a problem with the Law of the Sea negotiations in creating a policy process which allowed for public input.

I think we would be better off if we incorporated at the very beginning of this policy process some form of public input process. If not, someday you may find yourself with a real problem.

Dr. RAY. I think, if I may, that we have a rather different situation here where in contrast to the Law of the Sea area. We have a specific treaty with 12 signatory nations that spells out the mode of behavior and operation very clearly, and one of the problems with opening the question of resource development, if it is gone into any more than an informal consultative sort of manner, is that that could open the treaty for renegotiation or for change or possible alteration.

This leads into a whole series of problems of conflicting territorial claims and things of this sort, [deleted].

POSSIBILITY OF OIL AND GAS RESOURCES IN ANTARCTICA

There is no certainty that there are oil and gas resources there in commercial quantities which are the things of primary interest. And even if there were, the technology for their recovery is years into the future.

Senator PELL. I agree with you on the latter point. However, in the background reading that the staff gave me in preparation for this hearing, I saw an actual picture of coal being mined in Antarctica. I would think that where there is coal, there is oil.

Dr. RAY. I guess I would have to question the association of coal and oil. There are many, many places where coal is found in great quantities here in the United States, for example, but not oil or gas associated with it.

Now, coal is known to occur on the Antarctica land area. The idea of opening up the question of going to Antarctica to mine coal [deleted].

[The following information was subsequently supplied:]

This involves an assessment of alternative sources of supply, which are now plentiful, and serious problems encountered with the climate. I don't think exploitation of coal in Antarctica is in the picture for the foreseeable future.

SIZE AND CHAIRMAN OF U.S. DELEGATION

Senator PELL. To return to the question of the size of the delegation, on the one hand you want to make sure that you consider all U.S. interests, but you don't want to be the largest delegation.

Dr. RAY. [Deleted.]

Senator PELL. Whom do you expect to chair the delegation?

Dr. RAY. I was expecting to do that myself.

Senator PELL. Good.

Dr. RAY. [Deleted.]

KEEPING CONGRESS INFORMED

Senator PELL. I would hope as you move along that you will inform the Congress, as you are now. It is unlikely that anybody from Congress will be able to go to Oslo at that particular time. I think it would be better for Congressional relations if you request there be congressional observers or representation.

Dr. RAY. There has been in the past.

Mr. RICHMOND. To the Antarctic Sealing Convention.

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Senator PELL. I recall seeing a chart of Antarctica divided up into slices.

Mr. KEANEY. That map deals with the sovereignty issue.

Dr. RAY. This is the territorial claims situation.

Senator PELL. These have all been abrogated, as I understand it.

Dr. RAY. Those are claims that have been made. The United States does not recognize any of them and has reserved its own rights. We maintain, and I think it is supported by other countries, that internationally those claims are not valid.

Senator PELL. The only countries who recognize these claims are the countries themselves?

Dr. RAY. That have made them.

[The following information was subsequently supplied:]

In any event, Article IV of the Antarctic Treaty sets aside the claims issue for the duration of the Treaty so far as its implementation is concerned. The mineral resource issue, which is not dealt with by the Treaty, may raise the claims problem again.

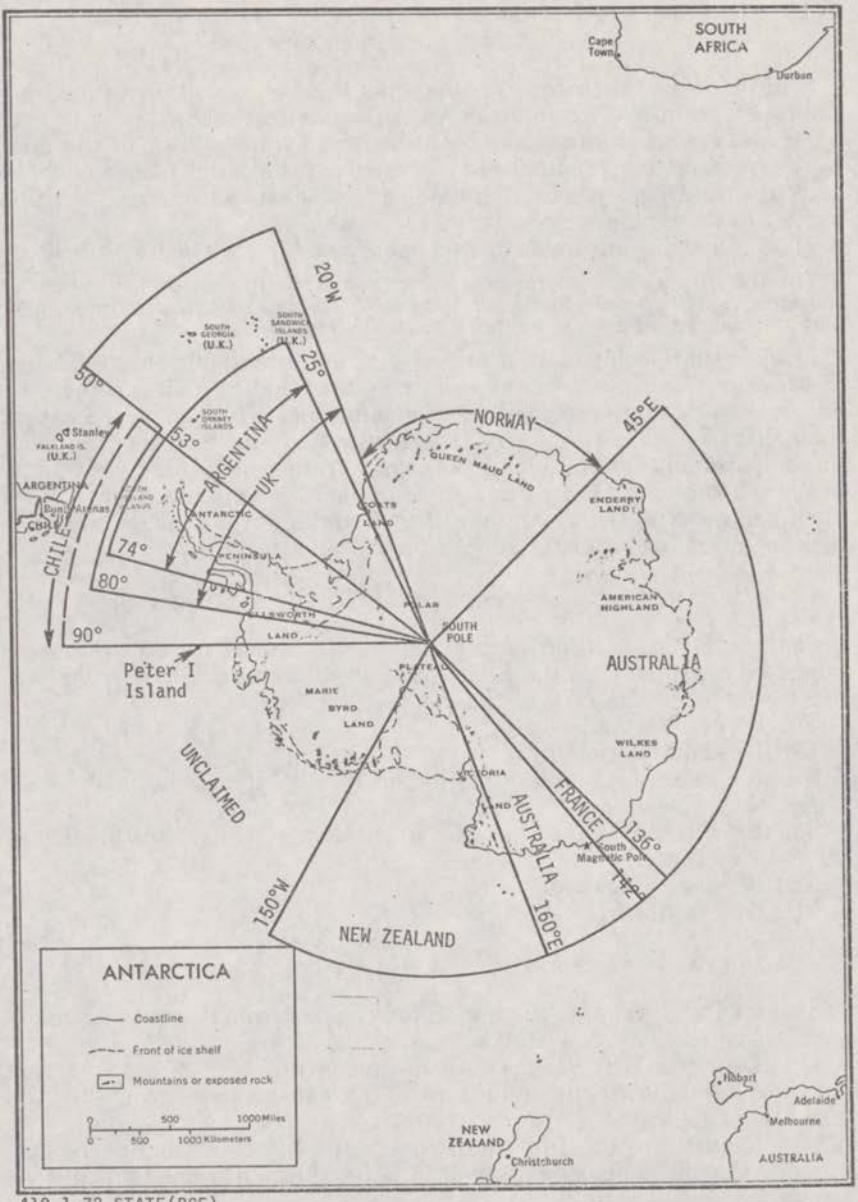
Senator PELL. Why is this map marked "Confidential"?

Mr. BURTON. [Deleted.]

Mr. SELLIN. Here is one [deleted]. A map of Antarctica showing the assorted claims.

Senator PELL. I think this should be put into the hearing record.

[The information referred to follows:]



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HISTORIC U.S. POSITION CONCERNING ANTARCTIC RESOURCE EXPLORATION AND EXPLOITATION

Senator PELL. Historically, what has been our position concerning the exploration and exploitation of Antarctic resources?

Dr. RAY. Our position has been one simply to hold open the door to the possible development of any resources that might be discovered and to encourage, where there was interest, to encourage scientific parties to do exploratory work.

[The following information was subsequently supplied:]

The U.S. has long maintained that there should be free access to all parts of the area, except specially designated areas, to develop natural resources under uniform and non-preferential rules applicable to all nations.

I think the Geological Survey—I am not sure about that—I know the *Glomar Challenger* was one of the ships that in doing some geophysical work there reported getting soundings which gave indication that there is ethane and methane present in the Continental Shelf there. Extrapolations of geologic analogy from neighboring continents similar to those of Antarctica suggests that the Antarctic Continental Shelf can be expected to contain thick unmetamorphosed sedimentary rocks. Our information is fairly sketchy and speculative.

ANTARCTIC RESOURCES AS HERITAGE OF ALL MANKIND

Senator PELL. Is there any thought that the Antarctic resources might be considered as the heritage of all mankind similar to the seabed resources in the Law of the Sea negotiations.

Dr. RAY. [Deleted.]

Mr. BURTON. [Deleted.]

Senator PELL. Has anybody opposed it? And if so, who?

Dr. RAY. [Deleted.]

Senator PELL. Has the United States taken a position in this regard one way or the other?

Mr. BURTON. [Deleted.]

Mr. BERNHARDT. [Deleted.]

REASON FOR PRESENT U.S. POLICY REEXAMINATION

Senator PELL. What is the reason for the reexamination of our policy at this time?

Dr. RAY. Primarily because it is on the agenda for the next meeting and was brought to the attention of the consultative group by the U.K. [Deleted.]

Mr. RICHMOND. In 1972, the seventh consultative meeting recommended that it be placed on the agenda for the eighth meeting that we study the issue carefully.

Dr. RAY. The subject came up at the Wellington consultative meeting. Following that meeting it was decided we should look at the totality of our interest in light of the fact that it would probably continue to be one interest to the Antarctic nations. So it is both reasons. Global events in the resources area since the last meeting have focused our attention on this issue.

Senator PELL. If we did not develop a policy what would be the result of such an action or inaction on our part?

Dr. RAY. If we had no policy, I would simply have to sit silent at the meeting in Oslo and our silence might be [deleted] misconstrued by other countries.

Do you agree with me?

Mr. SELLIN. Yes.

Dr. RAY. I think it is incumbent we do have a position so we can——

REVIVAL OF TERRITORIAL CLAIMS AT OSLO MEETING

Senator PELL. Will the territorial claims of different nations be revised at the Oslo meeting?

Dr. RAY. I'm afraid that is a serious risk.

Senator PELL. No way of avoiding that.

Dr. RAY. I would certainly hope so, but [deleted] and I think inevitably once the question of resource development occurs, then it raises this territorial question. The consultative parties can choose to approach the issue on a constructive and pragmatic basis.

Mr. BURTON. Yes; I think you have identified the basic problem and that is that any nation who takes its claim seriously, and that is most of the claimants, to one degree or another, could theoretically claim that no one may exploit a resource in their claim sector area unless they complied with the national laws. These countries, some of them, do take their claims very seriously and they regard the territory as if it were where their capital was in some respects. We would, of course, not recognize such claims or any action incompatible with our position.

PRESENT STATUS AND POTENTIAL OF ANTARCTIC MINERAL RESOURCES

Senator PELL. What is the present status of mineral resources in Antarctica? What has been discovered? What is your own view with regard to the potential for the future?

Dr. RAY. Except for rather extensive deposits of coal or ore hard minerals there have not been any to my knowledge discovered in commercial quantities that are in vital short supply anywhere. So that with respect to land mining, there is no overriding reason for any nation to try to develop ore to go to Antarctica to get any kind of mineral resource which would inevitably be ever so much more expensive because of the harsh climatic conditions and long distances of transportation.

I know of no deposits that would encourage any commercial development at the present time.

Mr. BURTON. On land that was the result of our study. Offshore there is some evidence that there may be significant quantities of hydrocarbons, as we have mentioned, but this conclusion was based on geological analogy to similar formations in other parts of the world and these two shows of gas which resulted from the *Glomar Challenger* expedition, so it is highly speculative as to whether there are commercial quantities.

Dr. RAY. I think it is significant, too, in the most recent publication by the National Petroleum Council of areas of exploration for offshore oil, based on information from oil companies and so on, the Antarctica is not specifically mentioned.

Senator PELL. That is what I was going to ask you. Has there been any serious economic interest in Antarctic resources expressed by any U.S. or foreign company?

Dr. RAY. We have had no direct contact from any company with plans to undertake activities. We understand through informal discussions with other agencies that they believe some companies might be interested.

Mr. BURTON. The Legal Adviser's office did receive a letter some time ago from a firm called Texas Geophysical Instruments. They have asked us for exclusive rights to explore the Ross and Weddell Seas for 10 years, which we thought was a very broad kind of claim. The Legal Adviser responded, indicating that there were no procedures for the grant of acquisition of such exclusive rights in Antarctica.

Senator PELL. We can't blame them for trying; it shows great initiative.

Then is it correct to say that in the short term, there is very little chance of mineral exploration and that the long-term perspective is an open book?

Dr. RAY. That is right. It depends on what you mean by "long term."

LEGAL STATUS OF LAND MASS, CONTINENTAL SHELF AND DEEP SEA BED

Senator PELL. Could you furnish for the record a legal memorandum on the international legal status of the land mass, the Continental Shelf and deep sea bed immediately off the Continental Shelf?

Mr. BURTON. Senator, that is a tall order for a lawyer.

Senator PELL. Don't do it now, but submit it for the record.

Mr. BURTON. I will use my best effort.

Senator PELL. I can see interest is going to develop in this and I would hope that this hearing and the information you are setting forth here will provide the groundwork for whatever basic opinion forming is done in the future. That is why this record should remain open.

[The information referred to follows:]

LEGAL STATUS OF AREAS SOUTH OF 60° SOUTH LATITUDE

[Supplied by Department of State]

Article VI of the Antarctic Treaty (TIAS 4780) provides as follows:

"The provisions of the present Treaty shall apply to the area south of 60° South Latitude, including all ice shelves, but nothing in the present Treaty shall prejudice or in any way affect the rights, or the exercise of the rights, of any State under international law with regard to the high seas within that area."

It is the purpose of this memorandum to review the legal status of the area to which the Treaty applies as this subject may be relevant to the question of exploration and exploitation of mineral resources in Antarctica.

I. LEGAL STATUS OF THE CONTINENT

Seven countries had made territorial claims in Antarctica prior to signature of the Antarctic Treaty. These were Argentina, Australia, Chile, France, New Zealand, Norway and the United Kingdom. The claims of three of these countries, Argentina, Chile and the United Kingdom, overlap and conflict in certain portions of Antarctica.

The Government of the United States has not recognized claims of territorial sovereignty asserted by any country over any portion of Antarctica. At the same time, the Government of the United States has not made a claim itself, and has consistently reserved all its basic historic rights in Antarctica. With regard to the overlapping and conflicting claims of Argentina, Chile and the United Kingdom, the United States has refrained from taking any action which might be considered discriminatory with regard to the interests of any one of those three

countries. See generally 1 Hackworth, "Digest of International Law" 399–400, 452–465 (1941); 2 Whiteman, "Digest of International Law"; 250–254, 1262 (1963). The Soviet Union and several other interested states similarly do not recognize any territorial claims in Antarctica. 2 Whiteman, *op cit.* at 1254–56.

All states with territorial claims in Antarctica, as well as the United States, the Soviet Union, Japan, Belgium and South Africa, are Parties to the Antarctic Treaty. Article IV of the Antarctic Treaty sets aside the claims issue in the interest of international cooperation under the Treaty:

1. Nothing contained in the present Treaty shall be interpreted as:

(a) Renunciation by any Contracting Party of previously asserted rights of or claims to territorial sovereignty in Antarctica;

(b) A renunciation or diminution by any Contracting Party of any basis of claim to territorial sovereignty in Antarctica which it may have whether as a result of its activities or those of its nationals in Antarctica or otherwise;

(c) Prejudicing the position of any Contracting Party as regards its recognition or non-recognition of any other State's rights of or claims to basis of claim to territorial sovereignty in Antarctica.

2. No acts or activities taking place while the present Treaty is in force shall constitute a basis for asserting, supporting or denying a claim to territorial sovereignty in Antarctica or create any rights of sovereignty in Antarctica. No new claim, or enlargement of an existing claim, to territorial sovereignty in Antarctica shall be asserted while the present Treaty is in force.

By virtue of Article IV, paragraph 2, mineral resources activities in Antarctica while the Treaty is in force will not constitute a basis for asserting, supporting or denying a claim to territorial sovereignty in Antarctica and will not create any rights of sovereignty in Antarctica. Such activities would, however, be within the "peaceful purposes" for which Antarctica shall only be used, as provided in Article I. Any stations, installations and equipment in Antarctica would be subject to inspection by designated observers and notice must be given of expeditions, in accordance with Article VII. Moreover, Article X commits each of the Contracting Parties to "exert appropriate efforts, consistent with the Charter of the United Nations, to the end that no one engages in any activity in Antarctica contrary to the principles and purposes of the present Treaty."

It is clear that any activities by treaty parties, including mineral resource activities in Antarctica would be subject to applicable provisions of the Antarctic Treaty and agreed measures in furtherance thereof under Article IX. Since the Treaty does not refer to mineral resource activities in particular, however, absent a specific understanding, it can be expected that the States concerned would react to such activities in light of their respective juridical positions on territorial sovereignty. In this connection, the U.S. would continue to consider that Antarctica, or any part thereof, is not subject to the sovereignty of any State.

II. LEGAL STATUS OF THE CONTINENTAL SHELF

It is generally recognized with respect to other parts of the world that a coastal state exercises over the continental shelf sovereign rights for the purpose of exploring and exploiting its natural resources. Article 2, *Convention on the Continental Shelf* (TIAS 5578). The International Court of Justice has recognized a customary rule of international law that "the rights of the coastal state in respect of the area of continental shelf that constitutes a natural prolongation of its land territory into and under the sea exist ipso facto and ab initio, by virtue of its sovereignty over the land, and as an extension of it in an exercise of sovereign rights for the purpose of exploring the seabed and exploiting its natural resources." North Sea Continental Shelf Judgment, I.C.J., Reports, 1969, p. 22.

As indicated above, the U.S. does not consider that Antarctica, or any part thereof, is subject to the sovereignty of any State. Pronouncements on the subject of the continental shelf almost invariably refer to the exercise of "sovereign rights" by a coastal state." Since the adjacent land is the legal source of the power which a state may exercise over the natural resources of the continental shelf, (cf. North Sea Continental Shelf Judgment, op cit. at 51) it follows that no state now exercises over the continental shelf of Antarctica sovereign rights for the purpose of exploring it and exploiting its natural resources.

Under these circumstances, the status of the Antarctic continental shelf is unclear. Any regime that is developed for the exploitation of Antarctic shelf resources would have to be consistent with the Antarctic Treaty, which, inter alia, protects the rights of states with regard to the high seas and provides for environmental safeguards and freedom of scientific investigation. Moreover, activities

relating to seabed mineral resources must be undertaken with reasonable regard for the interests of other states and in accordance with other applicable rules of international law. See Article 2, Convention on the High Seas (TIAS 5200). It remains to be determined whether exploitation of the resources of the continental shelf would be subject to the same legal regime as that applicable to the resources of the Antarctic land mass, or whether such a regime is in general based upon the freedom of the high seas, subject, of course, to the environmental and other measures applicable in the Antarctic pursuant to the Treaty.

III. RESOURCES SEAWARD OF THE CONTINENTAL SHELF AND SOUTH OF 60° LATITUDE

As is well known, a precise definition of the seaward limits of the continental shelf has not yet gained general recognition. See Article 1, Convention on the Continental Shelf (1958); Oxman, The Preparation of Article 1 of the Convention on the Continental Shelf, (1967). Nonetheless, it is clear that the natural resources of the seabed and subsoil of the high seas seaward of these limits and south of 60° South Latitude are subject to the same legal regime as other seabed resources beyond the limits of National jurisdiction, as well as applicable provisions of the Antarctic Treaty.

(The present memorandum does not address questions concerning the status of ice in Antarctica, nor questions concerning the territorial seas, contiguous zones, and fisheries jurisdiction, nor other concepts which may be applied to offshore areas).

INCORPORATION OF LAW OF THE SEA OFFICE

Senator PELL. I'm delighted that the Law of the Sea Office will be folded after this treaty is eventually promulgated, and incorporated in your office. I think that shows very good bureaucratic organization on your part.

In fact, you have preceded the Law of the Sea people on this subject.

Dr. RAY. Well, I think now that the delegation is back from Geneva we will have opportunities to work much more closely together than in the brief time we had before that session started, and I know our interests are entirely coincident.

ENVIRONMENTAL ASPECTS OF ANTARCTIC MINERAL EXPLOITATION QUESTION

Senator PELL. The question of mineral exploitation of Antarctica is just starting to bubble a tiny bit. Has it been raised at all among the environmental people of UNEP [United Nations Environmental Program] or Law of the Sea forum?

Dr. RAY. No, not seriously.

At the UNEP meeting, which was just concluded a week or two ago at Nairobi, the question was brought up whether the United Nations environmental program ought to have some role in Antarctica and whether in fact it could be useful. It was discussed in rather general terms and the group there decided—this was the governing body or executive group, the governing council—decided that inasmuch as the Antarctic Continent was the subject of an existing international treaty, and that that treaty was in force and not only with the signatories but other nations that from time to time have interests in Antarctica and have acceded; cooperated and adhered to the general principles of the treaty, that there was no particular reason for UNEP to become involved. The environmental questions could be handled better within the treaty mechanism which had been set up, inasmuch as the mechanism includes implementation of environ-

mental measures through these consultative meetings, which occur quite regularly.

[Deleted.]

Mr. BERNHARDT. [Deleted.]

OTHER INTERNATIONAL BODIES WHERE ANARCTIC QUESTION HAS BEEN RAISED

Senator PELL. Are there any other international bodies where this question has been raised, at least in the last 12 months, as far as you know?

Dr. RAY. No.

Mr. RICHMOND. It was raised several years ago, I think. It was raised 10 years ago or so, within ECOSOC, the Economic and Social Council, but it was never discussed. [Deleted.] There existed already a consultative body under the Antarctic Treaty which considered Antarctic questions.

ANTARCTIC TREATY'S SILENCE ON MINERAL EXPLOITATION ISSUE

Senator PELL. As I understand it, the Antarctic Treaty, is silent on the issue of mineral exploitation. Is that correct?

Mr. BURTON. That is correct. As you know, of course, there are a number of legal structures or rights which would be desirable if commercial activities are to commence.

Mr. BERNHARDT. [Deleted.]

Mr. RICHMOND. The treaty is generally considered to take the broader view that commercial activities are not prohibited and there have been significant commercial activities for profit that have taken place in the Antarctic, notably tourism.

Senator PELL. How many people a year?

Mr. RICHMOND. About 2,000.

Senator PELL. Where do most of them come from?

Mr. RICHMOND. Argentina has a significant traffic, and there is a good bit out of New York City in the full course of a year.

POLICY ALTERNATIVES AVAILABLE TO UNITED STATES

Senator PELL. What are the alternatives available to the United States as we develop a policy on this issue?

Dr. RAY. [Deleted.]

Senator PELL. We should recess for a few moments.

[Brief recess.]

Senator PELL. [Deleted.]

COURSE OF ACTION RECOMMENDED BY APG TO NSC

What course of action has the Antarctic Policy Group recommended to the NSC?

Dr. RAY. [Deleted.] We are in the process of consulting with the other agencies. It is certainly the trend, I think, in the Antarctic Policy Group to take the position that an internationally agreed upon approach, getting some form of agreement with the other signatories

of the treaty, is the better way to go, and that as much as possible we do hope this can be done without upsetting the conditions of the treaty and avoiding if possible reopening the treaty.

We wish to avoid doing anything that would cause any country to say "We will do that now," we have to go back and renegotiate the treaty.

CONSULTATION WITH CONGRESS

Senator PELL. This may not concern you since you have just recently come into the Department. It may concern the other individuals here. During the nomination hearings Secretary Kissinger stated that he intended to bring the Congress, and I quote, "into the early stages of policy." What efforts have you made along that line? Have you consulted with any Member of Congress?

Mr. BURTON. If I may address that question: The level of detail which we have reached in our international deliberations is still so general that I do not think we have reached a stage where important decisions are being made, which could be characterized as the kind of important policy decisions that we would want serious congressional attention to.

The general statement that we wish to seek an international agreed approach I regard, at least, as a kind of given base line.

Senator PELL. I strongly disagree with you because I think in these early stages there is a need to touch base with Congress. I had to take the initiative and ask you all to come up here and I think it would be wiser for you to touch base with the relevant committees even at this early stage.

Mr. BURTON. I think there have been a few informal contacts with some of the staff so that on that level it has not been a matter of total isolation. We would want to have the necessary data base.

I think as we progress through this we will certainly want to do that on a very close basis.

Senator PELL. I would think so, particularly if you are going to have a tough treaty to ratify in the end. [Deleted.] If you are going to get support in the Congress and get two-thirds majority in the Senate, it is better to have as many people on board as you can.

RAISING ISSUE WITHIN U.N. OR LOS CONFERENCE

Would you have any objection to the issue being raised within the U.N. or Law of the Sea Conference?

Mr. BURTON. [Deleted.]

Dr. RAY. [Deleted.]

Mr. BURTON. [Deleted.]

Mr. BERNHARDT. [Deleted.]

Mr. RICHMOND. [Deleted.]

ENVIRONMENTAL IMPACT STATEMENT ON ANTARCTICA

Senator PELL. Has there been any environmental impact statement made on this subject?

Dr. RAY. The only environmental impact statement on Antarctica is the one which is presently underway in the early stages of being drafted on the environmental impact of the scientific programs that

are underway under the National Science Foundation. It is quite clear if there should be a major federal action and determination to move toward a negotiation concerning an exploitation of resources, it would be a major federal action, and if that move were taken, then we would have to prepare an environmental impact statement under the requirements of the legislation.

How this would affect the other signatories to the treaty we do not really know; the question has not been discussed.

Senator PELL. It does not cover oil and gas?

Dr. RAY. No, no, it covers just the scientific work, the one that is being prepared.

ENVIRONMENTALISTS' INPUT IN POLICYMAKING

Senator PELL. As you move into this policymaking stage, what input are the environmentalists providing? Are they being involved in this?

Dr. RAY. Yes; through both the Environmental Protection Agency and the Council on Environmental Quality, they are among the groups that are involved. We have also consulted with representatives of private environmental groups recently.

Senator PELL. Who would be representing the EPA?

Mr. BERNHARDT. David Cook has been in on our study and so has Bob McManus.

Senator PELL. Wouldn't it be the international office, then, of EPA?

Mr. BERNHARDT. I think that he works closely with them.

INVOLVEMENT OF PUBLIC SCIENTIFIC GROUPS

Senator PELL. My recollection is that there has been little involvement of public scientific groups, would that be correct?

Dr. RAY. There has been a great deal of interest expressed through the pages of science magazines—considerable discussion there. [Deleted.]

DEVELOPMENT OF OIL RESOURCES FOR MANKIND'S BENEFIT

Senator PELL. Is there any doubt in your mind, if there are large quantities of oil there, that that oil resource should be developed for the benefit of mankind?

Dr. RAY. Yes; although the government has not yet decided whether to promote and encourage actual exploitation.

Senator PELL. Obviously leaving open the question of who gets use of it.

Dr. RAY. There is a question in my mind with respect to work at sea under adverse conditions, I have a hard time conceiving how, drilling for oil and safe installation of a wellhead could be accomplished.

In other words, the complete technology to work in that climate does not yet exist.

Senator PELL. That would be offshore, you are talking about?

Dr. RAY. Yes, sir, there is no indication of oil on the continent now except under the Shelf, so that the technology to develop an oil resource that might be found is just not available at the present time.

It may, of course, be developed should Antarctic oil become commercially attractive.

There is still another aspect of it, that looking at it from the environmental point of view must be taken into account. That is when test drilling is done, a test hole may be very hard to cap, and should a test hole be drilled in those waters at those latitudes and an enormous amount of oil comes gushing out, it would be very difficult to avoid major adverse impact, major oil spills.

Senator PELL. Because of the coldness, it would be a long time before it bio-degraded.

Dr. RAY. Yes. [Deleted.]

[The following information was subsequently supplied:]

This is another reason why we are proceeding with this policy process now. The technology for exploratory work, including drilling, will be available before the technology for commercial recovery operations is complete. Many of the problems are encountered at the exploration stage, such as the need to protect the environment from test drilling. The juridical issues could also arise sooner, whether it is the U.S. or someone else who takes the first step. We would hope to have the situation well in hand before a rush is underway and any nation take hasty actions that may not be in the interest of the Antarctic community.

Mr. BURTON. [Deleted.]

DELAY IN SUBMISSION OF ANTARCTIC SEALING CONVENTION

Senator PELL. I think the Antarctic Sealing Convention was signed a year ago. Why has it not come up here for ratification?

Mr. RICHMOND. We are expecting it up very shortly.

Senator PELL. Why has it waited a year?

Mr. RICHMOND. We have been working, for one thing, on an environmental impact statement with respect to that particular convention and I think that has been finished now.

Senator PELL. Does it take a year to do an environmental impact statement?

Mr. RICHMOND. Unfortunately this one has moved perhaps slower than some others but, in any event, it is not completed and it will be in final form.

Senator PELL. When do you expect the treaty to be before us?

Mr. RICHMOND. Do you know when? I don't know precisely.

Mr. BURTON. I can give you that information.

Senator PELL. Submit it for the record.

[The information referred to follows:]

SUBMISSION OF ANTARCTIC SEALING CONVENTION

[Supplied by Department of State]

We plan to submit the Convention as soon as we complete the environmental impact statement and do not expect this to take much time.

NSC STUDY MEMORANDUM ON ANTARCTICA

In connection with the general subject of Antarctica, has the National Security Council study memorandum been prepared on the subject?

Dr. RAY. There have been several memoranda prepared in the past, right?

Senator PELL. Does the most recent one submitted to the White House recommend the development or exploitation of the resources or——

Dr. RAY. It does not make any recommendations as such. It lays out for the President's consideration the various alternatives and the options [deleted].

Senator PELL. Which Government agencies would be involved in the preparation of such a statement? Could you tick them off?

Dr. RAY. State and Department of Defense and National Science Foundation, Departments of Commerce and Interior, Federal Energy Agency, the Environmental Protection Agency, Council on Environmental Quality, Treasury Department.

Senator PELL. Thank you.

DESIRABILITY OF INTERNATIONAL MECHANISM

Looking ahead 10, 20, 30 years, when many of these technologies will be with us, do we visualize a creation of various international mineral authorities, to be controlled by the——

Dr. RAY. I would hate to speculate at this moment. I think something of this sort may get discussed at this meeting in June and it would be important, I think, to know the positions of the other nations that adhere to the treaty.

I do not think we have any base to be able to project the desirability of an international mechanism at this time.

Senator PELL. I know I have also looked forward to the time when there will be a fairly vigorous mechanism for the deep sea bed, although I realize that is not the policy of the administration at this time.

The negotiations haven't gone as far as I would with an International Seabed Enforcement Agency. Can you see a global organization some day taking control of the development of Antarctica? Would the 12 nations that are presently involved there accept such a proposal?

Dr. RAY. This is very hard for me to speculate on. Just to comment personally, I think the difficulty is we don't really have an existing model already operating in a truly international manner. What we have as operating models at the present time are regional arrangements, some of which operate very well indeed, where those nations that have a vested or a keen interest in a particular subject, and in a particular region have been able to get together and bind themselves to a common code of conduct, to rules that they will adhere to, and we are finding this happening more in the environmental area now in regional groups of nations we have had with us for quite a long time in a number of fishery commissions where there are problems, but they are met and things were working relatively well.

In the case of Antarctica, the Treaty, itself, has, I think, served extremely well in the years since 1959 and these regional groupings where the nations that are involved are the ones that put themselves into the situation by common code are the best models we have for international behavior at the present time, and the kind of overall truly international situation involving all the nations, including those without a direct interest, is something that has not yet been put to the test.

NECESSITY OF FRAMEWORK TO DEVELOP RESOURCES

Senator PELL. I hope that out of this next meeting will come a set of guidelines or at least buoys showing where the shoals are that will really permit us to go to the next stage of this treaty, because it would seem to me with the shortages of mineral resources in the world we are going to have to develop some framework for the eventual development of those resources. Our own Government is to be commended in that it has not joined the other nations seeking to divide or carve up Antarctica. I would hope we would continue to have that international approach as we get into this area.

Is there anything any of you would like to add to the record?

[No response.]

Senator PELL. Then the hearing of the subcommittee is adjourned.

[Whereupon, at 3:40 p.m., the subcommittee adjourned subject to the call of the Chair.]

APPENDIX

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF MANAGEMENT AND BUDGET,
Washington, D.C., August 4, 1971.

[Circular No. A–51 revised]

To: The heads of executive departments and establishments.
Subject: Planning and conduct of the United States program in Antarctica.

1. PURPOSE

This Circular provides the basis for the planning, funding, management, and conduct of the United States program for Antarctica. This revised Circular replaces and rescinds Circular No. A–51, dated August 3, 1960.

2. ASSIGNMENT OF RESPONSIBILITY

(a) The Antarctic Policy Group shall continue to serve as the policy guidance body for the totality of U.S. activities under the Antarctic Treaty. The Antarctic Policy Group will review each year's operations plan for Antarctica on a schedule coordinated with the budget cycle. Antarctic Policy Group membership shall consist of the Secretary of State (Chairman); the Director of the National Science Foundation; the Secretary of Defense; or their designees, and representatives of such other agencies as may be invited by the Chairman to participate on an *ad hoc* basis. The Interagency Antarctic Committee shall serve as a coordinating organization for the Antarctic Policy Group. Committee membership shall include representatives of all agencies having significant interests or program activities in Antarctica, as determined by the Policy Group. The Antarctic Policy Group may establish such additional subsidiary committees as may be necessary to facilitate the work of the Group.

(b) The National Science Foundation shall:

(1) Be responsible for all aspects of developing and implementing an integrated U.S. program for Antarctica, except for responsibilities specifically assigned to other agencies by this Circular or by the Antarctic Policy Group.

(2) Fund the entire U.S. program in Antarctica, including logistic support activities, except where such services are funded by the Department of Defense or the Department of Transportation in accordance with the provisions of c. and d. below, or by other agencies as determined by the Office of Management and Budget.

(3) Continue to fund university or other non-Federal research programs and all Federal agency scientific programs insofar as they pertain to Antarctica.

(4) Draw upon the logistic support capabilities of government agencies on a mutually agreed reimbursement or non-reimbursement basis, or use commercial or other support and management capabilities where these are determined to be cost effective.

(5) Designate a Senior United States Representative in Antarctica.

(6) Serve as the clearinghouse and source of information regarding the existence and location of Antarctic records, files, documents, and maps maintained within the various executive agencies and non-governmental organizations.

(7) In consultation with the Department of State, coordinate and arrange for the conduct of cooperative scientific programs with other nations participating in Antarctica research under the terms of the Antarctic Treaty.

(c) The Department of Defense shall:

(1) Plan and carry out logistic support requested by the National Science Foundation, and such other programs and functions as may be requested by the Foundation or the Antarctic Policy Group, and in this connection assure the continuing availability, on a mutually acceptable reimbursement or non-reimbursement basis, of essential logistic support components.

(2) Fund and procure all aircraft required to provide the logistic support or perform other programs or functions requested pursuant to paragraph c. (1). Procure other essential logistic support components for the U.S. program for Antarctica on a mutually acceptable reimbursement or non-reimbursement basis.

(3) Through the Commander of the military support force, exercise operational management and control, including the determination of safety and feasibility, over logistic support and other programs and functions in Antarctica assigned or requested pursuant to paragraph c.(1) above and make all reasonable efforts to provide the support necessary to fulfill the objectives of the U.S. Antarctic program.

(d) The Department of Transportation shall fund icebreaker services requested by the National Science Foundation for the U.S. program in Antarctica through fiscal year 1972. Funding responsibilities for icebreaker services rendered in support of the U.S. Antarctic program after fiscal year 1972 shall be in accordance with arrangements mutually agreed upon by the Department of Transportation, the National Science Foundation, and the Office of Management and Budget. The Department of Transportation shall make all reasonable efforts to assure the availability of icebreaker services as requested by the National Science Foundation for the Antarctic program.

(e) The Department of State is responsible for the formulation of foreign policy and the provision of foreign policy direction relating to the development and implementation of an integrated U.S. program for Antarctica; for the conduct of foreign relations regarding Antarctica; and for legal matters relating to the interpretation and implementation of the Antarctic Treaty.

3. RELATIONS BETWEEN THE NATIONAL SCIENCE FOUNDATION AND OTHER ORGANIZATIONS IN CARRYING OUT AN INTEGRATED U.S. PROGRAM FOR ANTARCTICA

(a) Executive Departments and agencies shall cooperate with the National Science Foundation in fulfilling its responsibilities for the U.S. Antarctic program, and shall appoint agency representatives to advisory committees as may be requested by the Director of the National Science Foundation.

(b) Federal agencies interested in scientific or other activities for Antarctica, either to be conducted by their own staffs or by other agencies and personnel, should inform the National Science Foundation of their interests and of those aspects of proposed activities which might be included in the U.S. scientific program to be developed and funded by the Foundation. The Foundation shall make allocations to Federal agencies and grants and contracts to non-Federal organizations for scientific and logistic support activities it deems necessary and appropriate to the conduct of the U.S. program in Antarctica.

(c) The National Science Foundation shall advise the Department of Transportation, or other appropriate agencies, of the program plans for Antarctica in sufficient time and in sufficient detail so that the required supporting programs may be developed on an orderly basis. The Departments of Defense and Transportation, and other appropriate agencies shall in turn consult and collaborate with the National Science Foundation and keep it fully informed regarding all aspects of program support planning and operations for which they have been assigned responsibility. The Departments of Defense and Transportation or other appropriate agencies shall present to the National Science Foundation statements covering the actual and estimated costs of their support for the Antarctic Program. These statements shall cover the past, current and budget years and shall be submitted at an agreed time each year as necessary to meet the Federal budget requirements.

GEORGE P. SHULTZ, *Director.*

[For immediate release]

OFFICE OF THE WHITE HOUSE PRESS SECRETARY—MAY 1, 1965

THE WHITE HOUSE

The President today received the first report of his Antarctic Policy Group which was established at his request earlier this month. This group, composed of representatives from the State Department, the Department of Defense and the National Science Foundation has been charged with guiding our Antarctic policy

and helping develop the U.S. program in that region. The group's work has taken on special importance as part of the U.S. Government's observance of the International Cooperation Year. The President commented after receiving this progress report:

"I have been deeply impressed by the sensible way in which the 12 nations active in Antarctica work together. In that frozen continent we have, through international cooperation, shown how nations of many different outlooks can cooperate for peactful purposes and mutual benefit. National differences are no barrier to a common effort in which everyone gains and no one loses. The scientific findings of all countries are pooled for the benefit of all. Men in danger or in need can call for help knowing that it will be given unstintingly by any country that can provide it.

"We are now celebrating International Cooperation Year. It is our earnest hope that the same success that has marked the Antarctic program can be extended to every field of international endeavor, not only during this special year, but in future years as well.

"The United States today pursues a vigorous program in Antarctica. We have begun to explore the Southern Ocean and the last great unknown reaches of the Polar Plateau. We have established new research stations in West Antarctica and on the Antarctic Peninsula. We have completed geologic surveys of most of the ice-free areas of West Antarctica. We have photographed hundreds of thousands of square miles for mapping purposes. We are conducting scientific programs to study the unique physical and biological features of the area.

"We are pioneering new concepts of operations on the ice. We introduced nuclear power to Antarctica. Advanced construction techniques soften the rigors of polar life. Specialized aircraft and surface vehicles enable us to reach any point on the Continent, and to operate effectively when we get there.

"From our activities and those of other countries we acquire increased knowledge of the world in which we all live and which we must understand better to meet the challenge of the future. Already the research program has disclosed facts which may affect profoundly the future of communications, of space travel, and of the world's food supply.

"The kind of international cooperation that has become accepted practice in Antarctica is both practical and mutually beneficial. Argentina provided transportation and logistic support for three U.S. biological teams this year, and has also made facilities available to us at its Melchoir Station. The United States and four other nations man an Antarctic Weather Center in Melbourne, Australia.

"This year the first leg of a great traverse across the savage and unknown Polar Plateau was made by an American team which included a Belgian and a Norwegian. A number of Chilean scientists participate in our activities. When our research ship, the *Eltanin*, encountered a medical emergency, the Chilean Air Force and Navy provided drugs to the ship at sea, and hospital facilities in port.

"New Zealand continues to welcome our advance headquarters in Christchurch, N.Z., and to participate in the research programs on the ice. We, in turn provide them with transportation and other logistic support.

"This year again an American scientist is doing research at the Soviet Mirnyy Station and a Soviet scientist is studying at our McMurdo station. One of the monitoring instruments of our cosmic ray program is installed at a Soviet Station, where the Russians are operating it for us.

"France, Japan, South Africa and the United Kingdom are actively cooperating with the United States on a variety of Antarctic projects.

"The peaceful framework on which these widespread activities depend is the Antarctic Treaty. The countries adhering to the Treaty have pledged that Antarctica shall be used for peaceful purposes only. No activities of a military nature are permitted. Nuclear explosions or dumping atomic waste is prohibited. But scientific research is open to all, and international cooperation in that research is encouraged.

"Any signatory country may satisfy itself that the Treaty is being observed by inspecting any station or expedition anywhere in Antarctica. In short, the United States and other signatories have agreed that it is in the interest of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord."

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[For immediate release]

OFFICE OF THE WHITE HOUSE PRESS SECRETARY—OCTOBER 13, 1970

THE WHITE HOUSE

The President announced today that he had completed a review of United States policy for Antarctica, reaffirming a continuing U.S. interest in Antarctica and in the scientific work which is undertaken on that continent in cooperation with the other eleven nations signatory to the Antarctic Treaty.

In conducting his review of United States policy for Antarctica, the President has directed changes in the funding and program management of U.S. activities to bring about a more effective administration. In the past, the funding for the U.S. program in Antarctica has been divided among the National Science Foundation, which has funded and managed the scientific programs, and the Departments of Defense and Transportation, which have provided logistic support to these programs.

Because the U.S. effort in Antarctica is primarily scientific in nature, and in order to achieve maximum effectiveness in developing a national program, the President has decided to consolidate funding and program management responsibilities for all U.S. activities in Antarctica within the National Science Foundation.

The increase in the National Science Foundation budget for Antarctic activities will not cause a net increase in the total Federal budget, as the Foundation will be assuming budget items for logistic support currently provided by the Department of Defense and the Department of Transportation. The President directed the agencies to commence now the orderly transfer of administration and budgetary responsibilities.

The President noted that the United States policy in Antarctica includes several objectives:

To maintain the Antarctic Treaty and ensure that this continent will continue to be used only for peaceful purposes and shall not become an area or object of international discord.

To foster cooperative scientific research for the solution of worldwide and regional problems, including environmental monitoring and prediction and assessment of resources.

To protect the antarctic environment and develop appropriate measures to ensure the equitable and wise use of living and non-living resources.

United States interests in Antarctica extend back 150 years. It was then that Nathaniel Palmer of Stonington, Connecticut, made the first known sighting of Antarctica. The national exploration by Charles Wilkes in 1840 charted 1500 miles of the Antarctic coasts. In this century, the well-known exploits of Rear Admiral Richard E. Byrd, Dr. Laurence M. Gould and other explorers and scientists have constantly attested to the U.S. interest in Antarctica.

In 1958, President Eisenhower extended invitations to the Governments of the eleven nations which had conducted scientific research programs in Antarctica during the International Geophysical Year (1958) to participate in a conference with a view to writing a treaty "dedicated to the principle that the vast uninhabited wastes of Antarctica shall be used only for peaceful purposes". The Treaty was signed by the United States and the eleven other nations (Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, the Union of South Africa, the Union of Soviet Socialist Republics, and the United Kingdom) on December 1, 1959, and entered into force on June 23, 1961.

President Eisenhower noted that the "Antarctic Treaty and the guarantees it embodies constitute a significant advance toward the goal of a peaceful world with justice". Of the guarantees in the Treaty, any signatory country may satisfy itself that the pledge is being observed by inspecting any station or expedition anywhere and at any time.

The Treaty has provided an effective framework for the continued peaceful use of the area by the twelve nations conducting research and working together on the icy continent, an area as large as the United States and Europe together, where national differences are no barrier to practical and mutually beneficial cooperation. Each year the United States welcomes foreign scientists to its stations and sends American scientists to do work at stations of other countries. Annually the U.S.S.R. and the U.S. make bilateral exchanges of scientists to winter at a station of the other country. Science has provided a successful basis for international accord, and the Antarctic is the only continent where science serves as the principal expression of national policy and interest.

[From Science, Vol. 184, May 17, 1974]

Antarctica: World Hunger for Oil Spurs Security Council Review

(By Deborah Shapley)

A little-known government decision-making body, the Antarctic Policy Group, which is part of the White House's National Security Council (NSC) apparatus, is considering possible revisions in the historic 12-nation Antarctic Treaty in anticipation of the day when oil, gas, and minerals begin to be extracted from that continent. The review could result in the first major change in U.S. Antarctic policy in more than a decade.

Both the U.S. government and other nations that are party to the treaty are looking at this issue in preparation for negotiating possible changes in it at a forthcoming meeting in Oslo, Norway, next April. At the last biennial meeting of the treaty nations, one of them, New Zealand, proposed that the resource question be taken up. A unanimous vote of the 12 is needed to change the treaty.*

The Antarctic Treaty is something of an international benchmark. It bans emplacement of weapons and military activities in Antarctica; it requires free exchange of all scientific information gleaned about the continent. It has, in effect, reserved the continent and its surrounding waters for the twin purposes of scientific research and environmental preservation since it came into force in 1961.

But the treaty neither permits nor bans exploration for oil and minerals there. Officials are fearful that, if some preparation is not made, exploration for oil or minerals could lead to international conflict in this heretofore peaceable continent. At the moment, the treaty makes no mention of nonliving resource exploration and exploitation—although it facilitates preservation of the living resources, such as the seals, found in Antarctica. Hence, no one knows whether individual countries, or some international body, has the authority to issue licenses or resolve disputes over nonliving resources. At present any company that launched operations there would be working in a complete legal vacuum.

Another unresolved problem is that 7 of the 12 treaty nations have at some time or other made territorial claims in the Antarctic;† three of these claims overlap in one possibly mineral-rich region, the Antarctic Peninsula. A valuable sudden oil or mineral discovery could lead these countries to reassert their territorial claims. And, since the treaty explicitly holds all such claims in abeyance, such an assertion would weaken it drastically and open the door to international conflict over claims.

Herman Pollack, assistant secretary of state for international scientific and technological affairs, who heads the Antarctic Policy Group and the current review, is worried that these things may actually happen. "This is one treaty people haven't violated," he said. "We are considering what kind of proposal we would make as to how these parties would manage exploration and exploitation."

So far, no major oil or mining company has expressed serious interest in shoving off to the South Pole in search of greater wealth, although rumor has it that a nontreaty nation, Brazil, is interested in the possibility. However, no major find of these exploitable resources has yet been made, although a great number of commercially valuable minerals and fuels, from gold and diamonds to oil, are believed to exist there.

The technical problems of resource exploration and exploitation in Antarctica's harsh and dangerous environment are many. Nonetheless, scientists predict that technology for offshore drilling in the stormy, iceberg-ridden Antarctic waters and possibly for commercial mining could be available before a decade is over. After all, increased demand for new oil, at least has spurred drilling in other unlikely places. Wortimer Turner, a veteran Antarctic geologist with the National Science Foundation's (NSF's) Office of Polar Programs, compares it to Europe's North Sea. "The North Sea wasn't a very promising place 20 years ago. If the oil industry wants to recover oil and gas in the Antarctic it can do so. But it will take a decade or two of technological development and a lot of money."

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*Parties to the treaty are Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, South Africa, the Soviet Union, the United Kingdom, and the United States. Five other states have acceded to the treaty since it came into force in 1961.

†Australia, Argentina, Chile, France, New Zealand, Norway, and the United Kingdom have cut up Antarctica into pie-shaped pieces. The Argentine, Chilean, and British claims all overlap in an area including the Antarctic Peninsula, which is south of Cape Horn.

The State Department is keeping the NSC review administratively classified, despite the objections of some spokesmen. Robert Yoder, a recently retired Foreign Service officer whose expertise is in Antarctic affairs, explains that this secrecy is no different from that which precedes most U.S. negotiations abroad. But Richard A. Frank, who is in charge of international affairs for the Center for Law and Social Policy, a public-interest law firm, thinks otherwise. Frank is one of the few nongovernment experts who has participated in the review. "The whole idea that they shouldn't be forthcoming and talk to the American people and the press about what they're doing is ridiculous. For one thing, other governments know what they [the officials in the review] are thinking. To keep the American public ignorant of something foreign governments already know about is ridiculous."

Frank notes that the State Department in some other international negotiations, including those on ocean dumping and the law of the sea, has filed environmental impact statements. Hence the department may also be required to file a statement on its proposed position on Antarctica. "Because of the ignorance about the Antarctic, we simply don't know the adverse environmental consequences of an oil spill down there. . . . Resources developer could change substantially and pollute this last, large natural ecosystem," he says.

Although the NSC study is secret, some aspects of it have leaked out. One is an estimate compiled by the U.S. Geological Survey (USGS) that the western Antarctic continental shelves alone could have potential resources of 45 billion barrels of oil and 115 trillion cubic feet of natural gas—amounts that are roughly equal to the proven reserves of the United States.

Also known are some of the options under consideration. According to Frank, the Federal Energy Office and the Department of the Interior are seeking to enable oil exploration of Antarctica's shelves. The State Department, on the other hand, is fearful that such development would end the era of peaceful cooperation there and favor a moratorium on all such activities. Another possibility said to be under review is an international organization charged with managing Antarctica's resources on behalf of the international community. The scientists have had Antarctica as their own demesne for well over a decade—thanks in part to the treaty—and tend to think of it as a place with only intellectual interest. But others who have involved themselves with the continent have fashioned another tradition—hope that it would prove mineral-rich and commercially valuable. Many early explorers were financed by persons or groups with a resource bent: Admiral Richard E. Byrd was funded by John D. Rockefeller, for example. Although these patrons were not rewarded by big mineral or fuel finds, they did succeed in being immortalized by geographical names like Rockefeller Mountains and Mobiloil Bay.

In fact, far from being a separate issue, the conduct of research in the Antarctic region is intertwined with the hunt for resources—since the scientists are the ones now doing the hunting. Part of the current interest in Antarctic oil arose in January 1973, when the *Glomar Challenger*, NSF's research vessel, found traces of ethane and methane near the middle of the Ross Sea, Antarctica's largest single continental shelf area, which is about the size of France. Ethane and methane are indicators of the presence of natural gas and are sometimes also found where offshore oil is.

There have been other interesting finds. The Lassiter Coast, part of the Antarctic Peninsula, has yielded evidence of porphyry copper similar to that found in the Andes. A rare geologic formation, called a basic layered intrusion, the Dufek Intrusive, is suspected of containing chromium, platinum, and other industrially valuable metals. It is similar to one of South Africa's richest regions, the Bush Veld. The Dufek Intrusive is part of the Transantarctic Mountains which, as they stretch across the continent, also contain coal, ranging from low-grade to anthracite.

According to Arthur Ford of USGS, a Russian expedition has found iron deposits in another mountain range, the Prince Charles Mountains, which are on that part of Antarctica south of the Indian Ocean. "From estimates I've heard," Ford said, "it would be as large as any known deposit of similar material in the world." Gold has been found in Queen Maud Land, although the quantities and types examined are so far "of only scientific interest," Ford says.

These discoveries have aided researchers in concluding that west Antarctica is geologically similar to the mineral-rich mountain chains of the Pacific basin, which includes the Andes and the Rocky Mountains. Moreover, if, as is generally supposed, east Antarctica was once joined to South America, Africa, and Australia as part of the supercontinent Gondwanaland, it could be as rich as these in min-

erals. While none of the above finds has been substantial enough to warrant serious commercial interest, scientists think that it is just a matter of time before such a discovery is made.

The NSF has been redirecting its work in the Antarctic toward "the type of research that would give data that would be useful in finding resources," says Turner. Thus NSF research in McMurdo Sound, along the Ross Sea, has shifted from study of its volcanic history to its marine sediment history. A special study is planned of Seymour island, which is part of the continental shelf, in order to learn more about Antarctica's potentially valuable shelves. Capping this thrust at NSF, which Turner estimates has been going on for several years, was a proposal drawn up last winter during the government-wide crash search for new energy research projects. According to this proposal NSF, which sponsors some $3 million in research grants in the Antarctic per year, would sponsor a special, 5-year, $12 million program to make detailed estimates of the oil potential of the continental shelves.

Pollack and others hasten to point out that the prospects of resource recovery are nil in the immediate future, and that the NSC review is aimed at the long term. The land is 4 to 5 percent exposed; its ports are accessible for only a few months a year; and the industry which has started there, a Danish tourist voyage, is dependent on U.S. logistic support for its safety. Furthermore, Antarctica is a place where an airplane can hardly land safely because of hazardous conditions, and where human flesh can freeze in a matter of seconds if exposed to the elements. Thus any commercial operation there will have to overcome extraordinary hazards.

An economist with Resources for the Future, Inc., Neal Potter, in *Natural Resource Potential of the Antarctic*,‡ has written about the drawbacks. He said that some of the technology developed for oil and mineral exploration in the Arctic is not at the present time applicable in the Antarctic, and that the Antarctic has the additional disadvantage of having no inhabitants to guide prospecting expeditions to likely spots. Potter generally concluded that mineral and fuel recovery in the South Pole region will not be economically feasible in the near future.

But several USGS and NSF scientists are now referring to Potter's estimates as "conservative." His cost estimates, for example, have been dated by the dramatic rise in the price of fuel over the last year. Potter's study assumed that many of the metals found in Antarctica would continue to be in ready supply from other parts of the world; that too has changed as the major industrial nations face possible embargoes from traditional suppliers. As global market conditions change, some of the much-touted disadvantages of Antarctic exploration and exploitation have decreased.

It seems evident that the possibility of Antarctic oil and mineral development could have an impact on the scientific research done there, on the region's environment, and on the historic peace of the continent. It also begs the question of how interested the oil and mining companies really are in such a distant, expensive, and long-term endeavor. But despite the many interests that will be affected, it looks as though a new U.S. policy toward Antarctica will be formulated behind closed doors.

Antarctic Oil is Estimated as Enormous

[From the Washington Post, Mar. 3, 1975]

Honolulu, February 28—A Navy captain said that a potential 45 billion barrels of oil may be under the ice of Antarctica.

On a stopover here, Capt. Eugene Van Reeth, commander of the Navy's Antarctic support force said Thursday that geologists working in the Antarctic had surmised that the continental shelf off Marie Byrd Land "could have up to 45 billion barrels of oil."

Emphasizing that this was "just an estimate, something on which we can only speculate," Van Reeth said, "at this point there is no exploration."

"It's only been estimated that the continental shelf area is a possible source of oil," he said.

Van Reeth, who was in Antarctica as part of a Navy team that provides logistical support for scientists working there, said that besides the possible oil, deposits

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‡N. Potter, *"Natural Resource Potential of the Antarctic"* (Lane, Burlington, Vt., 1969).

of copper, nickel and iron have been found. The question of who has the right to extract these resources is unresolved.

"No one seems prepared to answer that," he said.

Oil authorities said a 45 billion-barrel field would be a major discovery.

"Under the terms of the Antarctic Treaty signed by 30 nations in 1961, any one nation or any one individual or company could exploit any oil deposits lying beneath the Antarctic continent or its offshore waters," Van Reeth said.

ESTIMATING THE ANTARCTIC OIL RESOURCES

[From the Washington Post, Mar. 12, 1975]

On February 28 you carried a UPI release in which Navy Captain Eugene Van Reeth noted that geologists have estimated a resource potential of 45 billion barrels of oil from the continental shelf off Marie Byrd Land, Antarctica. The source of that number is a U.S. Geological Survey internal document prepared two years ago for National Science Foundation in which we estimated the in-place oil that might be discovered in offshore Antarctica. In-place oil is the total amount of oil in a geological formation of rock. On the average only about one-third of the in-place oil can be recovered now by pumping oil out of the rocks. Thus, an in-place oil resource number is approximately three times larger than what one would expect to recover.

The Antarctic resource estimate that properly compares with the numbers commonly reported for offshore U.S. is therefore 15 billion barrels of oil—not 45 billion. For reference, the USGS estimated in March 1974, recoverable resources for the Atlantic of 10–20 billion barrels of oil and we estimated 30–60 billion barrels of recoverable oil for all of offshore Alaska.

A discussion of the geology on which our resource estimate was based is included in USGS Circular 705. If we were to appraise the area today, it is possible that new data that have become available in the past two years would cause us to change the original estimate—either up or down.

CHARLES D. MASTERS,
Chief, Office of Energy Resources,
U.S. Geological Survey.

Reston.

CIRC. 705

GEOLOGICAL SURVEY CIRCULAR 705

Mineral Resources of Antarctica

Mineral Resources of Antarctica

Compiled and edited by
N. A. Wright *and* P. L. Williams

GEOLOGICAL SURVEY CIRCULAR 705

1974

United States Department of the Interior
ROGERS C. B. MORTON, *Secretary*

Geological Survey
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Mineral Resources of Antarctica

Compiled and edited by N. A. WRIGHT *and* P. L. WILLIAMS

ABSTRACT

Although the existence of mineral deposits in Antarctica is highly probable, the chances of finding them are quite small. Minerals have been found there in great variety but only as occurrences. Manganese nodules, water (as ice), geothermal energy, coal, petroleum, and natural gas are potential resources that could perhaps be exploited in the future. On the basis of known mineral occurrences in Antarctica and relationships between geologic provinces of Antarctica and those of neighboring Gondwana continents, the best discovery probability for a base-metal deposit in any part of Antarctica is in the Andean orogen; it is estimated to be 0.075 (75 chances in 1,000).

INTRODUCTION

This circular attempts to (1) present a survey of the known mineral resources of Antarctica and (2) estimate Antarctica's mineral-resource potential on the basis of known mineral occurrences in Antarctica and known mineral deposits of neighboring continents. It does not attempt to make any judgements on whether or not the mineral resources of Antarctica should be explored for and exploited. Rather, an objective analysis is given of the present geologic information, aimed at appraising the mineral resources of Antarctica.

About 98 percent of the surface of Antarctica is covered by ice. The lack of exposed rock means that the survey of mineral resources of Antarctica presented here is incomplete. An analysis resulting from such an incomplete survey can be potentially misleading if taken out of context. Geologic studies to date, limited almost exclusively to exposed rock masses that have been analyzed primarily for scientific purposes, have not revealed any mineral concentrations rich enough to be classified as commercially exploitable ore deposits, but the probability that mineral deposits exist in Antarctica seems to be high. The crucial factor, however, is whether they can be found. The problems of finding deposits include such things as lack of rock outcrops, an extremely thick ice cover, almost permanently frozen coastal waters, and no population. The social and economic costs of search are high, but these costs have not stopped similar ventures in the past once zeal was stimulated, even when the chances of success were small. The danger lies in an unwarranted stimulation of zeal because of either a misinterpretation of terms or a failure to separate the appraisal of the resource from the actual costs involved in exploration and development.

The resource estimates are based on (1) present knowledge of mineral occurrences in Antarctica; (2) a theoretical geologic reconstruction of the ancient supercontinent of Gondwanaland and of the relationship of the major geologic provinces of Antarctica to comparable ones in the adjacent continental masses of South America, Africa, India, and Australia; and (3) the extrapolation of known resources in these adjacent, formerly contiguous landmasses to determine the expected frequency of comparable occurrences in Antarctica. This circuitous reasoning process produces estimates of anticipated resources that are subject to continuous review, modification, and refinement. It offers the most reasonable assessment of the mineral resources of the continent in view of the extremely limited amount of exposed bedrock and the extremely limited detailed studies of these exposures.

The terminology used in this summary is based upon the definitions presented by V. E. McKelvey in 1973. Figure 1 is a classification of resources adopted jointly in 1974 by the U.S. Geological Survey and the U.S. Bureau of Mines (Pratt and Brobst, 1974, fig. 1). Within

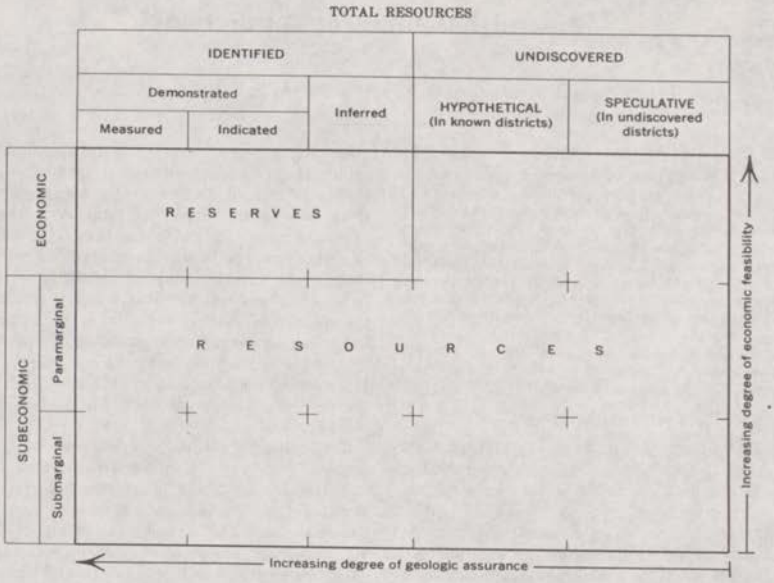

FIGURE 1.—Classification of mineral resources. Modified from Pratt and Brobst (1974, fig. 1).

the framework of figure 1, Antarctica now has no known economically recoverable resources of any category, nor does Antarctica have any known mineral districts. The few localities where valuable minerals have been identified must be classified as mineral occurrences; that is, occurrences of minerals that could constitute a resource if present in sufficient quantity but that have not been studied adequately to determine quantity. These occurrences would rate even lower than submarginal in figure 1 in degree of economic feasibility. Water and coal could constitute identified resources in Antarctica. Ice brought to the Antarctic coast by a glacier contains a volume of water that can be estimated. The coal resources in the Beacon rocks have been sufficiently measured in places to permit estimation of volumes. Present market conditions, as well as quality and location of the coal, indicate that it is not now possible for the coal resources to be considered economically usable; the identified coal and water are definitely submarginal. This conclusion is emphatically supported by the present high-cost practice of importing other energy sources to support scientific stations in Antarctica. Another example of mineral occurrence is the appearance of gas in a single drill hole, which was immediately capped. Favorable host rocks, favorable structures, and a first "smell" of gas do not constitute an identified resource; rather the gas is a proved mineral occurrence that supports estimates of the speculative resource potential for gas and oil. All mineral occurrences in Antarctica should be considered in this same context.

The resources of Antarctica are almost exclusively in the category of speculative resources on the basis of figure 1. Their position in this category is supported by the few mineral occurrences that have been found. Ranking of such resources according to feasibility of economic recovery is a futile exercise. Such ranking would depend on what, if anything, is found, where it is found, and the economic market at the time of finding.

Large accumulations of minerals very probably occur in Antarctica, for no other continent is void of mineral deposits. The major question is whether these can be found and exploited economically. Should advances in technology permit a cheaper, more precise search through the ice, exploration might be more effective in the future. Prediction of such advances in technology, however, would be the rankest sort of speculation. For the purposes of this evaluation, the knowledge that deposits of possible value should exist in Antarctica provides adequate background to stimulate productive negotiations.

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MINERAL OCCURRENCES

The symbols on figure 2 indicate mineral occurrences described in literature on the Antarctic; numbers in the symbols are keyed to table 1. No attempt has been made to indicate mineral concentrations on the map; concentrations range from less than 1 ppm (part per million) determined by chemical analysis, such as gold, to large concentrations of minerals such as coal, sand and gravel, and possibly iron. Most of the symbols, except for those for coal, sand and gravel, and iron, represent only mineral occurrences that have geologic significance as indicators of type of mineral province; they rarely represent large mineral concentrations.

SAND AND GRAVEL

Lowering of sea level during the past several thousand years has produced many raised beaches around the coastline of Antarctica (R. L. Nichols, *in* Craddock and others, 1969–70). The raised beaches are commonly wave-cut surfaces—a few to 100 m or more (300 ft or more) above sea level—mantled with alluvial material ranging in size from boulders to silt and clay; most of the deposits are made up of sand and fine to coarse gravel. Thickness is variable. Detailed descriptions of composition and tenor of deposits are nearly absent in the literature; table 1 summarizes what is known about most of the sand and gravel occurrences.

It seems unlikely that sand and gravel will ever be exported from the continent, but the availability of workable deposits may be an important factor in selecting the sites of future Antarctic bases.

OTHER NONMETALS

Most of the other nonmetallic mineral occurrences described below are in pegmatite and other crystalline rocks of Precambrian age in Queen Maud Land. Descriptions are based for the most part on reports by geologists of the Soviet Union.

Phlogopite (magnesian mica) occurs at locality 1 in the Humboldt Mountains in pods as large as 40 by 60 cm (1 by 2 ft). The pods are in pegmatite dikes injected into Precambrian metamorphic rocks. Crystals as large as 20 by 10 by 4 cm (8 by 4 by 1½ in.) are common. Concentrations estimated at about 2 percent of one metamorphic rock body measure 8 by 10 by more than 100 m (25 by 30 by more than 300 ft) (Ravich and Solov'ev, 1969, p. 279).

Beryl has been found at several localities in Queen Maud Land, but only at locality 2, the "Marble Nunataks," are there significant concentrations. There, altered pegmatite dikes contain pockets of prismatic beryl crystals 10–15 cm (4–6 in.) in diameter; crystals range in length from 0.5 to 7 cm (¼–3 in.), averaging 2 cm (¾ in.). The crystals are mostly cracked and cloudy. Associated with the beryl are topaz, tourmaline, and apatite (Ravich and others, 1968, p. 453).

Rock crystal (quartz) occurs on "Mount Titov" (loc. 65); crystals as large as 0.4 by 0.7 m (15 by 25 in.) make up 4–5 percent of slope debris. Talus in the "Marble Nunataks" (loc. 2) is rich in coarse quartz crystals as long as 20–25 cm (8–10 in.). In both localities, the quartz originated in pegmatite dikes. These occurrences are considered by the Soviets to be promising for future prospecting for optical quartz (Ravich and Solov'ev, 1969, p. 279–280).

Graphite has been described from two localities (6a and 6b) in crystalline rocks in Queen Maud Land. At locality 6a, graphite crystals 2–3 cm (¾–1 in.) in diameter make up 1–2 percent of pegmatite veins 1–2 m (3–6 ft)

FIGURE 2.—Known occurrences of potentially valuable minerals in Antarctica.

Base modified from the American Geographical Society

EXPLANATION

(NUMBERS REFER TO LOCALITIES IN TABLE 1)

- ■41 Sand and gravel
- ⊕6 Nonmetallic minerals
- △5 Iron
- △J Iron, area where jaspilite boulders occur in moraines
- ▲13 Copper
- ⧫16 Gold and silver
- ○20 Molybdenum
- ▬11 Nickel, cobalt, platinum, manganese, uranium, tin
- Area favorable for contact-metamorphic deposits and marble
- ✳ Active volcano, indicated by fumarole activity
- Area of geothermal potential, volcanic rocks less than 1 million years old
- ● Coalbeds
- Area underlain by coal-bearing and potentially coal-bearing rocks
- Proposed site for deep drilling by *Glomar Challenger*
- Anticline — Fold axes in sediments of the Ross Sea shelf. Direction of plunge given where known. Data obtained during *Eltanin* cruises 27 and 32
- Syncline
- Approximate outer limit of Continental Shelf
- Edge of ice barriers

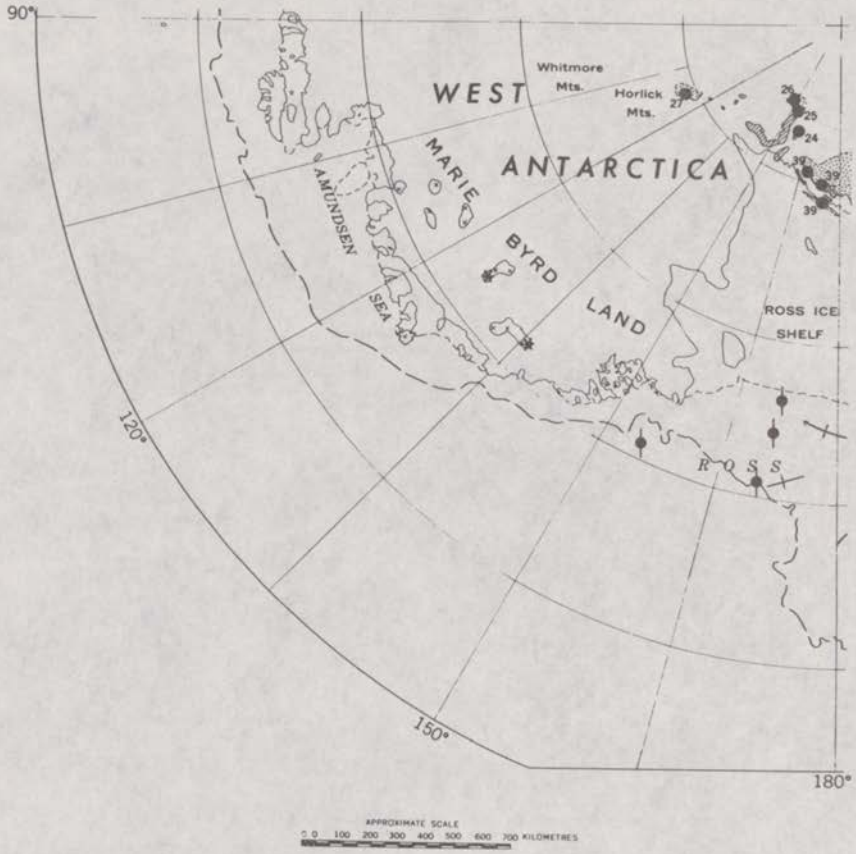

FIGURE 2.—Known occurrences of potentially valuable minerals in Antarctica—Continued.

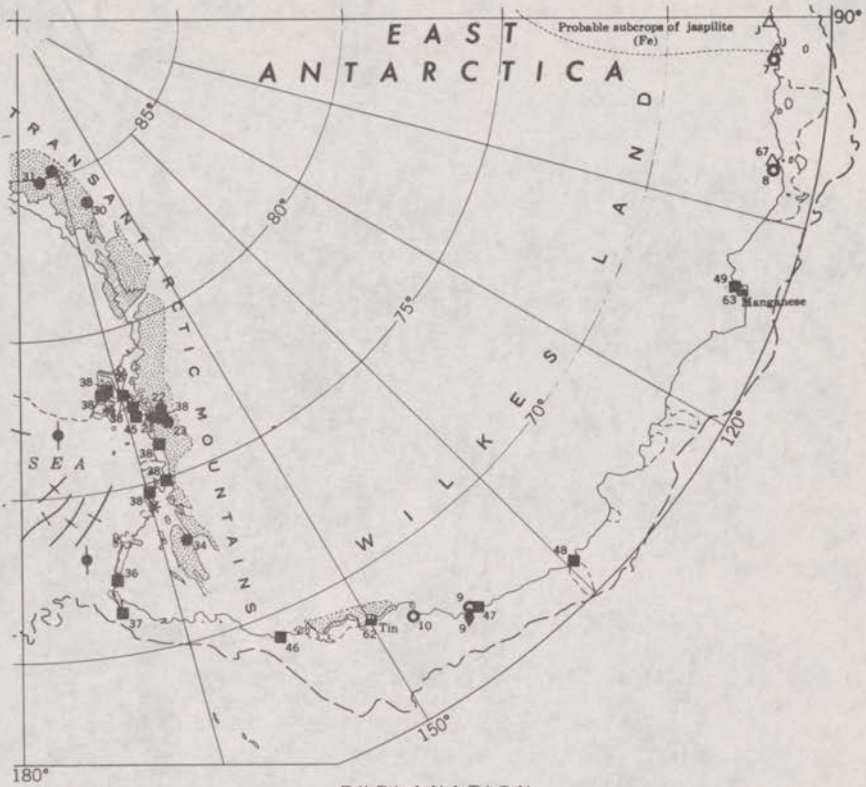

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TABLE 1.—*Mineral occurrences in Antarctica*

Locality No.	Place name	S. Lat.	Long.	Resource	Remarks
1	Humboldt Mountains	71°45′	11°30′E.	Mica	Magnesium rich.
2	"Marble Nunataks"	71°22′	07°35′E.	Beryl	Occurs with topaz and tourmaline.
3	"Mount Hedden"	72°05′	01°22′E.	Iron	
4	Mount Humboldt	71°45′	11°30′E.	do	Pods as much as 100 m thick.
5	Gburek Peaks	72°11′	0°15′E.	Iron and titanium.	
6	Conrad Mountains	71°48′	10°20′E.	Graphite	
7	Near Mirnyy Station	69°20′	72°34′W.	Molybdenum	
8	Bunger Hills	66°17′	100°47′E.	do	
9	Cape Denison	67°00′	142°40′E.	do	Molybdenite with arsenopyrite and sphalerite; traces silver and gold.
10	Ainsworth Bay	67°47′	146°43′E.	do	
11	Dufek-Forrestal Mountains.	82°36′	52°30′W.	Chromium, nickel, cobalt, platinum.	Disseminated in gabbro.
12	Central Neptune Range	83°50′	57°09′W.	Phosphate rock.	Pebbles and irregular pods.
13	Central Lassiter Coast ("Moats Nunataks").	74°22′	65°00′W.	Copper	Mostly chalcopyrite.
14	Copper Peak	64°43′	63°21′W.	do	Malachite stain.
15a	Coppermine Cove	62°23′	59°42′W.	do	
15	Greenwich Island	62°31′	59°47′W.	do	Average tenor less than 0.8 percent copper.
16	Stonington Island and vicinity.	68°11′	67°00′W.	Gold and silver.	Minor molybdenum.
17	"Eternity Range" (probably Leininger Peak), locality uncertain.	70°34.	62°15′W.	do	
18	Eielson Peninsula	70°35′	61°45′W.	do	With pyrite.
19	Stonington Island	68°11′	66°55′W.	Manganese and molybdenum.	
20	Beaver Lake	70°48′	68°20′E.	Coal	Beds average 0.8 m thick.
21	Mount Gran	76°59′	160°58′E.	do	
22	Willett Range	77°09′	160°25′E.	do	
23	Allan Nunatak	76°45′	159°40′E.	do	6 coal beds.
24	Nilsen Plateau	86°20′	158°00′W.	do	
25	Mount Weaver	86°58′	153°50′W.	do	7 coal beds 1.5–3 m thick.

TABLE 1.—*Mineral occurrences in Antarctica*—Continued

Locality No.	Place name	S. Lat.	Long.	Resource	Remarks
26	Mount Howe	87°21′	149°18′W.	do	Graphitic.
27	Mount Schopf and Mount Glossopteris.	84°48′	113°25′W.	do	Beds 1–3 m thick.
28	Mount Faraway	79°12′	28°49′W.	do	Low sulfur.
29	Polarstar Peak	77°32′	86°09′W.	do	Maximum thickness 30 cm.
30	Queen Elizabeth Range	84°00′	159°30′E.	do	
31	Dominion Range	85°05′	171°30′E.	do	3 m thick.
32	do	85°19′	168°00′E.	do	Anthracite, maximum thickness 5 m.
33	Ongul Islands	69°00′	39°35′E.	Sand and gravel.	Beach sand, a few metres thick.
34	Sheehan Tableland	73°00′	162°15′W.	Coal	
35	Pecora Escarpment	85°35′	70°00′W.	do	Carbonaceous siltstone.
36	Seabee Hook	72°19′	170°13′E.	Sand and gravel.	
37	Cape Adare	71°17′	170°14′E.	do	
38	McMurdo Sound area	78°–79°	163°–170°E.	do	Small to large deposits.
39	Dufek Coast area	80°–85°30′	168°–173°W.	Coal	Beds as much as 6 m thick.
40	Marguerite Bay	68°16′	66°50′W.	Sand and gravel.	Many deposits, large to small.
41	Mushroom Island	68°53′	67°53′W.	do	Small deposits.
42	Amiot Island(?)	67°36′	69°38′W.	do	Very small.
43	Hope Bay	63°23′	57°00′W.	do	
44	Herbert Sound	63°55′	57°40′W.	do	Bouldery clay.
45	Dunlop Island	77°14′	163°29′E.	do	Probably large deposit.
46	Lauritzen Bay	69°05′	156°50′E.	Sand and gravel?	
47	Cape Denison	67°00′	142°40′E.	do	
48	Lewis Island	66°06′	134°22′E.	do	
49	Windmill Island	66°20′	110°25′E.	do	
50	Vestfold Hills	68°33′	78°15′E.	do	
51	Ufs Island	67°28′	61°08′E.	do	
52	Cape Kolosov	66°29′	50°16′E.	do	
53	Alasheyev Bight	67°30′	45°40′E.	Sand and gravel.	Large, workable, and accessible deposit.
	Casey (Lena) Bay	67°36′	47°35′E.	do	
54	Shinnan Glacier	67°55′	44°38′E.	do	
55b	Greenwich Island	62°31′	59°47′W.	Sand and gravel; water.	
55	do	62°31′	59°47′W.	Sand and gravel.	Good quality; accessible.
56	King George Island	62°10′	58°25′W.	do	
57	West Livingston Island	62°38′	61°14′E.	do	Extensive deposits.

TABLE 1.—*Mineral occurrences in Antarctica*—Continued

Locality No.	Place name	S. Lat.	Long.	Resource	Remarks
58	South Orkney Island	60°35′	45°30′W.	do	Probably small.
59	Lutzow-Holm Bay	69°38′	38°18′E.	Uranium	Euxenite.
60	Hektoria Glacier	65°03′	61°31′W.	Marble	Outcrop is 100 × 200 m.
61	Aspland Island	61°30′	55°49′W.	Chromium, nickel, cobalt.	
62	Horn Bluff	68°26′	149°46′E.	Tin	Trace amounts only.
63	Clark Peninsula	66°15′	110°33′E.	Manganese (tephroite).	
64	Cockburn Island	64°12′	56°51′W.	Sand and gravel.	
65	"Titov Mountains"	71°58′	10°52′E.	Quartz	Optical quality.
66	"Mount Nikolaev"	71°58′	12°23′E.	Iron	
67	Bunger Hills	66°17′	100°47′E.	do	
68	Forrestal Range	83°00′	49°30′W.	do	
69	Mount Rucker	73°38′	64°45′E.	do	40–50 percent FeO_3.

thick. At locality 6b, gneiss layers 2–7 m (6–20 ft) thick and 100 m (300 ft) or more long contain 2–3 percent flaky graphite (Ravich and Solov'ev, 1969, p. 280).

Phosphate rock has been found in the Pensacola Mountains (loc. 12). Sandstones of middle Paleozoic age contain a few irregular layers and pods of phosphate rock as much as 1 m (3 ft) thick (Heiser Sandstone) and scattered phosphate pebbles (basal Dover Sandstone). The phosphate is of no projected economic importance, but it is of scientific interest because it is the only known phosphate occurrence in very high latitudes (J. B. Cathcart and D. L. Schmidt, oral commun., 1973).

Coarse pure-white marble has been described from the Hektoria Glacier area in Graham Land (loc. 60) by Fleet (1965). The area of outcrop is 100 by 200 m (100 by 200 yds). Marble has also been found in the Transantarctic Mountains (fig. 2).

IRON

Potentially mineable concentrations of iron are known mostly in Precambrian rocks in East Antarctica and have been described in Soviet literature (Ravich and others, 1969, p. 451–452).

In Queen Maud Land, iron occurs in garnet-magnetite veins at localities 3 and 4 ("Mount Hedden" and Mount Humboldt). At locality 3, the veins are 0.5–5 m (2–15 ft) thick; magnetite concentrations have not been stated. At Mount Humboldt, pods of iron ore containing 25 percent or more magnetite occur in bodies greater than 100 m (300 ft) thick. At locality 5 (Gburek Peaks), titanomagnetite occurs mixed with biotite in pods as much as 3 by 15 m (9 by 50 ft) and in monomineralic veins 10–30 cm (4–10 in.) thick. At locality 66, "Mount Nikolaev," glacial moraines contain considerable fragments of magnetite weighing as much as 5 kg (10 lbs). Soviet geologists consider the prospects of finding a major iron deposit in Queen Maud Land fairly good.

Elsewhere in East Antarctica, iron deposits are exposed in outcrops on the coast of Enderby Land (locations not specified) and in the Bunger Hills (loc. 67). Fragments of jaspilite (banded iron ore) occur along the coast from long 78° to 93° E. as morainal boulders as large as 2 m (6 ft); this indicates considerable amounts of iron ore beneath the ice inland from the coast. Jaspilite has also been reported (Solov'ev, 1972; Grew, E. S., oral commun., 1974) at Mount Rucker (loc. 69).

In the Forrestal Range (loc. 68), the upper part of the Dufek intrusion contains a stratiform gabbro of Jurassic age (see subsequent discussion of the Dufek intrusion). Several extensive layers of magnetite-rich rock (70–80 percent magnetite) have been reported by A. B. Ford (oral commun. 1973).

COPPER

Most copper deposits in Antarctica have been found in the Antarctic Peninsula and on islands off the coast of the peninsula. The deposits are mostly in diorite to quartz monzonitic plutonic rocks of mid-Cretaceous to early Tertiary (Andean) age. The deposits are similar to Chilean porphyry copper deposits, except that secondary enrichment is not known. None of the Antarctic deposits is known to be large. Small shows of copper, conspicuous because of the bright-green malachite and chrysocolla stains caused by weathering of sulfides, occur in many places throughout the continent.

In the central Lassiter Coast (loc. 13), low-grade copper mineralization occurs near hydrothermally altered shear zones that cut mid-Cretaceous granodiorite and adamellite. Small (a few centimetres) concentrations of massive copper sulfides occur in nonsheared rocks. Geochemical studies by the U.S. Geological Survey (Rowley, P. D., written commun., 1973) show anomalous amounts of Cu, Mo, Pb, Ag, Ni, Bi, and Co.

In other parts of the Antarctic Peninsula, Hooper (1962, p. 32) described a conspicuous green malachite stain on Green Spur, Copper Peak, Avers Island (loc. 14). The bedrock is diorite and tonalite cut by aplite dikes, which probably contain small amounts of copper sulfide weathered to malachite. Two veins (Mueller, 1963) 1–2.5 m (3–7 ft) wide occur at Greenwich Island (loc. 15) and contain 0.8 percent chalcopyrite. Small amounts of chalcopyrite from the Eielsen Peninsula (loc. 18) have been reported by Knowles (1945) in plutonic rocks of probable Andean age. Reports of several other minor occurrences of copper minerals in the peninsula have been made by P. D. Rowley and others (unpub. data).

In the northern Pensacola Mountains (loc. 11), traces of copper sulfide and green copper efflorescence occur sporadically in the outcrops of the Dufek stratiform intrusion (see discussion of Dufek intrusion).

GOLD AND SILVER

Gold and silver have been reported in trace quantities in pyrite-rich specimens of igneous and metamorphic rocks from three areas in the Antarctic Peninsula, localities 16, 17, and 18 (Knowles, 1945). Amounts of gold range from 0.3 to 2 ppm; of silver, 1 to 10 ppm. Traces of gold and silver have also been reported from sulfide-bearing quartz veins on the Adelie Coast, locality 9 (Ravich and others, 1968, p. 453). Traces of gold have also been found in rocks in Victoria Land.

Such occurrences of gold and silver are not significant for future prospecting. Most samples of pyrite and other sulfides from Antarctica or elsewhere would probably contain both elements in concentrations on the order of those reported above.

MOLYBDENUM

Small amounts of molybdenite have been reported from Precambrian crystalline rocks at localities 7, 8, 9, and 10 in East Antarctica (Ravich and others, 1968). Molybdenite is also present in West Antarctica at locality 19, Stonington Island (Knowles, 1945) and locality 13, central Lassiter coast. None of these occurrences points to large concentrations of molybdenum.

OTHER METALS

Manganese has been described from the Marguerite Bay area, Antarctic Peninsula, locality 19 (Knowles, 1945), and Wilkes Land, locality 63 (Stewart, 1964).

Tin is known only as detrital grains of cassiterite occurring in the heavy-mineral fraction of Paleozoic sandstones (Stewart, 1964).

Chromium, nickel, cobalt, and platinum occur in trace amounts in the Dufek intrusion, Pensacola Mountains (loc. 11), and are described later. They also occur in a mafic igneous rock (loc. 61) on Aspland Island, South Shetland Islands(Kosack, 1955).

Reports of uranium occurrences are, surprisingly, nearly absent in the literature. Euxenite was found as an accessory mineral in Precambrian pegmatite in the Lutzow-Holm Bay area (Saito and Sato, 1964, loc. 59). French geologists have reported anomalous amounts of radioactivity in Adelie Land.

POTENTIAL RESOURCES

MANGANESE NODULES

All the ocean area south of lat 60° S. and outside the Continental Shelf of Antarctica is floored by oceanic crust. The only presently known mineral-resource potential for this area

is manganese nodules. Extensive areas of the sea floor even at these latitudes have a covering of scattered manganese nodules, nodule pavement, or concretionary masses. Specific areas have been mapped by Goodell, Meylan, and Grant (1971). Manganese nodules are of interest because of their high content of copper, nickel, and cobalt rather than their manganese content. The amounts of these accessory elements included with the manganese are strongly dependent on the latitude (Horn and others, 1972). Nodules that accumulate near the equator are metal rich, whereas those that accumulate farther from the equator are leaner in metals. For this reason, the manganese nodules of the Antarctic environment represent the least desirable segment of the nodule resources of the oceans. This is not to say, however, that they could not be considered for mining at some future date.

Figure 3 is a computer plot of manganese nodule locations in the oceans south of lat 60° S.; table 2 lists coordinates of nodule locations. This figure serves only to show that manganese nodules do occur in extreme southern waters, for portrayed nodule distribution is most probably a function of where the research ship *Eltanin* dredged. No metals-content information is available.

GEOTHERMAL ENERGY

Most potential geothermal resource areas are related to active or recently active (Pleistocene to Holocene) centers of volcanic eruption. In Antarctica, these centers are along much of the Pacific margin of the continent—along the western border of the Ross Sea, in Marie Byrd Land, and in the South Shetland Islands off the northwest coast of the Antarctic Peninsula (fig. 2).

In addition to recency of eruption, there are two other indications of the geothermal potential of a volcanic area:

1. Composition of the magma. Silica-rich magmas that erupt to form rhyolites and dacites are derived from magma chambers high in the Earth's crust, and the heat source is relatively accessible to ground water; silica-poor magmas such as basalt are usually derived from an inaccessible heat source deep in the crust.

TABLE 2.—*Marine manganese nodule occurrences of lat 60° S.*

[From dredge and trawl samples. Ship: *Eltanin*. Source: unpub. data from the Smithsonian Institution Oceanographic Sorting Center]

Cruise	Station	Lat.	Long.	Depth (m)	Remarks (percent of nodules in total sample)
5	9	61°13′	67°50.5′W.	3863	30
5	9	61°15.5′	67°41.5′W.	3711	1–5
5	10	62°17.5′	67°51′W.	3822	20
6	28	62°52.3′	59°27.2′W.	1081	Trace
10	15	64°05.1′	75°23′W.	1828	20
10	17	62°00.2′	75°10.3′W.	4389	90
10	18	62°02.7′	75°03.8′W.	4471	100
10	19	60°05.6′	75°17.3′W.	4590	20
11	7	60°54′	114°47′W.	5033	100
12	12	60°15.5′	36°19.2′W.	1581	Trace
12	19	60°33.6′	36°59.2′W.	1161	1–5
13	20	65°37.0′	123°55.4′W.	4706	40
13	22	64°15′	130°13′W.	4813	100
13	23	63°36.5′	129°53.8′W.	4819	90
14	11	62°26.3′	160°07.2′W.	2926	60
14	12	62°45.5′	159°50.2′W.	2853	1–5
15	1	61°02′	95°02′W.	4993	40
15	7	61°02′	95°57′W.	4947	50
15	8	61°07′	104°58′W.	4826	90
17	9	64°03′	135°00′W.	4773	80
17	10	65°04′	134°53′W.	4362	10
17	13	67°59′	135°36′W.	4416	90
17	29	62°12′	94°46′W.	4898	100
20	13	60°20′	137°50′W.	4278	20
21	20	61°15.5′	120°25.5′W.	4981	60
23	3	61°27′	94°58′W.	4800	60
23	7	61°19′	101°32′W.	4862	80
23	17	60°24′	115°01′W.	5040	90
25	24	63°03′	128°12′W.	4682	30
33	12	69°29.2′	130°36.7′W.	3802	30
38	8	61°50.5′	149°53′E.	3000	20

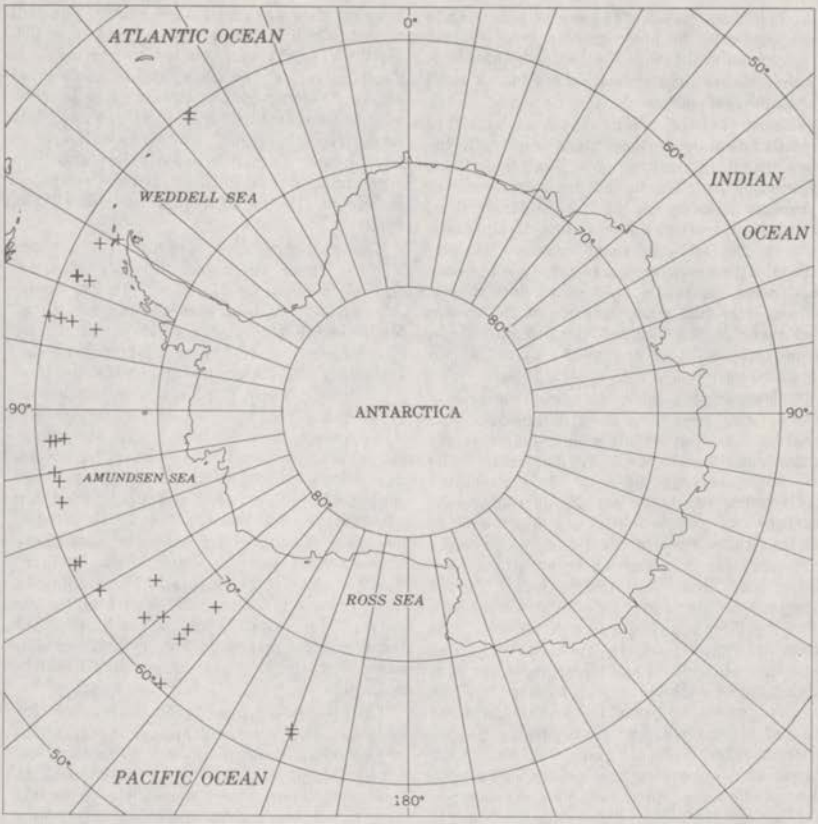


FIGURE 3.—Computer plot of manganese nodule occurrences in the oceans south of lat 60°S., based on dredge and trawl samples from *Eltanin* cruises. Source: unpublished data from the Smithsonian Institution Oceanographic Sorting Center.

2. Volume of rock. Large volcanic piles usually indicate the presence of a large magma chamber beneath the surface; these constitute a greater heat source than a small magma chamber.

Young volcanic rocks in Antarctica are mostly basalt, trachybasalt, and trachyte in the western Ross Sea region (Hamilton, 1972; Treves, 1970), basalt and felsite (the latter probably rhyolite and dacite) in Marie Byrd Land (LeMasurier, 1972), and basalt and andesite in the South Shetland Islands (Hawkes, 1961). These rock types are mostly silica poor and hence indicate a deep-seated heat source. The felsites that make up some of the stratovolcanoes of Marie Byrd Land form only a small proportion of the total volume of volcanic rocks.

The great preponderance of silica-poor volcanic rocks, indicating deep inaccessible heat sources, suggests a rather low potential for geothermal development in Antarctica. The best prospects are in areas where fumarolic activity has been observed during the present century (fig. 2) and indicates a heat source at or near the surface of the Earth. Second-rank prospects are in areas where eruptions have taken place in the last million years (fig. 2) and indicate the possibility of future eruptions. The 1-million-year figure is arbitrary; conceivably, volcanic activity could take place at any time along the Pacific margin of the continent but is much more likely to occur in areas of most recent eruption. In none of the areas judged favorable, described below, is the geothermal potential considered great. Future exploration for geothermal resources should concentrate on those young volcanic areas showing the highest degree of differentiation (Smith, R. L., oral commun., 1973).

In the Ross Sea region, large piles of young volcanic flows and palagonite breccias occur along the coast of southern and northern Victoria Land and make up several offshore islands. Fumarole activity at the summit of Mount Erebus on Ross Island was first reported in the 1840's and has probably been continuous since then. At present, the floor of the summit crater contains a pool of molten lava (A. B. Ford, oral commun., 1973). A drilling project on Ross Island was carried out during the past (1972–73) austral summer, but the geothermal gradient that was found is not known. The drill hole was still in permafrost at a depth of 200 m (660 ft), however, so a low geothermal gradient is likely. Conceivably, a small geothermal plant, if technically and economically feasible, might serve McMurdo Station (U.S.) and Scott Base (New Zealand), both of which are on Ross Island. Fumarole activity has also been reported at Mount Morning, 140 km southwest of Mount Erebus (LeMasurier and Wade, 1968).

The Hallett volcanic province of northern Victoria Land (near loc. 38) has been described in detail by Hamilton (1972). Fumarole activity has been observed only at Mount Melbourne, but very young (Holocene) cinder cones scarcely modified by glacial erosion attest to recency of activity throughout the province.

Studies in Marie Byrd Land by LeMasurier (1972) show that several volcanic piles contain lavas younger than 1 million years; the youngest rocks form small basalt cones. Ice towers caused by fumarole activity are present on the summits of Mount Berlin and Mount Hampton (Le Masurier and Wade, 1968). Lavas dated at less than 1 million years by the potassium-argon method occur at Mount Murphy, Mount Takahe, and Toney Mountain. Mount Siple, a huge volcano more than 3,000 m high on the coast of Marie Byrd Land, has not been visited because of its inaccessibility, but indirect evidence suggests that it is younger than 1 million years old.

The geologically most favorable prospect for development of geothermal power in Antarctica is Deception Island in the South Shetland Islands. Deception Island is a Pleistocene to Holocene caldera where fumarole activity has been known since 1831 (Hawkes, 1961). Two violent eruptions of basalt ejecta occurred in 1967 and 1969 and resulted in the destruction of scientific bases maintained there by Chile and Great Britain. In the 1967 event, three cinder and ash cones erupted within the caldera and coalesced to form a small island (Baker and others, 1969). The British Antarctic Survey has decided to abandon the island as a base site.

Small basaltic ash cones and scoria of Holocene age occur on King George Island in the South Shetland Islands, but fumarole activity has not been reported (Barton, 1965).

WATER (AS ICE)

The Antarctic ice cap may contain as much as 90 percent of the world's store of fresh water, an abundance for local use where energy is available to convert the ice to water. This supply is augmented by occasional ephemeral melt-water ponds. Most of Antarctica's annual precipitation goes to sea in the form of icebergs and melting glaciers.

Of direct importance to water-starved parts of the world is the possibility that some of this ice—in the form of seagoing bergs—could be transported somehow to more northern latitudes and converted to potable water (Potter, 1969). The volume of ice that breaks off into the oceans at the edge of the Antarctic Continent has been estimated (Loewe, 1967) to be about 1.4 trillion metric tons per year (1.5 trillion short tons), of which 45 billion metric tons (50 billion short tons) is produced at the edges of ice sheets, 450 billion metric tons (500 billion short tons) is from glaciers and ice streams, and 820 billion metric tons (900 billion short tons) is from ice shelves.

At present, this water seems to be a likely resource only for local use. Icebreakers require great expenditures of energy to move icebergs. Perhaps the natural ocean currents would be a possible future method of transporting the ice.

COAL

Coal deposits are known at many places around the perimeter of East Antarctica; the better known areas are shown on figure 2. Most of the coal symbols on the map indicate a measured section, commonly containing a considerable thickness of coal; other symbols indicate only an occurrence of coal or coaly shale. The stipple covers generalized areas where Permian (and in a few instances Triassic) coal-bearing formations occur in the mostly flat-lying Beacon rocks. Available information, although by no means conclusive, suggests that the coal measures extend from coast to coast under most of the great central ice mass.

Nearly all coal deposits seem to be of Permian age, and all seem to have formed in shallow swamps on rapidly aggrading broad sandy flood plains. Consequently, the coal is scattered vertically through a Permian sandstone sequence that is usually more than 500 m (1,600 ft) thick. Although individual coalbeds as much as 5 m (16 ft) thick have been reported, the coalbeds usually range in thickness from a trace to a maximum of 3 or 4 m (10 or 13 ft). Individual coalbeds tend to be lenticular and to have very limited horizontal extent. Coalbeds more than 2 km (1 mile) in horizontal extent appear to be uncommon. Most of the reported beds extend horizontally less than 1 km (0.5 mile). The coalbeds apparently range in rank from low-volatile bituminous to semianthracite. Rank determinations, however, may be uncertain because very few samples have been taken from unweathered coal. The supposed advanced rank probably precludes use of the semianthracite coal for coking or for coal gasification with the currently used techniques. The ash content commonly ranges from 8 to 20 percent. The presently known Antarctic coals will probably not be a valuable export commodity in the near future, but they could perhaps be used locally for heating and power production.

OIL AND NATURAL GAS

Sufficient information on which to base an estimate of the petroleum potential of Antarctica is not available. However, knowledge of the geologic histories of the continents and islands of the Southern Hemisphere and the results of exploration for oil and natural gas on continents other than Antarctica can offer some insight for speculation about the oil and natural gas resources that might be there.

Oil and gas are found, almost exclusively, in regionally unmetamorphosed sedimentary rocks that have been deposited in marine or near-marine environments. Wherever thick sections of such rocks are found, they may well contain at least some accumulation of oil and gas.

The onshore part of Antarctica, for all practical purposes, can be eliminated from a discussion of petroleum resources, although large basins have been inferred by geophysical soundings (for example, Wilkes basin and Polar basin). The land is covered by a very thick cap of ice that is in large part moving, and the sedimentary rocks that do stick out through the ice are largely metamorphosed, highly fractured, and intruded by igneous rocks. These conditions are not conducive to the preservation of oil and gas.

Parts of the Antarctic Continental Shelf, however, are free of ice during part of the year. If extrapolations of geology from neighboring

continents and their shelves are valid, the Continental Shelf of Antarctica may be expected to contain thick unmetamorphosed sedimentary rocks. This assumption is partly confirmed for some areas, particularly the Ross Sea region, by marine geological and geophysical work from research vessels. The USNS *Eltanin* spent 10½ years in the southern oceans, much of this time on or adjacent to the Antarctic Continental Shelf (Watkins, 1973, p. 71). Scientists on board carried out a systematic program of continuous surveys of bathymetry, sediment thickness, and magnetic and gravity fields, plus bottom sampling by piston cores and dredge hauls (Capurro, 1973, p. 58; Hayes, 1973; Simmons and Landrum, 1973; Watkins, 1973), and subsequent analysis and interpretation of the data (Bandy, 1973; Cassidy and DeVore, 1973; Hayes, 1972). In addition, deep rotary-drill holes were put down and cores were recovered from the Antarctic Continental Shelf by the drilling vessel *Glomar Challenger* in 1972 (Hayes and others, 1973).

Evidence strongly suggests that the geologic history of Antarctica is linked to that of the other continents and islands of the Southern Hemisphere and India and that these land areas were once joined to Antarctica on three of its sides except for a gap on its east side between about what is now long 80°–115° E. and its west side between about what is now long 60°–150° W. The former landmass has been called Gondwana or Gondwanaland. Some time during the middle of the Mesozoic Era, the present continents and islands began to drift away from Antarctica by the mechanism of ocean-floor spreading (Craddock and others, 1969–70). At the places where they were once joined, each of the new continents has since developed continental shelves, on which thick sections of Cretaceous and Tertiary sedimentary rocks were deposited. On some continents, sediments of these ages also accumulated in basins on the parts of the continents that later became land.

Petroleum test drilling and seismic surveys have been carried out in recent years on almost all the land and continental shelves of those areas that once touched on Antarctica. As a result, several oil and gas fields have been discovered onshore in southern South America and offshore of southeastern Australia, and strong showings of gas have been found onshore in Mozambique and offshore of South Africa, all in strata of Cretaceous and Tertiary age. The thickness of the Cretaceous and Tertiary rocks on the shelves of those continents has been determined as approximately 3–5 km (about 10,000–15,000 ft). The results of drilling so far, however, indicate that most of those shelves will not be prolific producers of oil and gas, except for the area off the southeast corner of Australia called the Gippsland Basin. Gippsland Basin contains proved reserves of 345 million metric tons (2.5 billion barrels) of petroleum and 220 billion m^3 of gas (7.8 trillion ft^3); this may be because the sediments were deposited in a closed basin during Tertiary time.

Present knowledge indicates an accumulation of sedimentary rocks ranging from Tertiary to Holocene age on the shelves of Bellingshausen Sea, Weddell Sea, and Ross Sea. The Bellingshausen shelf is believed to be geologically similar to the Pacific shelf of Chile, an area that has to date yielded only natural gas. The Weddell Sea shelf is thought to have affinities with the shelves off southern South America and South Africa, where only small oil and gas fields have been discovered to date. The Ross Sea shelf may resemble the Gippsland Basin of Australia, which contains significant amounts of oil and gas.

Antarctica seems to have some petroleum potential, but lack of information precludes any real appraisal. The presence of moving ice, the great depth of water over the Antarctic shelves, and the tremendous logistical problems posed by the area constitute operational obstructions that will greatly reduce the economic viability of potential Antarctic petroleum resources. Many other unexplored areas of the world have equal or better petroleum potential and do not present the formidable problems encountered in the Antarctic.

A thick succession of Cretaceous sandstone crops out at the north end of the Antarctic Peninsula (Bibby, 1966), and a few outcrops of sediments of Tertiary age have also been found there. Cores taken recently of the sediments on the shelf of the Ross Sea contained marine and nonmarine sediments ranging in age from early to late Tertiary and younger. Natural gas was detected in some of the cores.

Recently obtained geophysical data indicate that the sedimentary rocks on the Ross Sea shelf might be as much as 3–4 km thick (10,000–13,000 ft) and that this section is probably made up of Tertiary, and possibly some Cretaceous, strata (Dennis Hayes, oral commun., 1973).

Geophysical data for part of the Weddell Sea shelf, analyzed by J. C. Behrendt (oral commun., 1973), indicate the probable presence of 3–4 km (10,000–13,000 ft) of sedimentary rocks in parts of that area also. By analogy, these sediments could well be equivalent to those on the Ross Sea shelf and the shelves of the neighboring continents.

How prolific of oil and natural gas the sediments of the Ross Sea and Weddell Sea shelves will be depends on the depositional environments and on postdepositional geologic events. Because it has affinities with the Gippsland Basin of Australia, the Ross Sea shelf may contain more oil and gas than the Weddell Sea shelf. The Weddell shelf has affinities with the shelves of southern South America and South Africa, where only small oil and gas fields have been found.

The shelf off Antarctica between what is now about long 80°–110° E. apparently had access to the open sea more often during its history than the rest of the continent. This area may be comparable with the shelf off western Australia where large petroleum and gas fields have been found in relatively undisturbed strata of Permian to Jurassic ages. A similar comparison may be made with the Antarctic shelf between about 60° and 165° W., but orogenic activity has there greatly disrupted and partially metamorphosed Jurassic and older strata. On the shelf of the Bellingshausen Sea, however, relatively undisturbed Jurassic to Holocene strata could well be present; some of the strata might be expected to contain natural gas by analogy with strata of probable Tertiary age on the Pacific shelf of Chile in which natural gas has recently been discovered.

Regardless of their potential, the continental margins of Antarctica are very different in at least one respect from the margins of other continents—they are covered by a much greater depth of water. The seaward edge of the Antarctic Continental Shelf averages at least 500 m (1,650 ft) below sea level (fig. 2) in contrast to the average depth of most of the world's shelves, which is about 200 m (600 ft). The base of the continental slope of Antarctica appears to be at about 3,000 m (9,800 ft) below sea level in contrast to about 2,500 m (8,200 ft) for most of the rest of the world. The continental slope itself is also, apparently, considerably steeper than those of other continents. It has been postulated that these characteristics of the Antarctic Continental Shelf and Slope may be the result of the weight of the ice cap on the continent of Antarctica. The shelf and slope developed normally until the growing ice cap gained enough weight to depress the entire continent (J. V. A. Trumbull, unpub. data, 1958).

ECONOMIC POTENTIAL OF THE DUFEK INTRUSION, PENSACOLA MOUNTAINS

Because of the possibly great economic potential of the Dufek intrusion (loc. 11), it is treated separately.

A great variety of economic mineral deposits are associated with stratiform igneous complexes such as the Bushveld in South Africa, the Stillwater in Montana, and the Sudbury in Ontario. Important deposits include chiefly platinum, nickel, copper, and chromium. In the Bushveld, deposits of lead, zinc, vanadium, iron, cobalt, and even tin and gold have at times also been worked. Nearly all the major deposits are associated with ultramafic rocks in lower parts of the complexes.

One of the world's largest layered complexes was discovered in 1957 when an International Geophysical Year traverse party from Ellsworth Station visited the Dufek Massif. Studies by the U.S. Geological Survey in 1965–66 showed that this complex makes up nearly the entire northern third of the Pensacola Mountains. Reconnaissance geophysical surveys indicate a minimum areal extent of about 34,000 km² (13,000 mi²). The thickness is believed to be on the order of 7 km (4 mi), nearly 4 km (2½ mi) of which is exposed. Most of the body is covered by ice, but all major areas of exposed rock were either visited or viewed aerially at close range in the 1965–66 field season.

Field studies of this complex so far have been of a reconnaissance nature (Ford and Boyd, 1968). Iron is the only metal that has been found to occur in sizable concentrations. The iron occurs in the upper part of the body

as magnetite concentrations (70–80 percent magnetite) as much as several metres thick. The lowest part of the body, including a possible basal ultramafic zone, is not exposed. Sporadic traces of copper sulfides and copper efflorescences occur throughout the body but seem to be more concentrated in the magnetite-rich rocks, especially in the Forrestal Range. Although chromite was reported by the 1957 visitors, its presence was not substantiated by the 1965–66 studies.

Semiquantitative and quantitative analyses of rock samples from the stratiform Dufek intrusion (U.S. Geol. Survey, unpub. data) indicate that trace-metal abundances are similar to those described for other stratiform intrusions throughout the world. Copper amounts are generally between 20 and 110 ppm and are rarely as high as 2,000 ppm. Chromium and nickel amounts are mostly less than 100 ppm and are rarely as high as about 500 and 200 ppm, respectively. The platinum-group metals are below detection limits in most rocks but reach maximum amounts of 0.03 to 0.05 ppm in rocks having abundant magnetite. The magnetite-rich rocks also show maximum vanadium amounts of about 2,000 ppm. Diamond drilling could aid in determining whether or not higher amounts of these metals exist in unexposed rocks. Although no significant concentrations of metals are now known in this complex, its petrologic similarity to other metal-producing complexes warrants its consideration as having a resource potential greater than many Antarctic mountain areas. Available data, however, are inadequate for an accurate appraisal of this potential.

The Dufek intrusion is dated radiometrically as Middle Jurassic, and thus it is probably related to the Ferrar Dolerite intrusions that are widespread in the Transantarctic Mountains. Another layered complex of the Dufek type has been reported by New Zealand field parties in the Warren Range (78° 28′ S., 158° 14′ E.) in southern Victoria Land, but little published information on this body is available. Others may exist.

MINERAL RESOURCE ESTIMATION

Substantial resources of minerals are almost certainly present in Antarctica because no other continental areas of similar size are devoid of them. These resources are probably localized in restricted areas. Long human experience in the inhabited regions of the world testifies to the sporadic occurrence of ores and the difficulty in finding them even in relatively well exposed areas where, in fact, the ores are largely hidden by soil, postmineral "cover rocks," or other impediments to exploration. The ice cover of Antarctica adds yet another dimension to the problems of finding ore deposits there. Furthermore, many of the rich ore deposits in the world are the result of supergene enrichment related to Tertiary, Quaternary, and Holocene erosion. Under the very severe glaciation which prevails in Antarctica, such near-surface deposits probably have been removed, or perhaps would never have formed.

Comparison of the geologic provinces of Antarctica with those of other Gondwana continents, the mineral resources of which are known, forms the basis of the speculation that follows. Crawford (1970) is one of several who have used this technique on a smaller scale, but he did not include Antarctica in his study. Using the Gondwanaland reconstruction seems to be the most plausible method of arriving at a basis for speculation. It seems reasonable to assume that Antarctica may contain mineral deposits that formed at the same time and under similar conditions as the known deposits of Antarctica's Gondwana neighbors. Figure 4 shows the reconstruction of Gondwanaland made by Craddock (Craddock and others, 1969–70, pl. 23), which is essentially the reconstruction first proposed by DuToit (1937). Our map shows in a very generalized way the major geologic units and the more important economic minerals they contain.

GEOLOGIC PROVINCES OF ANTARCTICA AND PRESUMED RELATIONSHIPS TO GEOLOGIC PROVINCES OF NEIGHBORING GONDWANA CONTINENTS

The East Antarctic shield, the oldest and most stable region of Antarctica, consists principally of Precambrian rocks, overlain in part by essentially undeformed sediments (Beacon rocks and equivalents) of Paleozoic and early Mesozoic ages. Before the breakup of Gondwana, the western two-thirds of Australia, India, and part of southern Africa were close to this part of Antarctica, at least during the later Paleozoic and early Mesozoic Eras, as witnessed by the paleontologic record. South

America, though not contiguous with Antarctica, was close to Africa (fig. 4).

The Precambrian record in other Gondwana continents encompasses 2½ billion to 3 billion years, roughly five times the later geological history. There is no assurance that the present continental fragments of Gondwanaland maintained the relative positions shown on figure 4 for all or much of this period; therefore, no actual improvement in the odds on locating ore occurrences can be gained by direct comparisons of parts of the Antarctic Precambrian shield with shield areas of other continents in an effort to deduce any such pre-Gondwana drift. Geologic mapping reveals that other continents are made up of more or less oval (or equidimensional) cores (nuclei) of very ancient rocks, largely gneiss or granite, but including belts of greenstone and primitive sedimentary rocks, which are surrounded by belts of metamorphosed sedimentary and volcanic rocks intruded by igneous rocks (fig. 4). Gold and gold-copper veins; nickel and minor copper; iron; small deposits of lithium, beryllium, columbium, tantalum, and rare-earth elements; chromite; asbestos; and tin and (or) tungsten are the more common mineral commodities found in these nuclei. Such nuclei, as mapped on other continents, reach a maximum of 1,000 km or more in maximum dimensions. The Antarctic shield certainly is large enough to include several nuclei.

Other valuable ore deposits of the other Gondwana continents are contained in the younger Precambrian (roughly 2,200 million years or younger) sedimentary and volcanic rocks and in intrusive rocks cutting them (fig. 4). Many of these younger Precambrian deposits are stratiform and have considerably greater dimensions than the older ones; they therefore present larger and better exploration targets than those in the older Precambrian rocks. Among the known deposits that can be mentioned are: the extensive iron-formations (known variously as itabirite, banded quartz-hematite, and jaspilite) containing high-grade ore bodies and found in Australia, India, Africa, and South America; bedded manganese deposits that may or may not be associated with iron; conglomerate gold-uranium ores such as those best developed in South Africa (Witwatersrand); chromite, nickel-copper-platinum, and titaniferous magnetite-vanadium ores of the Bushveld mafic-ultramafic complex in South Africa; copper-cobalt ores of Zambia-Zaïre; and lead-zinc-copper-silver-gold ores of Australia (Mount Isa and Broken Hill). These younger Precambrian rocks, deposited unconformably on the eroded older basement, are in places themselves severely deformed, metamorphosed, and intruded and thus are very difficult to decipher. Elsewhere, however, they are slightly folded, and any extensive deposits they contain can be easily followed once they are discovered.

Most mineralization ceased in the shield areas of Gondwanaland by the end of the Precambrian; presumably this was also the case in East Antarctica. Very extensive erosion was followed by deposition of thick sediments, mostly of continental type, and of volcanic rocks of plateau basalt and allied types; such volcanic rocks are not generally accompanied by metallic ores, however. Extensive coal deposits are associated with these sedimentary rocks in Africa, India, and Antarctica. Some mineralization, however, is post-Precambrian and may even be related in a general way to the breakup of the ancient supercontinent. Many of the diamond-bearing kimberlite pipes of Africa are Cretaceous; they cut both the crystalline rocks and the sedimentary cover, and hence, they may be present below the ice in Antarctica even where the Beacon rocks overlie the Precambrian. Individual pipes, however, have cross sections measured only in tens or hundreds of metres, and only a small percentage of the pipes contain diamonds in economic quantities. The odds against finding one by blind drilling are astronomical. The early sources of South African diamonds were concentrations in alluvium (placers), and these placers still constitute the overwhelming sources elsewhere (especially southwest Africa, Angola, and Zaïre). In Antarctica, search for alluvial stones on beaches or in shallow shelf sediments might be successful. At Insizwa, South Africa, a layered gabbro that intrudes the Paleozoic-Mesozoic cover rocks contains low-grade nickel-copper ore near its base. Its similarity to the Dufek intrusive and its presence in a nonorogenic environment suggest that intrusions of this type could occur anywhere in the East Antarctic shield.

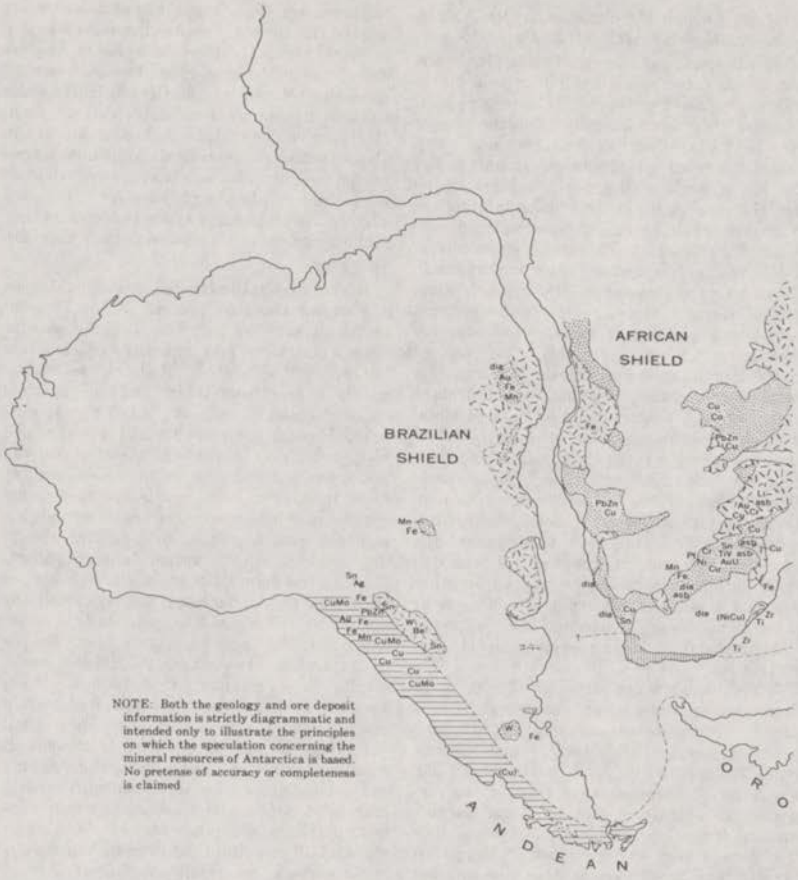
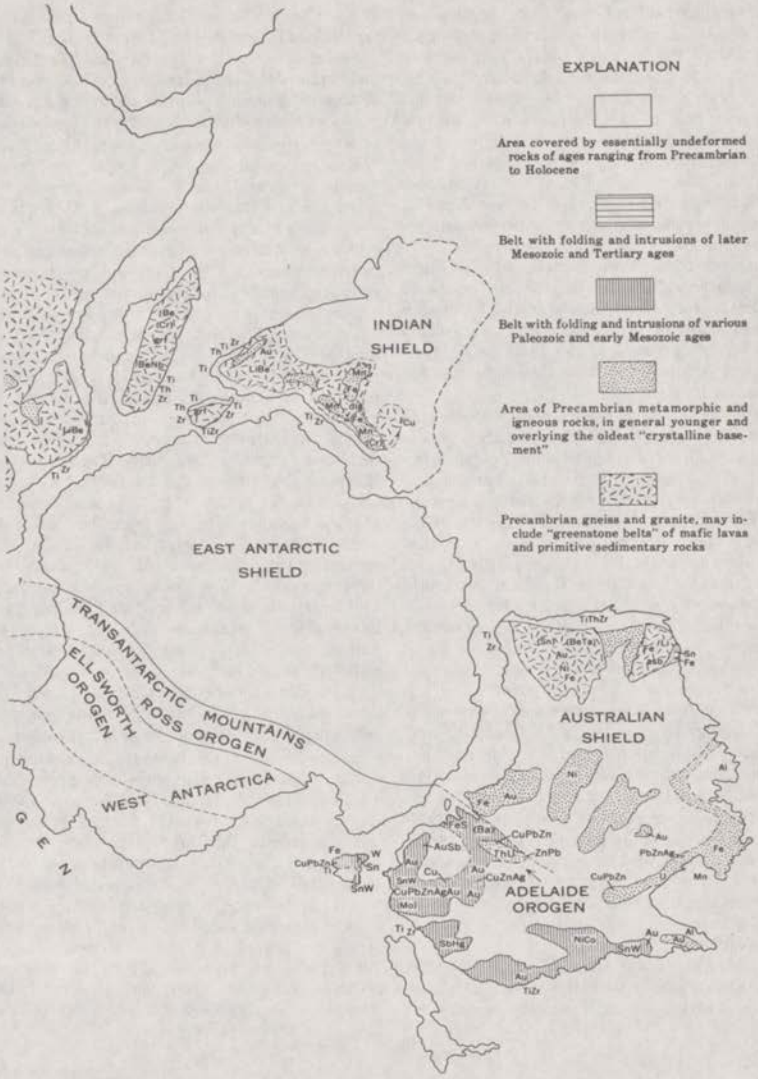


FIGURE 4.—Schematic representation of major features of the geology and ore deposits of Gondwanaland. parentheses indicate deposits of lesser importance.



Base modified from Craddock (*in* Craddock and others, 1969–70, pl. 23). Known deposits are labeled; Asb, asbestos; dia, diamond; grf, graphite.

Alluvial concentrations of titanium, thorium, and zirconium minerals are exceedingly common on all the margins of the continent of Gondwanaland that face East Antarctica (fig. 4). If once present, they have apparently not been preserved in exposed parts of Antarctica, no doubt because the movement of the ice cap or other erosional processes have removed them. Study of the shelf sediments in Antarctica might help to find remains of former deposits, and some accumulations may be present in protected spots under the ice.

Long-continued deep weathering has produced surficial bauxite deposits in parts of Gondwanaland. Conditions for its formation were probably favorable over much of geologic time, but preservation of the near-surface nonresistant ore bodies under the Antarctic ice cap seems doubtful.

Geologically, the Transantarctic Mountains of the Ross orogen combine features of the shield with those of younger belts. Precambrian rocks, affected by one or more metamorphic and intrusive events, and lower Paleozoic sedimentary and volcanic rocks were deformed and intruded by large granitic bodies during the Paleozoic Ross orogeny. The general picture is one of progressive addition to the East Antarctic shield toward West Antarctica, followed by extensive planation and deposition of continental sediments in middle and late Paleozoic time. Because the area is one of very considerable relief (as opposed to the rather uniform high ice cap over most of East Antarctica), exposures are fairly good (Craddock, *in* Craddock and others, 1969–70, pl. 20), and it is perhaps surprising that more evidence of mineralization has not been noted during their mapping.

In the reconstruction of Gondwanaland, the Ross orogen has no direct equivalent in Africa (fig. 4). Radioactive dating suggests a metamorphic event in eastern Africa roughly contemporaneous with the Ross orogeny, but no ore deposits have been found that can be attributed to this orogeny.

In the Australian Adelaide orogen, which Craddock correlates with the Ross, fairly numerous, though generally small, deposits of copper, lead, zinc, gold, barium, and manganese are known in late Precambrian and early Paleozoic sediments and volcanic rocks. In addition, important deposits of lead, zinc, silver, copper, antimony, and gold occur in older Precambrian rocks exposed within this orogen (fig. 4).

A progressive eastward younging of sedimentation, volcanism, deformation, and intrusion in eastern Australia continued through the Paleozoic and into early Mesozoic. Deposits of copper, lead, and zinc seem to correlate with periods of andesitic to rhyolitic submarine volcanism, whereas tin, tungsten, molybdenum, bismuth, gold, and other metals are probably related to somewhat later granitic intrusions in any one area. The belt, formerly called the Tasman geosyncline, is now referred to by Australian geologists as the East Australian orogenic province. Craddock distinguished a Borchgrevink orogen in Victoria Land, Antarctica, and equated it with the "Tasman"; it may be preferable to consider the entire Transantarctic Mountains province as constituting a Paleozoic-early Mesozoic orogen that in general becomes younger and dies out away from the East Antarctic shield. Mineralization generally decreases in intensity eastward in Australia and is very weak in New Zealand; the same may well be true in West Antarctica. This interpretation permits equating the Cape orogen of southernmost Africa with the outermost limit of the Paleozoic-early Mesozoic orogen of Antarctica. The Cape orogen strongly folded the latest Paleozoic rocks but did not produce any metamorphism, intrusion, or mineralization.

In summary, mineral deposits, probably of moderate size and grade, should be present in the Transantarctic Mountains. The most probable environments are: (1) layered mafic intrusions such as the Dufek; (2) sequences of marine sediments that incorporate substantial proportions of intermediate to silicic volcanic materials; (3) hypabyssal (porphyritic) intrusions of intermediate to silicic composition; and (4) contact zones of granitic intrusions, especially those near or adjacent to carbonate sequences. The area of northern Victoria Land (Craddock, *in* Craddock and others, 1969–70,

pl. 20) seems to combine the last three conditions.

The Ellsworth orogen,[1] the area of West Antarctica between the Ross Sea and Weddell Sea, is largely ice covered, and the bedrock is largely below sea level. Where exposed, the rocks are Paleozoic sedimentary rocks and Mesozoic intrusions devoid of known metallic mineralization. The area has been interpreted by Craddock as constituting a Mesozoic orogen that is partly athwart the neighboring older and younger zones; it is shown somewhat differently in figure 4 from Craddock's compilation (Craddock and others, 1970, pl. 23) to accord with the general principle of transition.

The probability that significant mineral deposits are present in this zone seems to be poor. Thick sequences of clastic rocks like those exposed in the Ellsworth Mountains ordinarily do not host metallic ores, although the presence of Mesozoic intrusive rocks in the Whitmore Mountains suggests somewhat more favorable conditions there.

The general situation in this part of Antarctica is reminiscent of that in South America, which has relatively few ore deposits in the area between the shield and the Andes and particularly few in the Paleozoic-early Mesozoic stratigraphic section.

The Antarctic Peninsula and the adjacent islands, the Antarctic Andean zone, are clearly the continuation of the Andean zone of South America (fig. 4) and, together with Ellsworth Land and Marie Byrd Land, form the southern margin of the circum-Pacific belt that has been geologically active to the present time. This activity contrasts with East Antarctica and the Transantarctic Mountains, which have been inactive—except for vertical movements with or without block faulting—since Precambrian and early Mesozoic time, respectively. As the Andes and other segments of the zone contain many and, in places, large ore deposits, this is probably the most favorable area of Antarctica for exploration. There are, however, gaps in the circum-Pacific belt in which little or no important mineralization is known, and it is not possible on the basis of present information to be sure whether this region constitutes an ore-rich segment or not.

Some factors that may bear on exploration are:

1. Most of the Chilean ores occur in association with late Mesozoic and early Tertiary intrusions into Mesozoic and (or) early Tertiary volcanic and sedimentary rocks. Similar rocks are present in the Antarctic Andean zone.
2. Ores tend to be localized at or near the tops (cupolas) of intrusive masses; hence, areas in which the igneous rocks have relatively small outcrop areas surrounded by or in contact with other rock types (that is, where erosion has not been deep) are more favorable than those with great extents of intrusive material. This situation seems to be present in the Antarctic Andean zone, especially in the mountainous areas of the Lassiter Coast (east coast of Weddell Sea from 73° to 75° S.) and eastern Ellsworth Land north and northwest of the Ronne Ice Shelf. The same situation contrasts strongly with that in the nearest segment of the western South American coast, where a batholith virtually devoid of any known mineralization stretches some 2,000 km (1,200 mi) between Cape Horn and central Chile.
3. The Antarctic Andean volcanic and intrusive rocks belong to the calc-alkaline magmatic suite with which most of the copper-lead-zinc and similar ores of the world are associated.
4. The paucity of reported mineral occurrences in the Antarctic Peninsula appears to be an unfavorable factor. Long before systematic prospecting or exploration for ores takes place, there must be more evidence of mineral-rich areas, such as placer accumulations of gold, detrital ore boulders, areas of rock alteration (which often accompanies mineralization), deep staining of the rocks, or silicification. Oc-

[1] The terms "Weddell orogeny" (Ford, 1972) and "Gondwanian orogeny" (Dalziel and Elliott, 1973) are closely synonymous with "Ellsworth orogeny."

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currences of a few metals have been noted (fig. 2; P. D. Rowley and others, unpub. data, 1974), but the Antarctic Andean zone is probably not as rich, for example, as that in central and northern Chile and Peru.

The foregoing discussion concerns the "typical" Andean mineralization of Cretaceous and Tertiary ages. As with other areas of the circum-Pacific belt, Precambrian and Paleozoic rocks are present also. In some southern continents, these rocks contain sporadic but occasionally large and rich ore bodies; such deposits may occur in the Antarctic Andean zone as well.

STATISTICAL SPECULATION

The mineral-resource potential of Antarctica can only be evaluated by comparison with other regions of the Earth's crust where the resource potential is at least partially known. The procedure used in this study to estimate the frequency of mineral-deposit occurrences is therefore based on the following assumption: The geologic and physical chemical processes that caused the formation of mineral deposits in the better known parts of Gondwanaland (Australia, India, Madagascar, Africa, and South America) caused the formation of an equivalent density of deposits in Antarctica, the least known part of Gondwanaland.

The paucity of geologic data, the fact that ice covers most of Antarctica, and the limitations on time for this compilation permit a geologic analysis on only the broadest scale. No attempt has been made, for example, to take into account the apparent change in age and frequency of deposits along the Andean orogenic belt. Accuracy of the evaluation varies for any given area because: (1) The data available from metallogenic maps vary highly in quantity and extent; (2) available maps portray only known deposits or large mineral occurrences, and therefore the data are highly skewed in favor of economically viable mineral occurrences; (3) the status of exploration and development differs greatly in the various nations and political units, and the areas of greatest exploration have the greatest impact on the analysis; (4) the date of publication varies for the reference sources; consequently, some regions have recent mineral-occurrence information, whereas other regions only have much older data; and (5) the necessity of excluding smaller occurrences, for cartographic reasons, from metallogenic maps has had a profound effect in reducing the number of occurrences, particularly in figure 4.

To estimate the density of mineral occurrences in Antarctica, the following procedure was used:

1. Gondwanaland was reconstructed, using the format of Craddock and others (1969–70).
2. Major tectonic belts of Antarctica were correlated with similar tectonic belts on adjacent continents (fig. 4).
3. On the basis of existing metallogenic maps, the density of mineral occurrences—divided into the categories of (1) ferrous, (2) base, (3) precious metals, and (4) other deposits (uranium, aluminum, tungsten, asbestos, rare earths, etc.)—was calculated for each similar adjacent tectonic belt on the neighboring Gondwana continents (fig. 4).

The density of mineral occurrences per unit area within the similar tectonic belts of adjacent Gondwana continents was then extrapolated to Antarctica, and the resource potential of the continent was calculated as follows.

1. The total land area versus exposed bedrock was measured in the four major geologic provinces of Antarctica.
2. In each of the geologically equivalent land areas in Gondwanaland, the land area was measured and the major mineral deposits were counted. Four classes of deposits were distinguished, as given above.
3. The total spatial density of deposits was estimated in each subsection of Antarctica by computing a weighted average.
4. The number of deposits in the land areas not covered by glacial ice was estimated by multiplying the estimate of the total number of deposits by the proportion of land areas exposed.

The procedure used to compute the number of deposits expected to occur in each region of Antarctica is given below for the shield part of Antarctica:

Deposit	Shield					Total expected deposits for Antarctic shield [1]	Deposits expected in exposed Antarctic shield area [2]
	Australia	India	Madagascar	Africa	Total		
Ferrous metals	9	57	15	76	157	138.4	0.29
Base metals	17	5	6	49	77	68.9	.15
Precious metals	9	5	13	48	75	66.1	.14
Other	5	28	10	40	83	73.2	.15

[1] Calculated from: Total $\times F_A$, where $F_A = 0.8817$, the area conversion factor.
[2] Calculated from: Total $\times F_A \times F_I$, where F_A is the same as above and $F_I = 0.0021$, the proportion of land area exposed in the Antarctic shield.

The area conversion factor F_A is the ratio of the area of the Antarctic shield to the total area in the four control areas of Gondwanaland (3,200,863/3,629,150 = 0.8817). All land areas are in square miles.

The proportion of land areas exposed F_I is the ratio of the area of exposed land in the Antarctic shield to the total area of the shield (7,041/3,200,863 = 0.0021).

Success in exploring for mineral deposits in Antarctica is a function not only of the number of deposits expected to exist but also of the intensity of the search. The chance of discovering a viable ore body is judged to be remote. For example, the number of base-metal deposits expected to exist in the exposed area of the Ross orogenic belt is 0.6. Assuming a chance of 1/100 of successful discovery, the expected number of deposits found on any single exploration attempt is only 0.006 or six chances in a thousand.

The histograms presented on figure 5 show the total number of mineral deposits that can be expected in Antarctica; this ranges from 380 in the Andean orogen to 33 in the Ross orogen. However, when the total number of mineral deposits is reduced by the number of deposits covered either by ice or Beacon rocks, figure 5 shows that the maximum number of mineral deposits to be anticipated ranges from 16 in the Andean orogen to less than 1 in the shield area. In table 3, the expected number of deposits in exposed areas and the expected frequency of discovery of a deposit are summarized for each of the orogenic belts.

The data presented in figure 5 show that the mineral-resource potential of Antarctica is very small because of the tremendous amount of ice cover on the continent. The potential is further reduced because the results of past exploration indicate that only a very small fraction of the mineral occurrences studied will have any significant resource potential. The costs and problems of exploration and development, in addition to the factors previously discussed, will further diminish the number of occurrences that have resource potential.

TABLE 3.—*Expected number of mineral deposits in exposed areas of Antarctica and the expected number of deposits to be discovered*

[On the basis of an assumed success rate of 1:100 for deposits once identified]

Type of deposit	Andean orogen		Ellsworth orogen		Ross orogen		Antarctic shield	
	Expected No. of deposits	Expected discoveries	Expected No. of deposits	Expected discoveries	Expected No. of deposits	Expected discoveries	Expected No. of deposits	Expected discoveries
Ferrous metals	2.5	0.025	1.0	0.01	0.6	0.006	0.29	0.0029
Base metals	7.5	.075	.7	.007	.6	.006	.15	.0015
Precious metals	3.5	.035	.1	.001	.3	.003	.14	.0014
Other	2.5	.025	.2	.002	.5	.005	.15	.0015

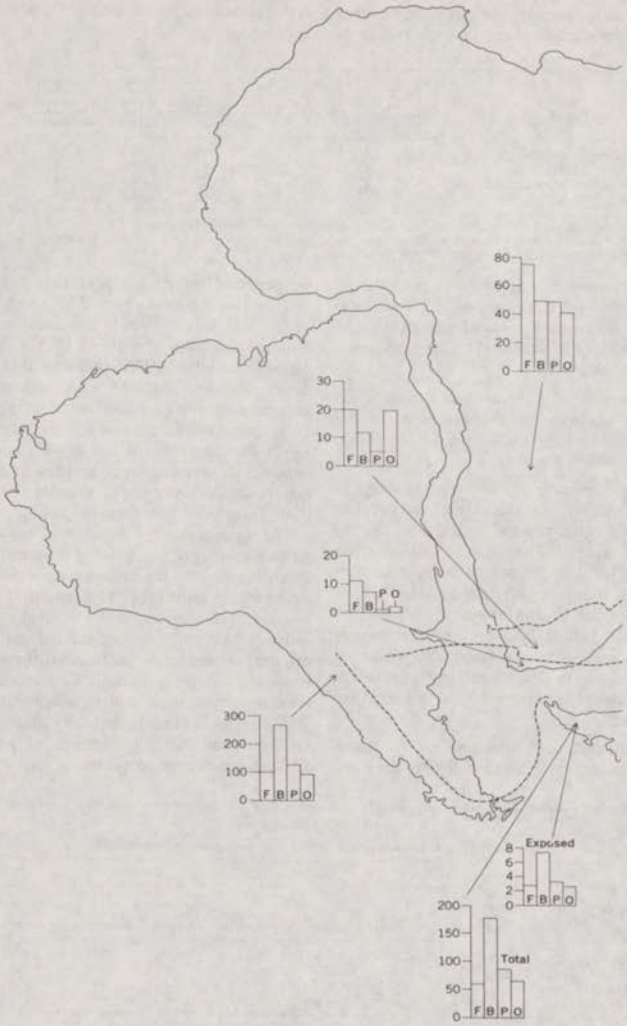
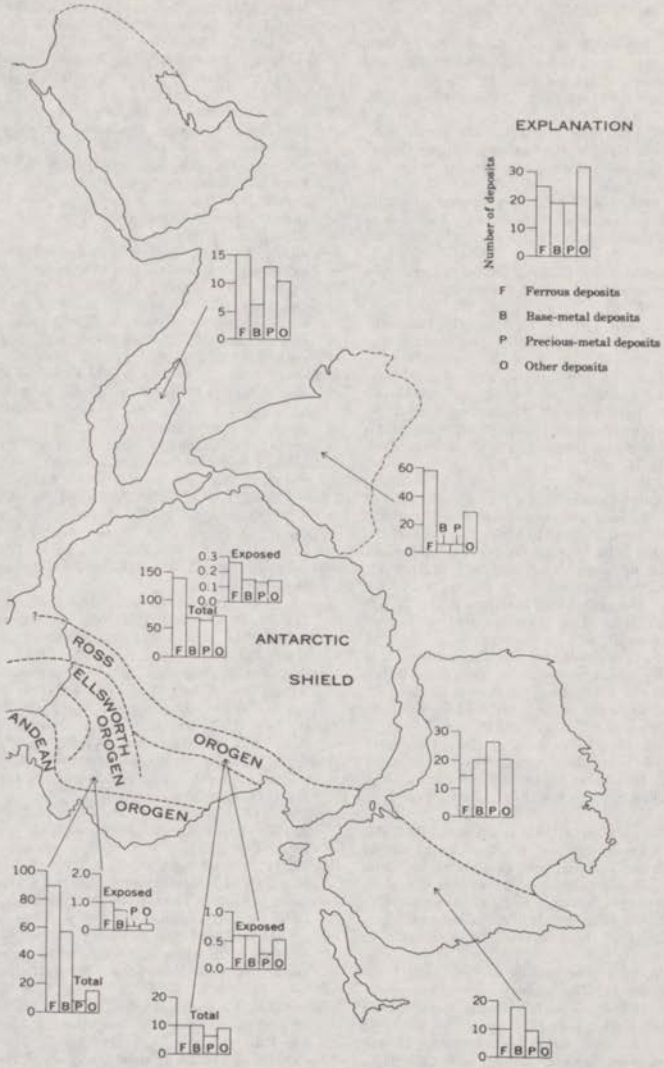


FIGURE 5.—Expected mineral deposits in Antarctica, on the basis



of mineral information from adjacent Gondwana continents.

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Antarctic Resources

Report from the meeting of experts at the Fridtjof Nansen Foundation at Polhøgda. May 30–June 10, 1973.

On May 30–June 10, 1973, an informal meeting of experts was held at the Nansen Foundation at Polhøgda for discussion of problems relating to mineral exploration and possible exploitation of natural resources in Antarctica. Some 30 experts [1] from the twelve countries [2] which are Consultative Parties to the Antarctic Treaty took part in the meeting.

BACKGROUND OF THE MEETING

For a number of reasons, including the growing demand for natural resources and rapid development in technology for polar, as well as for seabed mineral exploration, there is an increased interest in the possibility of finding exploitable minerals in Antarctica. As distinguished from purely scientific investigation, exploration with a view toward possible exploitation of natural resources in Antarctica raises a wide range of questions about the effects of such activity upon the environment as well as problems of a legal and political nature relating to the provisions of the Antarctic Treaty and the special status of the Antarctic Treaty Area.

The Antarctic Treaty places a special responsibility upon the Contracting Parties to insure that no one engages in any activity in the Antarctic Treaty Area contrary to the principles and purposes of the Treaty. At the Seventh Antarctic Treaty Consultative Meeting (Wellington 1972) the Representatives unanimously adopted Recommendation VII–6, recommending to their Governments—

". . . that the subject: Antarctic Resources—Effects of mineral Exploration" be carefully studied and included on the Agenda of the Eighth Consultative Meeting."

PURPOSE OF THE MEETING

In connection with the discussion of the subject at the Seventh Consultative Meeting, the Fridtjof Nansen Foundation confirmed an invitation to hold an informal meeting of experts for discussion of problems arising in connection with the growing interest in exploration of Antarctic mineral resources.

The arrangement was partly financed by a grant from the Norwegian Government. Planning and organization of the meeting, however, was the sole responsibility of the Nansen Foundation, which is a privately organized institute engaged in the study of legal, organizational and political problems and questions of international cooperation in the exploration of Antarctica and other "new territories".[3] The purpose of the meeting was to provide an opportunity for experts from countries which are Consultative Parties to the Antarctic Treaty to meet together for informal discussion of the problems relating to mineral exploration as a first step toward assembling and evaluating information required for further consideration of the problems by the Consultative Parties.

ORGANIZATION OF THE MEETING

Some 30 experts, coming from all the countries which are Consultative Parties to the Antarctic Treaty, participated in the meeting. Participants were invited in the individual capacity, on the basis of their personal knowledge and experience, for the contribution they could be expected to make to elucidate the problems and issues.

The meeting was opened by Ambassador Edvard Hambro, who acted as chairman in plenary session until the meeting was divided into one scientific and technical working group and one working group on legal and political questions.

Dr. Tore Gjelsvik acted as chairman of the scientific and technical working group, while Ambassador Edvard Hambro, Ambassador Finn Seyersted and Dr. Finn Sollie alternated as chairmen of the working group on legal and political questions.

Substantive discussions at the meeting were carried out in the two working groups and reported by the late Dr. Richard Willett and Mr. R. H. Wyndham. Their reports are enclosed. The Nansen Foundation is particularly grateful for

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[1] List of participants enclosed.

[2] Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, South Africa, USSR, United Kingdom, USA.

[3] Cfr. Finn Sollie et al., "The Challenge of New Territories," Universitetsforlaget, Oslo, 1974.

their contribution in reporting so excellently the discussions of the working groups. As agreed at the conclusion of the meeting, members in each group were allowed an opportunity to comment on the draft report from their group. The fact that no substantive requests for additions or alterations were made may be taken as additional proof of the success and fairness of the rapporteurs in reporting the often intense discussion on the complex issues before the meeting.

As agreed at the meeting, in the report statements were not to be attributed to individual participants.

FINN SOLLIE.
Polhogda, September 1974.

REPORT OF THE SCIENTIFIC AND TECHNICAL WORKING GROUP

1. The technical working group, under the chairmanship of Dr. Tore Gjelsvik, adopted the following headings as a guide to discussion:

I. Known mineral deposits and occurrences.
II. Arctic experience of mineral exploration and extraction: its relevance to Antarctic conditions.
III. Distinguishing commercial exploration from scientific exploration.
IV. Environmental effects of exploration and exploitation.
V. The question of urgency.

I. KNOWN MINERAL DEPOSITS AND OCCURRENCES

2. The working group heard accounts of the mineral deposits and occurrences in those parts of Antarctica of which the experts present had special knowledge. In abbreviating this information two definitions have been used:

(1) *Mineral deposits* are those that are known quantitatively to a greater or lesser extent and for which there is some qualitative information.

(2) *Mineral occurrences* are simply those minerals noted, during scientific investigations, as occurring in a formation. They generally have no quantitative measurements, but may have occasionally been analysed. Knowledge of these occurrences is currently of geological significance only.

The discussion which follows is further divided into three classes—metallic minerals, non-metallic minerals and energy minerals.

Mineral deposits

3. It was noted that none of the minerals listed below had been sufficiently studied, either quantitatively or qualitatively to be classed as "inferred" or "possible" in the U.S. Bureau of Mines categories of ore reserves.

Metallic minerals

4. An iron ore deposit in the southern Prince Charles Mountains has been delineated by an airborne magnetometer survey and is considered to extend horizontally over a distance of 120 km in one direction with a thickness of 100 metres. A similar deposit near Davis appears to extend over 160 km. These deposits consist of hamaetite, jaspertite, some magnetite and quartzite having a grade of 35–38% Fe and are regarded by some experts to be large enough to meet present world consumption for 200 years but not likely to be developed for perhaps 50 years. It is doubtful if iron ore of such a type and grade is worked elsewhere in the world at present. There are several large deposits of this grade in more accessible parts of the earth that would be developed before similar deposits in Antarctica. To increase the knowledge of this deposit, detailed prospecting work would be needed to bring it even into an inferred ore reserve category. Location, access and grade do not encourage such operations. These iron bearing rocks are the only metallic deposit so far known in Antarctica that can be considered more than an occurrence.

Nonmetallic minerals

5. Although nonmetallic minerals have been reported by geological expeditions from widely scattered points all over Antarctica, none have been examined quantitatively or qualitatively so are not regarded as deposits. Some, like marble and constructional materials, are obvious in the field and perhaps could be regarded as a deposit merely because of the massive extent of their exposure. Marbles are associated with the basement rocks at many points in the Transantarctic Mountains, being noteworthy from the Beardmore Glacier north to Cape Adare.

6. Constructional materials are sometimes used locally, e.g. Ross Island where the basalt scoria is quarried occasionally for road and foundation needs.

Energy minerals

7. Coal is probably the best known of all Antarctic minerals for its presence has been known since the early polar expeditions particularly in Victoria Land. Wherever Permian and Jurassic beds are found coal seams are frequently encountered as in the Horlick, Pensacola, Theron and Prince Charles Mountains. The seams are often traceable over some distance and their thickness has been measured at a number of localities. Surface samples show, in nearly all cases, a high volatile bituminous coal with a high sulphur and ash content. Such coals occur in the Beaver Lake area where some 60 seams are known between 2 and 5 metres thick. In the same rocks in north Victoria Land similar coals occur, reaching at one point a seam thickness of 9 m. In the Horlick Mountains seams of coal attain 4 metres in thickness.

8. In many localities the coal measures have been baked by invading dolerite volcanic sheets and dykes and the coals have been converted to anthracites.

9. The quality of Antarctic coal, its location and distance to a suitable point of exit on the coastline militate against any development in the foreseeable future. The present world wide diminishing reliance on coal by comparison with other energy sources must also place the use of Antarctic coals even further ahead.

10. Petroleum deposits are not known on the continent itself and the nature of the geological formations exposed on land are not such as to encourage geologists to regard any of them as source beds or reservoir beds for the generation and accumulation of hydrocarbons. On the continental shelf, however, the younger formations are more attractive and there is evidence, provided by recent drilling, of the presence of hydrocarbons in the form of methane with a little ethane. Sediments of Oligocene age beneath 500-650 metres of water have yielded this evidence after penetrating 500 metres of sediments at three sites in the Ross Sea. In general the shelf around the Antarctic continent only extends seawards for a distance of more than 200 miles except in the Ross Sea and the Weddell Sea areas. The Antarctic Continental Shelf is also found below much deeper water than in the rest of the world due to its isostatic depression in response to the weight of the Antarctic ice sheet.

11. The off-shore formation probably represents the most attractive mineral potential of the continent, largely because it is accessible by drilling ships despite the hazards of large Antarctic icebergs. Any product can be removed from the area without being involved in the immense difficulties of Antarctic land transport. The working group concluded that off-shore prospects are much more likely to attract active interest before anything at present known on land.

Mineral occurrences

12. A list of mineral occurrences, i.e. other than the normal rock forming minerals, could be as extensive as that compiled for similar geological areas elsewhere. Reports arising from the work of all geological expeditions mention many occurrences, but not deposits, of various economic minerals, i.e. minerals that are economically developed elsewhere in the world.

13. In this report a list of the more common minerals is submitted with some additional information available. Such a task has been attempted by several writers in the past and the resulting catalogues show a close similarity with those prepared for other areas of pre-Cambrian shield rocks with marginal folded sediments: they are not deposits nor do they indicate deposits. They are however, important geologically for correlation purposes and for understanding the metamorphic and subsequent geological history of the area. One major contribution in this field is the list prepared by Professor Duncan Stewart ("Antarctic Mineralogy", in *Antarctic Geology. Proceedings of the First International Symposium on Antarctic Geology, Cape Town, 16–21 September 1963.* Ed by R. J. Adie, sponsored by Scientific Committee on Antarctic Research (SCAR) Amsterdam, North Holland Publishing Co., 1964, p. 395–401).

Metallic minerals:	*Places found*
Beryllium	Antarctic Peninsula, Central Dronning Maud Land.
Chromium	Antarctic Peninsula.
Copper	Borgmassivet, Maudheimvidda 0.5 percent, several places in East Antarctica near Mawson, central part of Antarctic Peninsula.
Gold	Same as copper. 0.59 m/tonne.
Iron (all forms)	Prince Charles Mountains, Dufek Massif, Pensacola Mountains, Antarctic Peninsula, central Dronning Maud Land.

Metallic minerals—Continued	*Places found*
Lead	Antarctic Peninsula.
Niobium	Central Dronning Maud Land.
Manganese	Central Antarctic Peninsula Wilkes 39.1 percent Mountain.
Molybdenum	Antarctic Peninsula, Near Mawson, Near Davis.
Nickel	Antarctic Peninsula.
Sulphides (mixed)	Lassiter Coast, Antarctic Peninsula, Transantarctic Mountains, East Antarctica.
Titanium	Antarctic Peninsula, central Dronning Maud Land.
Tungsten	Antarctic Peninsula.
Vanadium (iron copper) bearing.	Dufek Massif, Pensacola Mountains, central Antarctic Peninsula.
Zirconium	Central Dronning Maud Land.
Nonmetallic minerals:	
Bismuth	Near Mawson.
Flourite	Southern Prince Charles Mountains, Prydz Bay, Goodspeed Nunataks.
Graphite	Central Dronning Maud Land, Conrad Mountains.
Gypsum	Coastal areas of East Antarctica.
Mica (all forms)	Central Dronning Maud Land (especially phlogopite mica), Alexander Humboldt Mountains.
Phosphate (Apatite).	Central Dronning Maud Land.
Quarz crystal	Central Dronning Maud Land at many areas.
Energy minerals:	
Geothermal steam	Mount Erebus, Mount Melbourne, Deception Island.
Uranium	Antarctic Peninsula, Kronprins Olav Kyst.

II. ARCTIC EXPERIENCE OF MINERAL EXPLORATION AND EXTRACTION: ITS RELEVANCE TO ANTARCTIC CONDITIONS

14. It was noted that mineral exploration and extraction under Arctic conditions has been proceeding for many years in Siberia, Svalbard, Greenland, Northern Canada and Alaska. The experience gained from these operations, largely concerned with the existence of permafrost, would only be applicable to the Antarctic if minerals were found on land not covered with ice. There has been no attempt in the Arctic to explore for or extract minerals under glacier ice and therefore Arctic experience cannot be applied to more than 95% of the Antarctic continent.

15. The predominant mineral development in Arctic offshore areas is the search for oil and gas and its subsequent development. All the known successful exploration for oil and gas in the Arctic has been onshore, but production has been successfully achieved offshore in Cook Inlet on the sub-Arctic south coast of Alaska where drifting fragmented first year ice floes up to 4 feet in thickness are found in winter. Unusually robust platforms have been built to resist ice impact and have been piled into the sea bottom and filled with concrete.

16. Although the Cook Inlet operation is hazarded by sea ice, there are no icebergs. No attempt has yet been made to extract oil or gas from offshore areas where heavy sea ice and icebergs are found in combination, but exploration drilling has started off the coast of Labrador—an area in which icebergs from Greenland are frequently found. Early holes were abandoned because of the difficulty of penetrating boulder clay below the sea floor. The final more successful hole was at several thousand feet when the location had to be hurriedly abandoned because of the unpredictable change in course of a large iceberg. Experiments have shown that it is possible to tow away smaller icebergs which were seen to be on a path that would have risked collision with the drilling rig. So far the only solution to the advance of a large iceberg is to remove the drilling outfit from its predicted path. During 1973 an attempt will be made to drill in these waters with a technologically advanced drillship, which is dynamically positioned and so does not have to recover or jettison moorings if danger threatens.

17. Since Greenland icebergs may average 100,000 tons in size and project 400 or 500 feet below sea level there are obvious dangers to submarine well heads. Such icebergs may gouge the sea bottom to depths of 40 feet or more. The only solution so far advanced is to put the well heads in sub-seafloor cellars, but this concept has not yet had to be put into practice. Even if this problem is solved satisfactorily there remains the bigger problem of getting the oil or gas ashore, or

into tankers. No-one has yet advanced even an outline concept of how this might be done.

18. A view was expressed that this Arctic experience was unlikely to be of much benefit to Antarctic operations because of the larger amounts of sea ice and the very much larger icebergs that would be experienced. It was pointed out, however, that the "Glomar Challenger" drilling ship, which had a dynamical positioning capability had already drilled four holes in the ice infested Ross Sea. Another view was that the considerably greater water depth above most of the Antarctic continental shelf might render the grounding of icebergs less likely. It was generally agreed that a great deal more research was needed into Antarctic sea ice conditions and the movement and grounding of Antarctic icebergs before any reliable assessment could be made of the threats they posed to any Antarctic offshore oil or gas developments.

III. DISTINGUISHING COMMERCIAL EXPLORATION FROM SCIENTIFIC EXPLORATION

19. Although both types of exploration use the same techniques it was generally accepted that in almost every case it would be possible to assign a particular exploratory investigation to either a commercial or scientific category. The following table sets out the principal differences:

	Commercial exploration	Scientific exploration
1. Objects	To find exploitable mineral resources	To increase knowledge.
2. Publication of results	Not done with a view to publication but may be published.	Done with a view to publication and nearly always eventually published.
3. Scale of investigations	Usually more detailed and concentrated.	Usually larger scale aimed at elucidating general structure and stratigraphy but may concentrate on problem areas.
4. Licensing	Usually licensed	Never licensed.

20. The view was expressed that while it was obvious that commercial companies were free to make use of the published results of scientific research one should not lose sight of the fact that the results of commercial exploratory activities were frequently made available and could be of great value as a contribution to fundamental geology. An example was cited of a recent large scale investigation of the south west Pacific and Tasman Sea by an international oil company which had invited participation by the adjacent national geological authorities. While not doubting that commercial exploration could make contributions to scientific knowledge a contrary concern was also expressed that if companies had been given licenses to explore in given areas for a period of years they would not welcome scientific exploration within those areas. It was suggested that if this was a real danger, a stipulation providing for freedom of scientific investigation might be a condition of the license.

IV. ENVIRONMENTAL EFFECTS OF EXPLORATION AND EXPLOITATION

21. It was generally accepted that the Antarctic ecological system was sensitive to disturbance, that parts of it would be unlikely to recover from gross disturbance for tens if not hundreds of years and that the present relatively undisturbed state of the Antarctic environment rendered its continued protection a matter of greater rather than lesser importance.

22. It was accepted that the present level of geological/geophysical exploration on land in the Antarctic is unlikely to create environmental hazards, but the geologists' desire and need for sub-surface information will require drilling as a further tool and could thereby create some local hazards. It was noted that scientific drilling has already been carried out on Ross Island and is planned for the 1973–74 season in the Lake Vanda area. Arrangements to remove all drilling debris from the area to prevent any contamination of the dry valley lakes have been agreed to by the three expeditions supporting the project.

23. Both scientific and commercial drilling in offshore areas carry the same potential hazards but to a greater degree where commercial drilling is concerned, although the working group was informed that much more elaborate methods to prevent oil or gas pollution are normally associated with commercial drilling than in the case of scientific drilling.

24. It was generally accepted that, in any drilling on the Antarctic continental shelf whether for pure scientific investigations or in the event of possible future commercial exploration the procedures used must be adequate to ensure protection of the environment from any harmful results of the investigations or from accidents that may occur while they are in progress.

25. Some members suggested that a body of scientists under SCAR, should consider the possible hazards and develop appropriate environmental guidelines for exploration on the Continental Shelf at the earliest possible time. An alternative view was expressed that measures to protect the Antarctic marine environment against oil pollution would require both scientific advice on its environmental effects and technical advice on suitable drilling practices. While the assessment of the environmental effects and the provision of biological, geological and glaciological scientific advice are proper concerns of SCAR, the preparation of regulatory guidelines for suitable drilling practices, if such were deemed to be necessary, would be more appropriate for action by Treaty governments.

26. The point was made that field research on the environmental effects of oil pollution in cold ice covered seas is at an early state of development and requires research into the effect of actual cases. The results of research programmes on oil pollution in connection with Arctic oil developments were unlikely to be of considerable assistance in reducing Antarctic field studies to a minimum. In this connection it was also noted there has recently been considerable technological advance in the development of anti-pollution devices aimed at the containment and cleaning up of oil spills. Apart from booms to contain spilled oil, and the use of dispersants, a mechanical system for skimming the oil from the surface has recently been perfected and will shortly be marketed. This system and others will be fully proved in more temperate climates within the near future, and should be available for Antarctica well in advance of any possible future oil discoveries. Whether these systems would cope with, or be operable in, ice encumbered seas, would need to be studied.

V. THE QUESTION OF URGENCY

Introduction

27. In the course of the first Plenary Session of the Conference a considerable difference of opinion became apparent as to:

(*a*) whether there is now, or there is likely to develop, a need for Antarctic minerals to be located, economically assessed and subsequently extracted, and

(*b*) whether there is a need for Antarctic Treaty governments to develop regulatory mechanisms to ensure that the process of location, assessment and extraction do not have a harmful effect on the Antarctic environment or prejudice the proper working of the Antarctic Treaty.

28. The Chairman of Plenary asked the Scientific and Technical Working Group to advise the Legal and Political Working Group on the first of these questions. A few members of the Scientific and Technical Working Group gave a confident negative answer to the first of these questions because, in their view the answer to the second question was that the Antarctic Treaty ruled out any commercial venture to locate, assess or exploit Antarctic mineral resources.[1] Several members of the group took a different view. They argued that while minerals on the Antarctic continent were unlikely to be commercially attractive in the foreseeable future there would be a steady, and possibly rapid, increase in demand to explore and assess the hydrocarbon potential of the Antarctic continental shelf. To them, the answer to the second question depended on the answer to the first. In their view, the problem of Antarctic Treaty interpretation and subsequent action by Treaty governments, in the light of the answer to the first question, were legal rather than technical matters and therefore not within the terms of reference of this working group.

28. The discussion which follows should be read against the conclusion which the working group had already implicitly reached: that world demand for Antarctic mineral resources was likely to arise first in the hunt for oil and gas resources in the Antarctic continental shelf. The possible utilization of continental minerals would, if it followed at all, be very much later.

Will there be a demand for Antarctic oil and gas?

29. Currently remaining world total proved reserves of oil amount to about 570×10^9 barrels while in 1972 World Oil Production was nearly 20×10^9 barrels. So at current rates of offtake there is enough oil now known and proved

[1] See paragraphs 20–26 of the Report of the Working Group on Legal and Political Questions.

to last 30 years. However, on past trends oil production should reach 33×10^8 barrels in 1980 and allowing for production in the intervening period the remaing reserves would then be sufficient for only 12 years supply *if no new reserves are discovered.* Estimates of future discoveries vary considerably from expert to expert, from a low of 400×10^9 to 1100 to 10^8 barrels.

30. There is therefore little doubt that heavy pressure is already on the oil industry to discover more and more resources of oil and gas world wide. It is generally agreed that such discoveries will be increasingly in smaller and less productive fields and in increasingly hostile environments. It is therefore only a matter of time before the attention of oil and gas companies turns to a consideration, if not the active investigation, of the Antarctic. Not all commercial concerns will share the generally unfavourable appraisal of Antarctic oil and gas potential, and it is likely that applications for prospecting rights will be made sooner or later.

31. The above conclusion was not accepted by all members of the group. The point was made that if the prospect of a world energy crisis was indeed as bleak as the above figures would appear to suggest, then the world's scientific capacity would be better applied to the development of alternative energy sources—e.g. solar energy, tides, nuclear energy, etc., than to a search for Antarctic oil. The Antarctic contribution to world oil and gas reserves would, in all probability, be small; the severe environmental hazards of extracting Antarctic oil and gas were so great as to be out of proportion to the small gain of energy in world terms. What was wanted now, in the view of one member, was the institution of an "international energy decade" in a bid to head off what could become an increasingly bitter international struggle for fossil fuel resources.

32. Although this approach to the problem was philosophically attractive to many, they felt that it was unlikely to achieve its object of reducing demand for Antarctic resources to negligible proportions. It was particularly noted that the commercial pressure to explore, if not to exploit, already existed. Account had to be taken of the enquiries that had already been received by some Antarctic Treaty governments from oil companies and oil exploration companies. The statement that almost all the enquiries received by one Treaty government had been from companies registered in a country which had not acceded to the Antarctic Treaty was thought to be particularly important in this respect. It was, however, indicated that up to the present time the enquirers had not made any detailed requests for exploration rights in an identified area. They had all sought information on the present Antarctic legal position generally or information about how a licence to operate within the Antarctic might be acquired. Among the companies seeking information were commercial prospecting groups with lengthy experience under Arctic conditions. It was reported that an exploration licence had already been given for oil exploration close to the Treaty Area near Iles Kerguelen on the Gaussberg-Kerguelen Ridge.

33. Another aspect of the hunt for oil could be of considerable significance to the continued successful operation of the Treaty. Oil companies are known to be interested in securing exclusive rights to explore and to exploit resources of specified areas for a specified period. There are many cases in which they have secured these rights well in advance of the time when they may wish to take any exploratory action. Although companies are at present only at the stage in which they are making enquiries about the conditions under which they might be able to secure such rights in the Treaty Area, they are likely to become progressively more interested. The view was expressed that it is realistic to expect this interest to increase within five or ten years to the point when companies may be willing to pay for these rights. According to this view it is by this stage that governments should have decided how they propose to deal with the problem; not at a much later stage when commerical exploitation may become practical.

The present expectations of finding oil or gas in the Antarctic

34. Although there is no evidence yet of the existence of oil in commercial quantities, the work of *Eltanin* and *Glomar Challenger* on or near the Antarctic continental shelf has shown that there are sediments, mostly of Tertiary age, at least 2000 m. thick in many places. The finding of traces of methane and ethane in three of the four holes drilled in 1972–73 by the *Glomar Challenger* in the Ross Sea showed that the Antarctic continental shelf is, at least, not barren of hydrocarbons.

35. The existance of a sequence of submarine sediments in the Antarctic containing organic matter will, inevitably, in due course, encourage a demand to determine whether reservoir beds capable of containing an appreciable quantity of

petroleum are present and whether there are suitable structures in which such petroleum might be trapped. The next logical step in exploration of the Antarctic continental shelf would be reconnaissance and geophysical surveys by a well-equipped vessel, such as those recently carried out in many continental shelf areas. If such reconnaissance surveys gave further evidence of favoruable structural conditions, detailed seismic surveys and possibly eventually drilling would normally follow.

36. In this connexion it was noted by several members that to allow competent commercial oil search groups to operate under license was an effective way of obtaining further information on the continental shelf area. Several members expressed views based on their experience that information from such commercial research is readily available and, as has been noted previously, the free availability of scientific results could be made a condition of the license.

Utilization of Antarctic oil and gas: the role of technological innovation and development

37. Technological innovation is widespread and advancing rapidly in the oil and gas industry—what seems impossible today may become feasible ten years from now and commonplace in twenty years time. Eventually the major limiting factor to any development is likely to be economics.

38. With modern techniques it is possible to do seismic work and carry out exploratory drilling in many parts of the Antarctic offshore. The main problems are logistical and the proportion of effective working time available in a hostile environment. Development drilling and completion of oil and gas wells for production are a different matter. No technology exists, not even in the conceptual stages, for establishing offshore petroleum development in those Antarctic marine areas where icebergs are in danger of grounding on the sea bottom.

39. For the deeper waters however, where submarine installations would be below the bottoms of icebergs, the technology is already well advanced. Systems have been developed for submarine well completions for oil and gas; these are generally associated with installations at the surface of the sea for oil and gas separation, storage and delivery to pipeline or tanker. It is conceptually possible for such installations to be also placed on the sea bed below the bottom of floating icebergs, with connection to the sea bed being made from a tanker when required. However, the engineering designs for such facilities are not even in the preliminary stage.

CONCLUSIONS

40. Political matters were outside the terms of reference of the Scientific and Technical Working Group and it was therefore not possible to attempt to build any bridges between the two fundamentally different approaches to this problem of urgency that existed within the group which have been outlined in the Introduction to this section. For that reason, any attempt to arrive at a consensus on this problem was likely to represent only a partial view of the question of urgency. Nevertheless the group was able to agree to the following:

"The Working Group reviewed the present knowledge of mineral resources in the Antarctic Treaty Area.

In relation to the land area it was noted that, although there have been a large number of mineral occurrences in the Antarctic, none of these appeared likely to be commercially attractive within the present century.

The Working Group had available to them less geological and geophysical information about the continental shelf area than about the land area. It was agreed, however, that the continental shelf is inherently more accessible to investigation.

The Working Group drew attention to the importance of continuing scientific cooperation aimed at elucidation of the geological and structural history of the continent and its adjacent shelf areas. This is essential for any further assessment of the Antarctic Treaty Area, which needs considerably more and more sophisticated, geological and geophysical investigations. The members of the technical group have found it difficult to agree about various aspects of the problem of urgency. A majority concurred however, that it is urgent for the Antarctic Treaty Consultative Parties to reach agreement on adequate political and legal measures to be taken within the framework of the Antarctic Treaty to avoid uncontrolled commercial mineral exploration on the continental shelf within the Treaty Area. A minority view was expressed that although the matter is important it is not urgent."

41. In amplification of these agreed statements, the view held by several members was that unless the Treaty governments decide soon that exploration and exploitation of mineral resources on the Antarctic continent should be com-

pletely prohibited, there is an urgency to begin as soon as possible to establish regulatory measures under which exploration of the Antarctic continental shelf can be administered, conceding that it will inevitably take several years for such machinery to be set up. Although there is no urgency about the Antarctic continent itself, if measures are being established for the continental shelf, they might as well be set up for the continent at the same time. It will not do any harm to have them available even if they are not used; there is always the possibility, slight as it may be, of the discovery of a mineral deposit on the continent large enough and rich enough to be of immediate commercial interest.

Report of the Working Group on Legal and Political Questions

EXISTING LAW

1. The Working Group began by attempting to set out factually the present national and international law relevant to the authorization or prohibition of mineral exploration and exploitation for commercial purposes in the Antarctic Treaty area:

Relevant provisions of the Antarctic Treaty and subsequent recommendations

2. The Antarctic Treaty does not contain any provisions which expressly mention non-living resources of the Antarctic. (Living resources are dealt with by Article IX(1) (f) and Recommandation of III–VIII—the Agreed Measures for the Conservation of Antarctic Fauna and Flora.) Recommendation VII–6 calls for further study of the subject of "Antarctic Resources—Effects of Mineral Exploration", but even though the Recommendation does not deal substantively with the subject it contains several relevant principles in its Preamble.

3. However, the Antarctic Treaty does contain a number of relevant provisions, including the following:

(*1*) The Preamble states that "It is in the interest of all mankind that Antarctic shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord" and that "a treaty ensuring the use of Antarctic for peaceful purposes only and the continuance of international harmony in Antarctica will further the purposes and principles embodied in the Chapter of the United Nations."

(2) Article II provides for the continuation of freedom of scientific investigation and cooperation in the Antarctic, subject to the Treaty.

(3) Article III promotes international cooperation in scientific investigation by providing for the exchange of information and results of research, as well as scientific personnel.

(4) Article IV concerns the question of territorial sovereignty in the Antarctic.

(5) Article VI defines the area to which the Treaty applies.

(6) Article VII provides for wide rights of inspection of all areas of Antarctica by nationals of the consultative parties and for the exchange of information regarding expeditions to and stations in Antarctica.

(*7*) Article IX provides for consultation among the Parties to the Treaty on matters of common interest pertaining to Antarctica.

(*8*) Article X contains an undertaking to exert appropriate efforts to the end that no-one engages in activity contrary to the Treaty.

(*9*) Article XI provides for procedures to be followed in the event of a dispute over interpretation or application of the Treaty.

4. In addition, there are some relevant Recommendations of Consultative Meetings. Recommendation III–VIII regarding Agreed Measures for the Conservation of Antarctic Fauna and Flora (and subsequent related Recommendations) provide for the creation of a number of Specially Protected Areas and specially protected species to be accorded special protection because of their unique scientific interest. The Agreed Measures also contain general provisions which may be relevant to mining operations, for example in addition to Article VII on minimising harmful interference. Recommendation VI–4 recognises that the consultative parties should assume responsibility for the protection of the environment and the wise use of the Treaty Area and the same point is recognised in Recommendation VII–6.

Relevant national legislation

5. The contracting parties to the Antarctic Treaty have taken such legislative steps as are appropriate under their respective constitutional systems in order to give effect to the Treaty and to Recommendations adopted under it.

6. In addition, other legislative and administrative arrangements have been adopted in some of the participating States in connection with the Antarctic Treaty.

7. Some of the Consultative Parties have a large body existing legislation enabling them to issue licenses for mineral exploration and exploitation within parts of the Treaty Area. (See also paragraph 16).

Different systems of jurisdiction

8. The laws are based on different systems of jurisdiction.

(*a*) *Jurisdiction based on territory*

9. Each Consultative Party which has asserted the rights or claims mentioned in Article IV of the Antarctic Treaty asserts rights to exercise jurisdiction over persons present or actions occurring in the area which it claims, subject always to the provisions of the Treaty as well as general international law. Where these claims exist, they include claims to any minerals to be found within the areas concerned. It was noted that at least two Consultative Parties which had legislated in the past on a territorial basis had applied recent legislation to its nationals throughout the Treaty Area.

(*b*) *Jurisdiction based on citizenship*

10. All parties to the Treaty, whether or not they have asserted the rights or claims mentioned in Article IV, may exercise jurisdiction over persons who are their nationals in respect of acts or omissions occurring in the Antarctic, subject to the same provise for the Treaty and international law. Article VIII(1) of the Treaty provides that observers and exchanged scientists, together with their accompanying staffs, are to be subject only to the jurisdiction of the State of which they are nationals.

(*c*) *Jurisdiction based on origin of operations*

11. The exercise of jurisdiction based on the origin of an operation is unusual. It is provided for in a certain sense by Article VII(5) which requires each party to give advance notice of expeditions proceeding from its territory to the Antarctic. The Treaty does not prohibit the exercise of regulatory discipline by leaders of expeditions and station commanders over persons of whatever nationality who are members of the expedition or station as the case may be. Recommendations VI–7 acknowledges that station commanders may impose certain conditions or restrictions on the movements of tourists and visitors to scientific stations, having regarded to safety requirements and the need to safeguard scientific programmes.

12. As a result of these different systems, there exists in the Antarctic the possibility of concurrent jurisdiction. Article VIII(2) of the Treaty provides for immediate consultation in the event of disputes about the exercise of jurisdiction in the Antarctic.

The position in international law of various parts of the Treaty Area

(*a*) *Land territory*

13. Article VI of the Treaty applies its provisions to the whole area South of 60°S latitude including all ice shelves (thus assimilating them to land territory), subject to a special provision for the high seas. Accordingly, all the land areas and ice shelves south of 60°S latitude, whether forming the continent or islands, are subject to the Treaty, whether or not the rights or claims mentioned in Article IV exists. The sector which has not been claimed has the status of *res nullius* but is subject to the provisions of the Treaty, notably Article IV(2). States claiming territory in the Antarctic claim also a belt of territorial sea around the coasts of their claim, but states which do not recognise their territorial sovereignty do not recognise such a claim.

(*b*) *Continental Shelf*

14. There exist, south of 60°S latitude, submarine areas which are, in a geophysical and legal sense, continental shelves, those of greatest extent being in the Ross and Weddell Seas. Land territory which is under rights or claim of territorial sovereignty may have a continental shelf in the legal or political sense consisting of any adjacent submarine areas (outside territorial waters) which constitute a natural prolongation of the land into and under the sea. The continental shelf appertains to the land without any special legal process having to be gone through (see The North Sea Continental Shelf Case), I.C.J. Reports, 1969 page 4 at page 22). The Continental Shelf Convention of 1958 (to which all the consultative parties except Argentina, Belgium, Chile and Japan and all the according states are parties) define the Continental Shelf as " the seabed and subsoil of the submarine areas adjacent to the coast but out—or, beyond that limit, to where the

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depth of the superjacent waters admit of the exploitation of the natural resources of the said areas . . ." The water column above the continental shelf (defined in the legal sense) forms part of the high seas. States which do not recognise any claims to territorial sovereignty in the Antarctic do not recognise any sovereign rights over continental shelf appertaining to areas claimed.

(c) *The deep sea bed*

15. South of 60°S, there exist large areas of deep sea beyond the edges of the continental shelves. The deep sea bed (as well as the continental shelf) is covered by high seas. Article VI of the Treaty provides that nothing in it "shall prejudice or in any way affect the rights, or the exercise of the rights, of any State under international law, with regard to the high seas" south of 60°S latitude. Rights on the high seas under customary international law include the right to take fish and other resources, whether living or not, from the water column or the seabed and its subsoil, subject to reasonable regard being bad to the interests of other states in their exercise of the freedom of the high seas (Article 2 of the High Seas Convention of 1958). At the present time, preparations are in hand for a third Law of the Sea Conference to be held under the auspices of the United Nations. This conference will consider proposals for a new Treaty concerning *inter alia*, the legal regime of the deep sea bed beyond the limits of national jurisdiction. Such a Treaty is foreshadowed in the "Declaration of Principles Governing the Seabed and the Ocean Floor and the Subsoil thereof beyond the Limits of National Jurisdiction." (General Assembly Resolution 2749 (XXV) of 17 December 1970) Paragraph 1 of that Resolution declared that the seabed and ocean floor beyond the limits of national jurisdiction with their resources are "the common heritage of mankind".

Operations under existing law

16. Expeditions proceeding from the territory of contracting parties are subject to the requirement of prior notification by virtue of Article VII(5) of the Treaty. Nationals of a contracting party would be subject to the personal jurisdiction of that party. Claimant states would, in addition, claim territorial jurisdiction in their territory, although that jurisdiction may not be recognized by other parties. At present, some Consultative Parties have directly relevant legislation to the question of commercial mining operations which could be used to prevent their companies from beginning such operations either in the Antarctic Treaty area as a whole or in the sector they claim. Other Parties have no legislation which could be so used. Some of these would require an international agreement in a broad sense to enable them to enact such legislation.

17. If expeditions proceeded from the territory of non-contracting parties, Article X of the Treaty would be relevant, as would the statement included in the final report of the Seventh Consultative Meeting held in Wellington in 1972. This states as follows:

"15. The Meeting considered the question of possible substantial or continuing activities or territorial claims in the Antarctic Treaty Area by states that are not Contracting Parties to the Treaty.

"16. It agreed that, in such circumstances, it would be advisable for Governments to consult together as provided for by the Treaty and to be ready to urge or invite as appropriate the state or states concerned to accede to the Treaty, pointing out the rights and benefits they would receive and also the responsibilities and obligations of Contracting Parties.

"17. The Meeting recalled the principles and purposes of the Treaty, in particular that the Antarctic Treaty Area should continue to be a Zone of peace and scientific cooperation and should not become the scene or object of international discord. In this connection the Meeting drew attention to the provisions of Article IV of the Treaty."

18. Operations may be organised by international corporations. The view was expressed in the Working Group that an international corporation is made up of a series of national corporations, whether subsidiaries or parent companies and that jurisdiction could be exercised over one or more component companies in the corporation. It was stated, on the other hand, that, from a realistic and distinct from a formal point of view, international corporations were very difficult for one state to control.

19. Operations can be imagined which are in overt disregard of existing national law, especially where the basis for it is not recognised by other states. Operations in overt disregard or international law can be imagined, for example, where the provisions of Article III regarding the exchange of information are not fulfilled.

In this connection, the Working Group's attention was drawn to a problem which could arise in certain circumstances in reconciling international obligations under the Antarctic Treaty with obligations under other treaties. (e.g. the Treaty of Rome).

The relationship of commercial mining activity to the Antarctic Treaty.

20. The Working Group discussed the compatability of commercial mining operations with the Antarctic Treaty and the possibility of dealing with the subject under the Treaty. Various views were expressed.

21. According to one view, in the present state of the relevant international regulations, the principles of international law and the applicable national legislation, it was not possible to begin commercial mineral exploration in the Antarctic. New international measures, including amendment of the Treaty, would be necessary in the future if serious problems were not to arise.

22. Those who held this view argued that scientific research, which was one of the main objects of the Treaty, was continuing Commercial mineral exploration would disturb scientific activity would constitute a serious danger for the Antarctic ecosystem, and could cause the contamination of its seas, ice and land despite the fact that the requirements of scientific investigation are that the Antarctic should be a non-contaminated area. The attention of the Group was drawn to the preoccupation of successive Consultative Meetings with the preservation of fauna and flora, which, according to this view, was incompetable with commercial mineral exploration. Finally, attention was drawn to Article IV of the Treaty and the comment made that the beginning of commercial mining would raise problems of jurisdiction which it would be better at this time to avoid.

23. According to another view, the Antarctic Treaty does not directly prohibit and at the same time does not permit commercial exploration and exploitation of mineral resources. The Antarctic Treaty does not directly govern this matter. However, any action (unilateral, bilateral or multilateral) by either contracting parties or non-contracting parties aimed at commercial exploration and exploitation of mineral resources will be contrary to the purposes and objectives of the Treaty and therefore should be considered as a violation of the Treaty if undertaken before the consent of all consultative parties to the action has been given. Such action should be considered as a violation of the Treaty because it is incompatible with the following provisions of the Treaty:

(i) "Antarctica . . . shall not become the scene or object of international discord" (Preamble).

(ii) "a treaty ensuring . . . the continuance of international harmony in Antarctica will further the purposes and principles embodied in the charter of the United Nations" (Preamble).

(iii) "Each of the Contracting Parties undertakes to exert appropriate efforts, consistent with the charter of the United Nations, to the end that no one engages in any activity in Antarctica contrary to the principles or purposes of the present Treaty". (Article X).

Additionally, Article II and Article III i. (a) and (c) and Article VII are contrary to the rules of national and international companies providing for protection of commercial and industrial secrets and prohibiting the discovery and exchange of data and the results of explorations for minerals for commercial exploitation.

Several members of the Working Group felt that the Antarctic Treaty does not prohibit exploration and exploitation of mineral resources. Thus, a contracting party (or a national thereof) could now engage in such activity without causing a violation of the Treaty, as long as the activity was consistent with relevant provisions of the Treaty and Recommendations in effect. The relevant provisions of the Treaty and recommendations provide, *inter alia*, that such activity be for peaceful purposes (the Preamble and Article I); not conflict with freedom of scientific investigation (Article II); include exchange of information and research (Article III) and rights for inspection (Article VII); comply with obligations to provide notice of expeditions (Article VII); not violate Specially Protected Areas or cause harmful interference with fauna and flora (Recommendations III–VIII and III–IX regarding Agreed Measures for the Conservation of Antarctic Fauna and Flora); and not conflict with the responsibilities of the Consultative Parties for the protection of the environment (Recognized, for example, in Recommendation VI–4).

24. Those who held this view agreed that the Antarctic Treaty contains certain specific prohibitions and certain specific requirements for consultations. Neither the prohibitions nor the requirements include reference to the economic exploita-

tion of the Antarctic, nor does any article imply such a prohibition. The economic exploitation of the Antarctic is one of the peaceful purposes referred to in Article I and, they believed, must be regarded as a matter left within the competence of individual states. However, precisely *because* it is a legitimate use of the Antarctic for peaceful purposes under Article I, they believed that, although it is not included among those matters specially listed in Article IX, it is one of the matters about which consultative parties may consult under Article IX. In this connection, they believed that, for a number of reasons, including the fact that the Treaty is based on a principle of multinational approach to Antarctic problems and is premised on the unique importance of the area to science, the Consultative Parties should resolve the issue multilaterally, by consultation under Article IX.

INTERNATIONAL ACTION

25. The Working Group held an exchange of view on the nature of the problem of commercial mineral exploration and exploitation in the Antarctic and its possible regulation. The Group agreed that it was not competent to decide whether such activities should be permitted and, if so, how they should be regulated, but agreed to have an exchange of views on the factors which would need to be thought about if and when the Contracting Parties decide that such regulation is necessary.

1. *General considerations.*

26. On the one hand, it was noted that there are a number of countries with sectors in the Antarctic which would wish to make use of their rights as sovereign countries regarding the exploration and exploitation of minerals. Nevertheless, it was necessary to take account of the reality of the Antarctic Treaty. It was essential to settle on a system to regulate the exploration and exploitation of minerals which reconciled the rights of the countries with established sectors with the wishes and expectations of the other Parties to the Treaty. The system should take full account of the Treaty and should elaborate norms that can be applied effectively and will prevent the development of conflicts. Meanwhile, according to this view, it was essential to adopt a moratorium which forbids all commercial exploration and exploitation of mineral resources.

27. Concerning the sense of urgency that some experts have considered characteristic of the present situation, referring to exploration and exploitation of mineral resources, in the light of the disequilibrium existing between technological advances and progress in juridicial-political matters, it was said that one could ask where, in reality, was this urgency. It was quite clear that, in principle, it corresponded to the interest of some privileged economic groups distant from the particular interests of the contracting parties and mankind in general. On the other hand, if there was no juridicial-political decision from the Parties to the Treaty before the realization of commercial exploration and exploitation by these groups, a serious crisis would be created. However, according to this view, the fact of trying to hasten a decision by the Parties to the Treaty to allow exploration and exploitation, based upon an artificial sense of urgency, would also bring forward as a consequence the appearance of a serious conflict between the Parties to the Treaty, which could easily be extended to countries which are not Parties to it.

28. Regarding this last question, another view was expressed that there was an aspect which could be of great urgency for the continued successful operation of the Treaty. Oil companies were known to be interested in securing exclusive rights to explore and to exploit resources of specified areas for a specified period. There were many cases in other parts of the world where they have secured these rights well in advance of the time when they might wish to take any exploratory action. Although companies were at present only at the stage in which they were making enquiries about the conditions under which they might be able to secure such rights in the Treaty Area (and a number had already been received by governments), they would become progressively more interested. According to this view, it was realistic to expect this interest to increase within five or ten years to the point when they might be willing to pay for these rights. It was by this stage that governments should have decided how they propose to deal with the problem; not at a much later stage when commercial exploitation may become practical. It was urgent to have agreed arrangements in the event of anyone wanting to explore and to begin mining. A chart illustrating the various stages of commercial operations was tabled by a member of the group. It is attached as Annex A. It was referred for comment to the Working Group on Technical Questions.

2. *Possible courses of action.*

29. The discussion was held in the order indicated in the following summary of possible courses of action tabled by one member of the Working Group:

(a) The 12 Consultative Parties take no collective action. Possible consequences:
  (i) companies engage in mineral exploration etc. and are not (or cannot be) stopped;
  (ii) unilateral issues of licenses under national law; in the absence of agreed arrangements;
  (iii) assertion of competence by the United Nations over whole or part of the Antarctic Treaty Area;
  (iv) unregulated activities by non-Contracting Parties.

(b) The 12 Consultative Parties do make new arrangements:
  (i) participation—which parties? (The 12; or the 17; some of the 12; accessions to the new arrangements);
  (ii) substance—what arrangements? (Short moratorium; long moratorium; international licensing system);
  (iii) procedure—how to make arrangements? (under Article IX of the Treaty; under its Art. XII; separate Convention; Supplementary Protocol to the Treaty).

(*a*) *The consequences of inaction*

30. A number of views were expressed on the substance of these matters. It seemed generally agreed that the possibilities listed in (a)(i)–(iv) would be highly prejudicial to the continued effective working of the Antarctic Treaty. If any occurred, the Consultative Parties should meet, as provided for under Article IX, bearing in mind, where relevant, for example, Articles X and XI and paragraphs 15–17 of the Report of the Seventh Antarctic Treaty Consultative Meeting.

31. Regarding point (a)(i), it was agreed that, depending on the exact circumstances, some or all of those provisions of the Treaty referred to in paragraph 3 above may apply. It was also stated by some members of the Group that they expected pressure from this direction to increase and that the more agreement it was possible to reach among the Consultative Parties, the greater would be the ability of Governments to resist.

32. The importance was stressed of the fact that the Treaty did not solve the question of jurisdiction except in the case of observers. In these circumstances, if problems arise, the interested states should consult with a view to finding an amicable solution.

(*b*) *Possible action*

33. It was generally agreed that the initial steps should be taken by the Consultative Parties.

34. One member of the Group expressed the view that since the basic problem in mineral exploration was security of title, the problem could ultimately only be resolved by facing up to the problem of territorial sovereignty. The present Treaty could shelve this problem because scientific exploration does not require its resolution. He felt that a possible solution to the problem could be found in the pooling of sovereignties by the 12 i.e. some sort of condominium. This would create the necessary objective regime binding also on non-signatory states since it would create not merely personal rights between the parties but also real rights vis-a-vis the territory that had the necessary recognition.

35. It was stated, on the other hand, that the Parties to the Antarctic Treaty had undertaken certain obligations in respect of the Antarctic and had therefore certain rights vis-a-vis non-Parties to the Treaty.

36. The question of procedure, point (b)(iii) of the summary, was discussed in some detail. Several members of the Group believed that all matters connected with commercial exploration and exploitation of mineral resources in the Antarctic should be solved by the Consultative Parties in the framework of the Antarctic Treaty on the basis of agreed "measures" under Article IX. Others thought that Consultative Parties might adopt Agreed Measures investment of found territory, while proceeding in respect of the seabed by means of a separate convention, in order to obtain a wider group and in order to prevent the "veto" provisions of Article IX being used to prevent progress. In the latter respect, one member of the Group mentioned that even under Article IX it would be possible for the Consultative Parties unanimously to adopt a "measure" under which certain decisions—e.g. the issuance of individual licences—would be adopted by a "qualified" majority. Another thought that it was preferable to proceed

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entirely by separate convention because the Treaty neither permits nor prohibits commercial mineral exploration and exploitation. A new convention would have to be closely linked to the Antarctic Treaty, which would be a defence for it. Finally, the possibility was raised of acting under Article XII to add a supplementary protocol to the Treaty to add to it the elements of whatever international arrangements might be agreed.

37. As an interim measure, there was widespread support in the Group for a moratorium, but some thought that the moratorium should apply to exploration and exploitation, while others thought that it should apply only to the latter. The basis of this disagreement was whether or not a moratorium on exploration would interfere with scientific research and therefore be contrary to Article II of the Treaty because of the difficulty of distinguishing between commercial exploration and scientific research. It was noted that this question was under discussion in the Working Group on Technical Questions.

38. The attention of the Working Group was drawn to the fact that a temporary moratorium for a reasonably short duration could be implemented by the Consultative Parties administratively, but that in order to implement a long-term moratorium, some Consultative Parties which have existing domestic legislation, would have to enact new legislation.

39. The view was expressed that, in any case, no licences should be issued by Consultative Parties until agreement has been reached by the Consultative Parties about the ways in which mineral exploration should be regulated. It was desirable that there be agreement in principle that a joint management plan for the mineral resources of the Antarctic Treaty area will become necessary, involving licences issued under the agreed authority of the Consultative Parties, acting in concert.

3. *Possible content of international arrangements*

40. One member of the Working Group tabled a list of matters which might be studied in connection with the possible regulation of the exploration and exploitation of Antarctic mineral resources. This list was as follows:

1. *Basic provisions:*
   - (a) Measures to ensure that control is retained by the Consultative Parties;
   - (b) Measures to protect the environment;
   - (c) Measures to protect Antarctic research;
   - (d) Measures to ensure income for the Consultative Parties from the time that exploration licences are first issued;
   - (e) Measures to ensure equitable sharing of the benefits between the Consultative Parties for purposes of scientific research in the Antarctic.

2. *Administrative arrangements:*
   - (a) Establishment of an administrative and regulatory body;
   - (b) Designation of continental shelf areas for petroleum exploitation;
   - (c) Regulations for exploration:
     - (i) Annual rental (eg. 1 cent per acre=36,40 per square mile),
     - (ii) Work commitments (eg. 5 cents per acre for 3 years escalating to 10 cents per acre for next 3 years etc.),
     - (iii) Surrender provisions after 12–15 years (creation of Treaty reserve areas available for competitive bidding);
   - (d) Regulations for exploitation:
     - (i) Calculation for Royalties on production,
     - (ii) Drilling and production regulations in accordance with good oil field practice,
     - (iii) Unitizing provisions between adjacent operations in the same field;
   - (e) Liability for damage;
   - (f) Regulations for abandonment;
   - (g) Settlement of disputes.

41. Some members of the Working Group did not feel the Group was competent to discuss such a list and felt the list was possibly very incomplete. Others welcomed the list as a useful stimulus to thought which would greatly assist further study of the subject.

42. Comments were made on some specific questions regarding the possibility of agreed arrangements.

43. It was noted that the Parties pursuant to their obligation to protect the environment, must avoid harm to the environment from any exploration or

exploitation, and that adequate safeguards to this end were essential so that significant injury to the Antarctic environment from such activity could be prevented. The Group noted the constant attention given by the Consultative Parties to environmental questions and believed that existing provisions of the Treaty and Recommendations made under it should apply to this new activity if and when it begins.

Members of the Working Group noted that further study of this question in the Consultative Meeting context was scheduled for the Eight Consultative Meeting. Before deciding whether or not exploration and exploitation of mineral resources should occur and, if so, under what conditions, the Consultative Parties should prepare and consider a thorough analysis of the potential environment impact of such activity. The analysis should include consideration of alternative courses of action and safeguards. The Working Group stressed the need for delegations to approach this discussion fully briefed and, in order to achieve this, for thorough prior study of the problem by individual governments. It was noted that at least one government is obligated by law to prepare an environmental analysis before taking positions on these issues and that other governments have planning legislation or other comparable procedures.

The attention of the Working Group was drawn to the need to consider in the course of such studies the conclusions of other international meetings concerned with the protection of the environment, in particular the recommendations of the United Nations Conference on the Human Environment. The view was expressed that the disposal of industrial waste from operations in the Antarctic should be prohibited and that SCAR should study what damage such disposal could do to the Antarctic environment and ecosystems.

44. There was some discussion of the type of licensing system that would be required. One possibility was that licenses should be issued by states parties to the new arrangements subject to conditions laid out in these arrangements. Another possibility was the issue of licenses by the Consultative Parties, either acting jointly or through an authority established by them for the purpose. Those who favoured the latter emphasized that the authority would be quite small, certainly in the early stages. The view was also expressed that licenses should be issued only to states parties to the arrangements, who might, if they wished, reissue them to companies or other bodies. It would be the responsibility of states to which licenses were issued to ensure that whatever operator they permitted to use their licenses did so in conformity with the arrangements and with the Antarctic Treaty.

45. The relative advantages of national and international licensing were discussed. The advantages of the former were said to be its simplicity, lack of cost and its consequential avoidance of all the problems said to be inherent in the establishment of an international authority—its location, staffing, powers, cost etc. In this connection, reference was made to the Spitsbergen Treaty of 1920 as an interesting Antecedent for an agreement in which sovereignty was retained by Norway while other parties enjoyed equal treatment for all their citizens. On the other hand, some members of the Group felt that an agreement to establish an authority could more easily solve a number of problems including that of jurisdiction, since the arrangements would be inter-state rather than supernational. It was also stated that the issue of licenses by individual states was neither practical nor politically possible in the Antarctic.

46. The Working Group also discussed briefly the interaction between any new arrangements for mineral exploration and exploitation and the Agreed Measures for the Conservation of Fauna and Flora. It was agreed that there were a number of possibilities which would have to be studied. It was assumed that mining would not be permitted in Specially Protected Areas and Sites of Special Scientific Interest, but the possibility was raised of having to protect these further by forbidding mining in a wider area around them. Other parts of the Antarctic Treaty area might be reserved for noncommercial activities. It was noted, finally, that under Agreed Measures, the Treaty Area is considered as a Special Conservation Area.

47. There was also a brief discussion of the settlement of disputes. It was noted that there are provisions of the Treaty, in particular Articles IX and XI, relevant to disputes between the Consultative Parties. On the other hand, if a state issued a license or if a state which has received a license from the Consultative Parties issued licenses to operators, disputes with the operators would be solved according to domestic law, subject to the obligations of the state in question in particular those under the agreed arrangements and the Antarctic Treaty.

49. Members of the Working Group mentioned the need to study the problem of commercial exploitation in relation to the negotiations being undertaken regarding the law of the sea and the view was expressed that the Consultative Parties should adopt a common approach regarding the Antarctic to the results of the Law of the Sea Conference.

49. It was suggested, finally, that the subjects of liability and enforcement should be among those matters which might be studied in relation to possible arrangements for mineral exploration and exploitation in the Antarctic.

50. The group confined its discussions to the exploration and exploitation of *mineral* resources as this is the heading of the item on the agenda of the forthcoming Oslo meeting of the Consultative Parties. However, the group noted that another—even more urgent—problem is the exploration and exploitation of *living resources*. It recalls that the Antarctic *whales* were close to extermination before the states concerned were finally able to agree upon sufficiently effective means of conservation. And even with these—unless further strengthened—it will take several (human) generations before the stock will be restored to its former level. On the other hand, with respect to seals, it was possible—for the first time in history—to establish an agreement before exploration has started—with the Convention for the Conservation of Antarctic Seals signed in London in 1972. (No agreement has yet been elaborated on krill and fish). There, for once, the lawyers and politicians were ahead of the technical and commercial development. The group hopes that it will also be possible to establish the necessary legal dispositions before mineral exploration and exploitation gets under way—with or against the will of the Contracting Parties.

ANNEX A.—STAGES IN COMMERCIAL OPERATION

[Total time span approximately 20 yr]

Commercial activities kept secret				
Exploration			Open commercial operation	
2–3 yr	2–3 yr	2–3 yr	Exploitation	
Specific items searched for future exploitation: Natural gas; oil; iron ore, etc.	Deposits found: Economic evaluation of deposit: High grade ores only.	Layout scheme planned.	4 yr production (extraction) in maximum efficiency. Investments paid off.	Slow down production. Exhaustion.
Preinvestment survey (initial cost).		Investment.		

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SOVEREIGNTY IN ANTARCTICA

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Antarctica, as its etymology implies, until recently was popularly conceived as a region of icefields opposite the North Pole, a final frontier of continental unknowns inhabited by penguins and friendly seals. Formerly the almost exclusive province of exploration giants such as Amundsen, Perry, Shackleton and Scott, that continent has increasingly become the object of large national and international expeditions since the Second World War. Time and technology have started to erode the peaceful state of earlier years. Since the entry into force of the 1959 Antarctic Treaty,[1] these factors have generated a renewed interest in the legal rights and relationships in the continent, especially insofar as they have been affected or altered by the treaty regime.

The treaty, although a laudable and extremely practicable approach to international political problems associated with Antarctica, does little more, legally

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speaking, than preserve an opaque *status quo ante*, putting on ice the complex and contradictory rights and claims lodged earlier by the contracting parties. Most of these rights and claims were voiced in an earlier age and based, with one notable exception, on traditional international legal modes of acquiring title to territory. While it is true that the moratorium created under the treaty causes unique problems in relation to sovereign claims, the foundation of the issue is independent of the treaty, and although the issues are temporarily eclipsed by the latter, they will ultimately, in no small measure, be resolved by recourse to the traditional underpinnings. A reassessment of the problem is due given recent developments in: (1) the law of the sea; (2) the technological ability to explore and to exploit minerals in a highly interdependent world rudely introduced to the energy crisis; (3) the increase in activity of a permanent nature in Antarctica; and (4) the imminent equinox of the Antarctic Treaty's envisaged duration.

This article is divided into several sections. After a brief historic and geologic description of Antarctica, certain provisions of the Antarctic Treaty relating to the issue of sovereignty are identified and discussed. Then a section will follow which treats the problems evinced in the treaty language by the fact that much of Antarctica is composed of ice. The remainder of the article deals with the problem of acquisition of territory in Antarctica under traditional and nontraditional modes. Although not specifically intended to posit United States' practice *vis-à-vis* Antarctica, reference will be made to that practice as a convenient analytical mode of examining the entire question.

I. Historic and Geologic Description of the Antarctic Continent

Antarctica, traditionally *terra australis nondum gognita*,[2] is the fifth largest continent of the world, comprising five and one half million statute square miles.[3] The continent is generally considered as consisting of two major areas, Eastern (Greater) and Western (Lesser) Antarctica, divided by the Transantarctic Mountains.[4] Whereas Eastern Antarctica consists largely of a high ice-covered plateau, Western Antarctica consists of an archipelago of mountainous islands covered and bonded together by ice.[5] Primarily overlain by a continental ice sheet averaging 6,500 feet thick, many deep embayments of the Ross and Weddell Seas are covered by ice shelves, or ice sheets floating on the sea.[6] The Ross, Ronne and Filchner Shelves around the continental periphery, along with lesser shelves, constitute approximately ten percent of the area of Antarctic ice. These shelves and ice sheets "calve", or discharge icebergs into the sea along the continental perimeter.[7]

Relatively little knowledge has been gleaned on the geologic substructure of Antarctica. However, recent discoveries have indicated that Eastern Antarctica is made up of a stable Precambrian shield, while Western Antarctica consists of a mobile belt separated from East Antarctica by a fault block belt or horst, the Transantarctic Mountains. Although it has been proposed that Western Antarctica might be an oceanic island, its crustal thickness of about twenty miles indicates an absence of oceanic structure.[8]

As will become apparent from a theoretical legal viewpoint, the relationship of the ice to the geomorphologic basement is important in weighing the merits and demerits of applying a continental versus high seas regime to Antarctica. Apart from the question of whether the ice is fresh water or sea water in origin the fact that the immense weight and thickness of the ice cap, shelves, and sheets have severely depressed what otherwise would have been a continental land mass with perhaps arcuate chains gives rise to intriguing legal issues.

In considering the rock elevation beneath the thick, grounded ice of Marie Byrd Land, it should be remembered that the weight of the overlying ice has depressed the land surface approximately 500 meters, and up to 1,000 meters in the deepest part of the central basin. Thus, sea level before the growth of the ice in Western Antarctica could be represented fairly well by the 500 meter contour.[9] Although the legal consequences, if any, of a "lost continent" depressed under the Antarctic Ocean by the polar ice cap must await the further development and refinement of geophysical techniques, the very existence of the basement itself and its sialic nature indicates a closer relationship to terrestial rather than to submarine areas.

Webster's New World Dictionary defines "land" as being "the solid part of the earth's surface: distinguished from sea." [10] The immediate question which arises

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is whether a land or high seas regime should be applied to Antarctica. This in turn depends on several factors: the historic nature antecedent to the current traditional high seas doctrine; the nature of the ice formations under discussion; and article VI of the 1959 Antarctic Treaty.[11]

II. Historic Antecedents to the Freedom of the High Seas Doctrine

The traditional high seas freedoms beyond the territorial seas of nation-states have enjoyed a checkered history, primarily dictated in less enlightened eras by England's ability or inability to dominate the high seas. De Grotius contended that the sea could not be state property because it could not really be taken into possession through occupation, from which it followed that the sea was free from the pretensions of sovereignty by any state.[12] This power concept of the effectiveness of occupation and control found further form in the establishment of the three mile territorial sea,[13] a distance predicated at that time on the theoretic range of coastal cannon, and the state's consequent ability to defend the territorial sea from invaders.[14]

Before Drake and the weather destroyed Philip II's Armada in 1588, during an era in which the Armada was the paramont naval force afloat, Queen Elizabeth I was the first European sovereign to enunciate the freedom of the seas doctrine. As Balch states:

"What is the law applicable to the sea? Originally formulated by Queen Elizabeth and more fully expounded by the Hollander, Hugo Grotius, the freedom of the high seas was controverted in the reign of Charles the First by the publication of the treatise *Mare Clasum* written some years before by England's ablest jurist at that time, John Selden." [15]

As mentioned above, Grotius gave scholarly vent to the freedom of the seas doctrine in his treatise *Mare Liberum*, first published in 1609 in justification of the allied Low Countries' rights against Portuguese sea power.[16] John Selden, however attacked *Mare Liberum* in his treatise *Mare Clausum*,[17] and established a principle incorporating English domination. The latter principle remained part and parcel of the English high seas doctrine, whereby English men-of-war on the high seas required foreign ships to dip their colors to the English standard in deference to the latter's claim to the high seas. The doctrine remained in vogue until the mid-Napoleonic period, when pre-eminent English sea power, the burgeoning of global trade, and a nascent empire dictated an endorsement of the freedom of the high seas principle as inuring to the English advantage.[18]

The original reason postulated by De Grotius for freedom of the seas was that the high seas were incapable of effective occupation. Another prevalent rationale involved the notion that the riches of the sea were inexhaustible and that there was therefore no need for any state to claim them to the exclusion of others. Neither of these notions are currently maintained. However, the third reason then espoused, the need for unimpeded passage and communication, is still prevalent:

"[T]he real reason for the freedom of the open sea is represented in the motive which led to the attack against marine sovereignty, and is the purpose for which such attack was made—mainly, the freedom of communications and especially commerce, between the states which are separated by the sea. The sea being an international highway which connects distant lands, it is the common conclusion that it should not be under the sway of any state whatsoever. It is in the interest of free intercourse between the state that the principle of the freedom of the open sea has become universally recognized and will always be upheld."[19]

Thus, the prevailing reasoning behind the high seas principle appears to have little applicability to Antarctica. A further examination of this issue, therefore, must be undertaken. It will be preceded by a discussion of the nature and characteristics of Antarctic ice.

III. The Antarctic Ice

Antarctic ice occurs in three major forms: pack ice, ice shelves, and ice sheets. Pack ice is generally categorized as sea ice, and is formed by the freezing of sea water. Although normally brittle and broken up by the sea state, pack ice near land may attach itself to shore and become what is called an ice foot. Shelf ice, initially generically the same as pack ice, forms on the surface of the sea, but normally in bays or other sheltered area. Such deposits may build up a shelf which remains attached to the land for many years. Such shelf ice can reach thickness of 500–1000

Footnotes appear at end of article.

feet, as in the Ross Sea, and on its most seaward extremities is subject to calving; that is, the breaking away of large pieces into the sea. Ice sheets, on the other hand, are generally considered land ice, and are formed on land by the freezing of fresh water or the compacting of snow as layer upon layer adds to the pressure on that beneath. On the Antarctic Plateau ice caps form and remain throughout the year, some attaining several thousand feet in thickness.[20]

When the ice is terrestrial in nature, as is sheet ice, not as many legal problems are evinced. But where the ice is sea-based, such as is the case with pack ice or shelf ice, fifty years of exegesis have not resolved the regimes issue.

An interesting vantage on the ice issue is tangentially provided by Oppenheim in his definition of high seas:

The open sea, or the high seas, is the coherent body of salt water all over the greater part of the globe, with the exception of the maritime belt and the territorial straits, gulf, and bays which are part of the sea but not part of the open sea. Wherever there is a salt-water sea on the globe, it is a part of the open sea, provided it is not isolated from, but coherent with, the general body of salt water extending over the globe, and provided that the salt water approach to it is navigable and open to vessels of all nations.[21]

Leaving aside the navigability and open approach issues which would clearly remove most Antarctic ice from any high seas regime, Oppenheim maintains that the high seas must be a "coherent body of salt water." [22] Would this, then, imply that fresh water could not be the subject of a high seas regime, and possibly provide a partial key in resolving this issue?

The nature of the ice precludes such a possibility. Depending upon the temperature, the trapped brine in sea ice either freezes or remains liquid but due to its density, settles downward. As settling occurs, the ice gradually freshens so that after two years of initial formation, virtually all salt has been eliminated. Icebergs originally formed from sea ice contain no salt with the passage of time, and uncontaminated melt water obtained from them is fresh. Thus it would be highly impractical, if not impossible, to ascertain the "dividing line" between the high seas and mainland Antarctica based on the above criterion. In similar vein, even if Oppenheim's definition were accorded oecumenical subscription it would be impracticable to insist that ice shelves over the open sea are not a "coherent body of salt water" [23] merely because ice, especially that composing the Antarctic barriers, is not coherent with the body of water comprising the high seas.

The Arctic experience of the late nineteenth and early twentieth centuries has provided much guidance on possible approaches to the ice problem. However, given the fact that Arctic ice is completely devoid of terrestrial origins, and that the North Polar ice cap is completely floating on the high seas, much of the guidance provided is initially misleading if not carefully evaluated. Lakhtine, in discussing Arctic ice, states with regard to the above distinction.

"We are of the opinion that floating ice should be assimilated legally to open polar seas, whilst ice formations that are more or less immovable should enjoy legal status equivalent to polar territory." [24]

Although much of Lakhtine's writing was written in the 1920's in a quite apparent and febrile attempt to substantiate the then recently proclaimed Soviet sector principle and, therefore, should largely be discounted, there is merit to his distinction drawn here. Balch neatly draws this distinction when he states that the frozen oceans of the North Pole, as they are in continual motion moving from the Bering Straits towards the Atlantic Ocean, are incapable of being owned; but that immobile ice such as exists at the South Pole may be made the subject of sovereignty.[25] Rolland maintains that a permanent surface of ice extending from the coast out towards the sea should be a continuation of the land.[26]

There are an equal number of proponents of the view that ice is not land and therefore is incapable of being subsumed in any terrestrial regime. Clute maintains that even if large areas of the Arctic Sea are frozen up, it must still be regarded as an open sea and thus not subject to claims of sovereignty.[27] Oppenheim asserts that the North Pole cannot be occupied "as there is no land on the North Pole."[28] Fouchille maintains, on the other hand, that ice, being in its nature essentially different from water as well as from dry land, can be made with some limitations the object of exploitation.[29]

Smedal, in his excellent and definitive article *Acquisition of Sovereignty over Polar Areas*, on which much of the sector principle discussion of this article is

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Footnotes appear at end of article.

based, ably synthesizes these convergent views and provides a basis on which to proceed:

"[I]f we now raise the question whether the Ross Barrier can be subjected to sovereignty then the question is least difficult to answer with regard to that part of the Barrier which rests on solid ground. It must be put on a par with a land territory, and it can be occupied.

"What has been said above on the question of sovereignty in respect to Ross Barrier, applies also to other barriers resembling the Ross Barrier." [30]

Smedal's synthesis, accounting for the dichotomy between floating and non-floating ice, proceeded one step further. In examining the Ross Barrier he addressed the subject of thick floating ice, which for all apparent purposes is immobile, even though it is in fact slowly advancing towards the open ocean where it calves. Although this phenomenon was not *per se* mentioned in his article, he was doubtless cognizant of it, its discovery having been attested to in another article two years before:

"Captain Scott in his two studies of the Barrier Edge in 1902 and 1911 noted that the greater part of the ice-field had advanced at the rate of about a mile a year, but he also found that there were two fixed points where neither advance nor recession was appreciable." [31]

It is further submitted that Smedal's analysis should not be discounted merely due to the phenomenon of calving. While it is true that under general terrestrial principles the loss of such legal portions of a land domain is unusual, the process should be analogized to accretion, erosion, and avulsion, as these processes are not inherently dissimilar in nature. While calving generally produces sudden, significant territorial changes, avulsion also refers to a "sudden change in the channel of a stream, . . ." [32] Even fewer problems are present if wave action causes the gradual erosion of the seaward edge of an ice barrier, as this phenomenon is very similar to erosion.

Earlier objections raised to the treatment of Arctic ice under a terrestrial regime were to a large degree based on the inherent difference between the nature of Arctic and Antarctic ice. Pharand objects to the treatment of Arctic polar ice as immobile, not because of the type of mobility associated with the Ross Barrier, but because, unlike the latter, no part of the Arctic polar ice cap proper is either attached to or resting upon land. The problem he refers to is that Arctic ice is and was originally pack ice, and thus in constant motion without reference to any fixed continental point. "Such a view [that Arctic ice should be a valid object of territorial sovereignty]," he says, "does not take sufficient account of the fact that the North Pole [rests] on 4,300 meters of water. . . ." [33] Balch alludes to the same problem:

"But the ice at the North Pole is never at rest. It is in continual motion. It moves slowly in a direction from Bering's Strait towards the Atlantic Ocean. Consequently any habitation fixed upon it would be continually moving. And such possible occupation would be too precarious and shifting to and fro to give anyone a good title. And so the rules of the Law of Nations that recognize the freedom of the high seas, would seem to apply naturally to a moving and shifting substance like the North Polar Sea ice at all points beyond the customary three-mile limit from the shore." [34]

The above illustrations demonstrate that given an appreciation of the fixed versus floating nature of the ice in the antipodes, prior legal authorities would not necessarily share similar sentiments were they writing today on the same issue in Antarctica.

When examining "continental" Antarctica as distinguished from the ice shelves and the barriers, unique problems also arise. As alluded to earlier, Eastern Antarctica presents little problem; the continental mass is typified on a large scale by a simple structure of broad basins and swells, with the rock surface being at an altitude of zero to two hundred meters.[35] However as a result of glacial depression, there are several depressions below present sea level.[36]

The subglacial topography of Western Antarctica, however, is more complicated. Much of central Western Antarctica is a deep basin, with depressions as great as 2500 meters below sea level. This channel is connected by other channels to the Bellingshausen, Amundsen, and Ross Seas, all of which, even after isostatic rebound, would remain under present sea level. Such isostatic rebound would isolate the high standing areas of coastal Marie Byrd Land and Thurston Land as islands.[37]

Footnotes appear at end of article.

What real-world significance does isostatic rebound and Antarctic subglacial geomorphology hold for us? Rebound in itself, and a presence of islands and surrounding seas in Western Antarctica, should be accorded but slight attention. Even if man is able, it is highly unlikely that he will embark on so ambitious a project as one which would submerge most of the major coastal cities and adjacent coastal plains of the world. Nor will such a phenomenon occur during the projected future of mankind. In that it precludes any possibility of navigation, however, it is significant that a depressed geologic basin is extant in most of Eastern Antarctica and part of Western Antarctica. For that matter, the very thickness of the shelf ice precludes submarine navigation for the greatest part of the continent. Seismic tests by the United States Navy in the immediate vicinity of the South Pole indicate there was an accumulation of 8,200 feet of dense ice, topped by twenty feet of harder ice, topped, in turn, by surface layers of snow and ice seventy-seven feet thick.[38]

In this regard, Hayton states:

"In any event the complications for international law are numerous when it must be conceded that thousands of square miles of interior Antarctic surface are are in reality ten thousand feet of rigid ice over rock that is well below sea level. If this ice were melted, much of the area would clearly be only "high seas." Such a holding under present conditions is patently absurd. It is not yet known whether the ice in these below-sea-level regions is frozen fresh or frozen sea water. Even if a basic continent with its major portions above sea level is finally confirmed and delimited, there may be the anomaly of fringe portions of the Antarctic totality consisting of "islands" bound together for eons by a layer of solid ice rising from below sea-level bedrock to an altitude of several thousand feet above sea level. If Marie Byrd Land should turn out to be this kind of ice-bound archipelago, what should the U.S. position be with respect to the application of the law in this case? " [39]

If the isostatic rebound argument or the geologic inquiry is carried beyond these reasonable initial observations in any exhaustive analysis, the difficulties raised far outweigh any real-world solution to be derived therefrom. For example, if the summit of Marie Byrd Land, which would be islands if the ice sheet was removed, would be considered as islands in the present frozen "sea," then the ice sheet covering the "island" above sea level could be subjugated to a land regime. But could this island "coast" be determined with any accuracy?

If the Antarctic Treaty language itself is examined it is apparent that article VI of the treaty treats all ice shelves, as distinguished from pack ice, as *glacies firma*. it provides:

"The provisions of the present Treaty shall apply to the area south of 60° South Latitude, including all ice shelves, but nothing in the present Treaty shall prejudice or in any way affect the rights, or the exercise of rights, of any State under international law with regard to the high seas within that area." [40]

The above article, while answering some questions, also raises some. It certainly assimilates ice shelves to the "area" of Antarctica and therefore presumably to a land status. The adverb "presumably" is used not *ex abundanti cautela*,[41] for nowhere in the treaty is the word "land" or "continent" used as referring to Antarctica. Rather, it is always referred to as "Antarctica" or "area." Thus, as a matter of technical interpretation, it is unclear whether any part of Antarctica at all is to be considered land. There are, however, several valid rejoinders to this question. First, mountain chains of both sea level and ice level cannot be considered as anything but *terra firma* from a logical viewpoint. Second, article VI of the treaty in a comparative fashion distinguishes between "high seas" and "area,"[42] and since (in the Antarctic context at least) the only principal regimes would be the high seas and the land, it can reasonably be assumed that "area" equates with "land." Finally, the acts of the parties, during both the term of the treaty and the period of discovery of the continent, have indicated the parties always acted toward Antarctica as if it had been land. This being so, ice shelves to all intents and purposes have been assimilated to the land regime. Since the treaty specifically provided for this particular category of ice to the exclusion of any other, it can be assumed that pack ice has not been included within the land definition. The same may also be held to apply to ice islands which occur in the area south of 60 degrees south latitude.

The freedom of navigation principle, as the basis of the high seas regime today, has already been discussed. Little need be said to indicate that the Antarctic presents very limited opportunity for traditional surface or subsurface navigation.

Footnotes appear at end of article.

"By far the greater part of the interior is covered by an unknown thickness of snow and ice which extends generally as far on the coast. Along the coast there is a special formation of ice called shelf ice or the barrier. It stretches from land towards the sea and varies in height from some few feet to over 100 feet above the level of the sea. Its surface is approximately horizontal, but it terminates on the sea side in vertical cliffs" [43]

Finally, in connection with navigation and Antarctic ice, the argument could be voiced that because navigation might be possible to some degree under the seaward coast of certain ice shelf borders of Antarctica, it would be impossible for any states to claim sovereignty over such an area from a security viewpoint. Several responses could be made. First, under prevailing international law, the right of innocent passage is accorded all ships, including submarines, although the latter are required to navigate on the surface and show their flag.[44] Second, assuming that sovereignty over the submerged lands of the adjacent continental shelf has already been granted coastal states, is there any valid reason why the reverse of this state of affairs could not equally apply as a valid one, (that is, to treat the land above as sovereign and the waters below *res communis omnium*)? First of all, from a practical vantage, the problem would be *de minimis*, as only few areas of Antarctica would admit of such submarine navigation; second, in most places where the ice shelves would so admit, their thickness would be so great as to preclude any danger from submarine navigation to the territorial sovereign above; third, a territorial sovereign would in all probability be entitled to a territorial sea in which he could in his discretion, prohibit such subsurface navigation, thereby preventing the problem from ever arising. While recognizing the present right of innocent passage accorded capital ships through the territorial sea, a submarine under thick ice would in all probability render little threat.

In summary, there is no logical or compelling legal reason, including navigational freedom, why the shelf and sheet ice of Antarctica should not be assimilated to a land regime governing that continent.

IV. Effect of Treaty Termination

As alluded to previously, prior discovery and exploration and current activities of the United States in Antarctica achieve their greatest relevance and significance when applied to the sovereignty issue in light of the legal state of affairs which will apply after the treaty terminates. Although the treaty does not provide for any specific termination date *per se*, it has been the practice of most contracting parties to regard the treaty regime as a temporary one and to interpret article XII(2)(a) of the treaty as one signifying the termination of the present regime 30 years after the entry into force of the treaty. Article XII(2)(a) of the treaty provides:

"If after the expiration of thirty years from the date of entry into force of the present Treaty, any of the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX so requests by a communication addressed to the depository Government, a Conference of all the Contracting Parties shall be held as soon as practicable to review the operation of the Treaty." [45]

In addition to this contemplated date, the complementary provisions of article XII (1)(a) and (2)(c) provide for possible withdrawal by any contracting party:

"XII(a) The present Treaty may be modified or amended at any time by unanimous agreement of the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX. Any such modification or amendment shall enter into force when the depository Government has received notice from all such Contracting Parties that they have ratified it.

"XII 2(c) If any such modification or amendment has not entered into force in accordance with the provisions of subparagraphs 1(a) of this Article within a period of two years after the date of its communication to all the Contracting Parties, any Contracting Party may at any time after the expiration of that period give notice to the depository Government of its withdrawal from the present Treaty, and such withdrawal shall take effect two years after the receipt of the notice by the depository Government." [46]

It can be seen from an interpretation of the last two provisions that it would be an extremely straightforward matter for any contracting party whose interests dictated disassociation from the treaty regime to release itself therefrom. Either it could fail to ratify a modification or amendment by another contracting party, or on its own initiative, it could submit a modification or amendment which could not fail to elicit disapprobation by another contracting party. In either case

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Footnotes appear at end of article.

the result would be the same: release from the treaty regime within two years of the submission of the amendment. This, it should be remembered, is entirely independent of the thirty year term intimated in article XII(2)(a), and could theoretically occur within two years of the present.

If, however, there remains any doubt as to the interim nature of the treaty and the effect of article XII(2)(a), any modicum of reflection dictates that no state has permanently surrendered its claims to Antarctica.[47] Article IV of the treaty, the single article perhaps most responsible for the signing of the treaty by the original contracting parties in 1959, confirms the fact:

"1. Nothing contained in the present Treaty shall be interpreted as:

"(a) a renunciation by any Contracting Party of previously asserted rights of or claims to territorial sovereignty in Antarctica;

"(b) a renunciation or diminution by any Contracting Party of any basis of claim to territorial sovereignty in Antarctica which it may have whether as a result of its activities or those of its nationals in Antarctica, or otherwise;

"(c) prejudicing the position of any Contracting Party as regards its recognition or non-recognition of any other State's right of or claim or basis of claim to territorial sovereignty in Antarctica.

"2. No acts or activities taking place while the present Treaty is in force shall constitute a basis for asserting, supporting or denying a claim to territorial sovereignty in Antarctica or create any rights of sovereignty in Antarctica. No new claim, or enlargement of an existing claim, to territorial sovereignty in Antarctica shall be asserted while the present Treaty is in force." [48]

The primary justification dictating the preparation of this article is embodied within the terms of these last provisions. They are the operative ones with respect to the entire sovereignty question in Antarctica for the present and envisageable future, and with respect to the past as that may be interpreted in the present and future.

Having considered the general reservation of the *status quo ante*, the first point to be noted is that article IV(b) provides that nothing in the treaty shall be interpreted as a renunication or a diminution of a claim which a party *may* have.[49] It is possible that the use of the word "may" could be construed so as to signify a possibility or likelihood in the future.[50] It is clear that activities initiated after the treaty is in force can be used as a basis for asserting sovereign claims on the continent. The executed nature of continuing activities initiated during the treaty regime lends itself to a similar interpretation. Also, if it is recognized that only such claims as are continuing after termination could be used successfully to assert sovereign claims on the basis of occupation given the present situation in Antarctica, and that it is unlikely that bases found under the present regime will be abandoned or not continue to be the scene of continuing activities, the real-world effect would be the same regardless of time of initiation of such activities. However, due to the executed nature of such activities, the following explanation indicates that such a treaty provision cannot have any effect after termination.

Two articles in the 1969 Vienna Convention on the Law of Treaties are pertinent to any discussion of Article IV of the Antarctic Treaty. Article 43 of the Vienna Convention states:

"The invalidity, termination, or denunciation of a treaty, the withdrawal of a party from it, or the suspension of its operation, as a result of the application of the present Convention or of the provisions of the treaty, shall not in any way impair the duty of any state to fulfill any obligation embodied in the treaty to which it would be subject under international law independently of the treaty." [51]

Article 70 of the Vienna Convention provides:

"Unless the treaty otherwise provides or the parties otherwise agree, the termination of a treaty under its provisions or in accordance with the present Convention: (a) releases the parties from any obligation further to perform the treaty; (b) does not affect any right, obligation or legal situation of the parties created through the execution of the treaty prior to its termination." [52]

Article 43 creates no problem for contracting parties whose obligations under the Treaty have terminated, as there is clearly no obligation under international law either to refrain from acts of discovery or occupation in *terra nullius*, or in areas in which the state justifiably fails to recognize sovereign claims put forward by other states. Article 70, however, presents more difficulty. Is there any obligation or legal situation incumbent on a party created during the time the treaty is in force which perforce continues after termination? To answer this question there must first be an examination of the nature of the activity in question, such as future construction of bases on Antarctica.

Footnotes appear at end of article.

Lord McNair indicates the appropriate distinction to be drawn:

"In so far as the provisions of a treaty have already been executed and have had their effect before the termination, they have passed beyond the sphere of the operation of the termination; something has been done; for instance, territory has been ceded, persons or movables have been surrendered, and in many cases new rights and statuses have been created which, although they owe their origin to the treaty, have acquired an existence independent of it; the termination cannot touch them. On the other hand, other provisions take the form of continuing obligations and operate *de die in diem* so long as the treaty remains in existence, for instance, to surrender alleged criminals of certain types, to attribute a particular nationality to persons born in certain circumstances; upon termination no further rights of this type can accrue. If we may borrow the terminology of English law, this is the difference between executed and executory obligations: . . ." [53]

Some doubt might be raised as to whether erecting sites are activities which "have already been executed and have had their effect before the termination." [54] However, doubt is removed upon reading the second part of the compound beginning "on the other hand," [55] as it seems clear that such activities are quite unrelated to Lord McNair's given examples. Such an act is therefore beyond the sphere of application of the treaty. Such acts, while "non-rights" during application of the treaty, must become vested ones after the treaty termination, for it would be impossible to ignore the existence of such bases and continuing activities associated with them.[56] However, after lapse of the treaty regime it would perhaps be politic *pro forma* to make a new formal declaration as to such bases and send new teams to them in order to disassociate such continuing activities from those conducted under the treaty, thereby giving them an independent, *de novo*, existence.

Sir Gerald Moore supports Lord McNair's reasonings:

"It is an accepted rule of treaty law that the termination of a treaty, for whatever cause and in whatever way, can only affect its continuing obligations and cannot *per se* affect or prejudice any right already definitively and finally acquired under it, or undo or reverse anything affected by any clause of an executed character in the treaty. Thus a payment made under the treaty does not become repayable; a settlement of a dispute affected by a treaty does not become reopened because the treaty terminates or is denounced; demarcated frontiers are not rendered indeterminate; sessions of territory are not cancelled, etc." [57]

Lord McNair's explanatory footnote to the first sentence of Sir Gerald's observation is most germane:

"[W]hich would, as I understand it, denote not only rights acquired at the time of, and as a result of, the conclusion of the treaty but also rights which a party has acquired later, for itself or its nationals, during the currency of the treaty and before termination, in pursuance of a power conferred upon it by that treaty; for instance to acquire concessions upon a defined area of the other party's territory." [58]

Both Lord McNair and Sir Gerlad, in discussing the nature of the obligation, had occasion to refer to the word "rights," a nebulous term of art. Taken in a broad concrete sense, a right signifies a power, privilege, faculty or demand, inherent in one person and incident upon another, or as "powers of free action." In a narrower sense and one more appropriately suited to our examination the term denotes an interest or title in an object of property.[59]

A distinction should be observed here. Lord McNair speaks concurrently of both obligations and rights. In the example posited for discussion, that is, the construction and maintenance of Antarctic bases, we are talking of two separate problems: first, the obligations, if any, of the contracting party to refrain from using bases constructed during the treaty regime as a basis for posttreaty sovereign claims, and second, the status of the base itself. The first obligation is a right *in personam*, one imposing obligations on a definite person natural or judicial; the second is a right *in rem*, being one which imposes an obligation on persons generally. If one, for the purpose of discussion, treats the treaty parties as being all the world, Lord McNair's analysis of article IV(2) of the treaty would translate the latter as both a right *in rem* and *in personam:* the former, as the right to property erected in *terra nullius* can only amount to a right *in rem* (in the claimant's view) as against all the world (and given the temporary nature of the treaty); the latter, as the obligation owing the other treaty parties to refrain from using such bases as claims to sovereignty during the treaty regime. Therefore, it is submitted that there is indeed a right attaching to the establishment of bases and related activities

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Footnotes appear at end of article.

thereto in Antarctica, that the right is the large part executed although executory in nature, and that article IV of the treaty would not preclude the contracting parties from continuing to utilize bases constructed during the period in which the treaty was in force and to lodge claims to territorial sovereignty theron.[60]

V. Traditional Modes of Acquisition Territory Applicable to Antarctica

Having concluded that article IV of the treaty does not jeopardize the previously asserted rights or claims to territorial sovereignty in Antarctica, and that activities initiated during the treaty regime may, after its termination, provide the basis of sovereign territorial claims in Antarctica, the modes of acquisition of territory in Antarctica must be examined.

A. Territorial Acquisition in General

"The sovereignty of territory may be acquired by occupation, prescription, cession, conquest, and accretion." [61] Of these five, only two actually apply to Antarctica. Cession, a mode of transferring title to territory from one state to another, has not occurred in Antarctica and need not be discussed. Given the Charter of the United Nations and the duties incumbent on its members thereunder, it is highly doubtful whether conquest is still a valid means of acquiring title to territory. Cetainly it has not been a form of title evoked in Antarctica to date; it would not be allowed under the treaty, and it is highly improbable after its termination. As already discussed, accretion occurs in Antarctica only in a related and reverse form (calving.)[62]

The primary mode of acquiring sovereignty in Antarctica is *occupatio*, coupled with discovery. [63] Diverse problems associated with the history of Antarctica and continuing into the present time—problems to a large degree dictated by the severe climatic conditions of that continent—have created certain exceptions to the traditional *occupatio* doctrine. Before applying it to Antarctica, therefore, an examination of the nature of the doctrine and of its historical antecedents is warranted.

James Cook was the first explorer of modern times to be associated with Antarctica when he circumnavigated that continent during the years 1772–75.[64] Although open to conjecture, Gottlieb von Bellingsheusen, a Russian, is credited with first sighting the continent in 1820.[65] Thereafter, the coasts of Antarctica were the subject of whaling and sealing expeditions by many nations. The first notable historic claim *per se* to Antarctica was forwarded by Dumont D'Urville 1837–1840, when he claimed Adélie Land for France.[66]

Most discoveries and formal claims were espoused during the first two decades of the twentieth century. Scott and Shackleton led three expeditions deep into the Antarctic hinterland, with Scott attaining the South Pole in 1911–1912.[67] The Norwegian Roald Amundsen also reached the Pole in 1911.[68] Admiral Richard Byrd in several expeditions from 1926–1947 introduced airplanes into Antarctic exploration, and in 1926 was the first to fly over the Pole.[69]

The activities which occurred during the early twentieth century led to conflicting claims among seven states to areas of Antarctica, especially in the Palmer Peninsula (Graham Land) area. However, no permanent settlements or continuous activities colored the claims forwarded until the 1950's.[70] Since 1924, it has been the policy of the United States to refrain from espousing any claims itself and from recognizing those made by other states, due to the lack of actual settlement in the areas claimed.[71]

Because of the nature to date of Antarctica as *terra nullius*, the principal mode of acquisition to territory in the continent has been *occupatio*, usually coupled with discovery as previously stated. As the remaining part of this section will largely concern this concept, one of fundamental importance in Antarctica, it is important to understand the nature and reasoning behind the concept. Vattel, in *Le Droit des Gens*, has given what perhaps is the best description of the role *occupatio* performs in international law:

"[*B*]ut it is questioned whether a nation can, by the base act of taking possession, appropriate to itself countries which it does not really occupy, and thus engross a much greater extent of territory than it is able to people or cultivate. It is not difficult to determine that such a pretension would be an absolute infringement of the natural rights of men and repugnant to the views of nature, which, having destined the whole earth to supply the wants of mankind in general, gives no

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nation a right to appropriate to itself a country except for the purpose of making use of it, and not of hindering others from deriving advantage from it".[72]

This analysis emphasizes the basic logic behind the doctrine: utilizing the resources of territory as efficiently as possible and permitting only those persons best in a position to utilize them to do so. The argument has been voiced in connection with the polar regions however, that due to their distant, inhospitable, and unique nature, an exception to the general rule should be made. Smedal replied to this contention:

"[I]n the theory and practice of international law it is laid down that sovereignty over a no man's land must be acquired by occupation if all the interested powers are not agreed to place such land under the single State. As mentioned several times before, there is no valid reason for departing from the rule in the polar regions. In fact, it cannot be dispensed with, for it cannot be replaced by any other rule to which the comity of nations is willing to adhere. There can be no doubt that the States are unwilling to renounce in the polar regions the role of occupation".[73]

The *occupatio* doctrine is the basic mode of acquisition of territory today, having its origin in the Roman law of property in which the element of control exercised by the owner was essential. It has enjoyed a steady and continuous development after its resuscitation by the discovery of the New World and promulgation of the Papal bull *Inter Caetera* (the latter actually being a precedent on which certain South American States base their sector claims to Antarctica).[74] The continued emphasis on effective control, whatever form it may take, has always been present.

According to Oppenheim:

"Theory and practice agree nowadays upon the rule that occupation is effected through taking possession of, and establishing administration over, the territory in the name of, and for, the acquiring State. Occupation thus effected is *real* occupation, and, in contradistinction to *fictitious* occupation, is named *effective* occupation. Possession and administration are the two essential facts that constitute an effective occupation.

"(1) *Possession.*—The territory must really be taken into possession by the occupying State. . . .

"(2) *Administration.*—After having, in the aforementioned way, taken possession of a territory, the possessor must establish some kind of administration thereon which shows that the territory is really governed by the new possessor. If, within a reasonable time after the act of taking possession, the possessor does not establish some responsible authority which exercises governing functions, there is then no effective occupation, since in fact no sovereignty is exercised by any State over the territory." [75]

If, then, we are cognizant of the nature of sovereignty and of *occupation* and if we are convinced of the strict applicability of the latter to Antarctica, an examination of its basic elements is in order.

B. THE NECESSITY OF STATE ACTION

As only states are properly the subject of international law, only acts of acquisition to territory undertaken by them in their sovereign capacity or through the acts of their agents, actively and contemporaneously supported by the state, are recognized by the family of nations. Regardless of the special bond of nationality existing between a state and its subjects, the latters' discovery and occupation of *terra nullius* will not validate subsequent state claims to such lands without prompt endorsement of them. In words of Smedal:

"[S]overeignty can only be exercised by a State, not by private persons or companies, *e.g.*, colonization companies. This fact has not always been clearly recognized. Colonists may, however, form their own State, and this State can then exercise authority." [76]

In the case of the United States, all early major discoveries were the acts of private citizens not officially endorsed at that time by the United States. The classic statement of positive disavowal by the United States was made by Secretary of State Hughes in 1924 concerning Admiral Byrd's expedition to the South Pole. When he presented the South Pole to the United States, the Secretary of State said:

"It is the opinion of the Department that the discovery of lands unknown to civilization, even when coupled with a formal taking of possession, does not support a valid claim of sovereignty unless the discovery is followed by an actual settlement of the discovered country." [77]

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What are the legal consequences of such a course of action? At best, it could give the United States an inchoate title, a state of affairs also engendered by the failure of the state effectively to occupy territory discovered by it.

"If, however, the latter [*i.e.*, a state with inchoate title] omits to take effective possession of the land during the time in which the prior right is valid, the land is again considered to be without a master and can be occupied by another State." [78]

Admiral Byrd's 1929 flight over the South Pole and purported attempt to claim the area for the United States, which for many years thereafter did not man expeditions to the area, has become a *locus classicus* as to the effect of an inchoate title by right of discovery not followed by subsequent occupation or administration. Contemporary comments attendant to Byrd's flight and purported claim to the Pole show the world's interest and amazement. As one observer said, "[H]e [Byrd] has seen things [the South Pole lands] as we all have seen the moon." [79]

The question may arise as to whether subsequent activities of states whose earlier activities gave rise to inchoate titles can revalidate the earlier inchoate title. This depends on several facts. First of all, if in the ensuing interval no second state intervened in the area by way of discovery, administration, or settlement, the problem is academic as subsequent activities of the original state will in themselves revalidate the title. If, however, a second state did intervene, the inchoate title of the original state, if not coupled with *occupatio*, may well have lapsed and have been superseded. But the same rules would in turn apply to the second state. The real difficulty appears when an inchoate title established by discovery without settlement or administration by state A is shortly thereafter contested by state B, which also "discovers" the area. What is the period of grace accorded an inchoate title? The period varies according to the authority selected. Fauchille states one year.[80] Some have stated twenty-five. The Russians, for practical reasons, regard the period an indefinite one, thus repudiating the inchoate title doctrine. As one scholar relates:

"The Soviet practice, however, seems to exceed all the other views. As stated by Professor Kalesnik, the validity of the prior right, based on Russian discoveries in the Antarctic, is considered to be valid for more than 130 years. In his own words: Russia has never renounced her rights, and the Soviet government has never given its consent for anyone to dispose of territory discovered by Russian navigators." [81]

C. EFFECTIVENESS OF OCCUPATION

Effectiveness of occupation is not only the touchstone on which all title to territory is based, but also is that element of *occupatio* which presents the greatest difficulty in analyzing the Antarctic experience. Although conceptually difficult to disassociate effectiveness of occupation from an integral discussion dealing with *animus occupandi* [82] (evaluated objectively in examining acts of display of sovereignty), for the purpose of analysis an artificial dichotomy is made here.

Effectiveness should be viewed as the objective manifestation of a continuous development of control commencing with discovery and subsequent inchoate title and continuing by permanent settlement and administration. Given the situation prevalent in Antarctica today, no valid claim to territory can be enjoyed without such effective exercise. In matter of fact, the most difficult question concerning Antarctic sovereignty is whether or not exceptions should be made for such an inhabitable area and if so, the form of and degree to which they should be articulated.

De Grotius wrote:

"No one is a sovereign of a thing which he himself has never possessed and which no one else has ever held in his name . . . . To discover a thing is not only to capture it with the eyes but to take real possession thereof . . . . The act of discovery is sufficient to give a clear title of sovereignty only when it is accompanied by actual possession." [83]

In contrast to its antecedent in the Roman Law of Property, contemporary effectiveness is generally associated with non-absolute degrees of possession. To maintain that actual continuous possession is required in a largely uninhabited land is to misconstrue the real nature of *occupatio*. Effective possession requires only that degree of control which is necessary under the totality of the circumstances prevalent in the area to make the presence of authority of the occupying state felt by and against all others. It is therefore a flexible and comparative standard:

"Effective occupation as generally required does not imply its extension to every nook and corner. It is sufficient to dispose at some places within the terri-

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tory of such a strong force that its power can be extended if necessary over the whole region in order to guarantee a certain minimum of legal order and legal protection within the boundaries, and to exclude any interference from a third State . . . ." [84]

By far the best philosophical explanation of effective occupation is also that of Van der Heydte:

"Effectiveness then seems to be best illustrated by actual display of sovereign rights, the maintenance of order, and protection. But as a matter of fact sovereign rights can be exercised only over human beings, in inhabited lands; . . . and protection too can be granted only to human beings. It would be a misconstruction of the doctrine of effectiveness to say that sovereignty over completely uninhabited land presupposes in every case actual occupation." [85]

This definition, then indicates clearly how the scope of effective control over largely uninhabited lands can be circumscribed without jeopardizing the effectiveness of that control; for political control is but a relative concept in that a human relationship is required. Political control over territory cannot be said to exist without the existence of either a permanent or transient population or occasional influx of human beings. The same principle applies both to a nation, which cannot exist without a people, and to the very principle of territorial sovereignty itself, which is meaningless without reference to the nation-state concept. Thus it should be kept in mind that when exceptions to the effectiveness principle for Antarctica are discussed, what is really at issue is not its extreme climate and latitude, but rather its lack of population. This then in itself will vitiate the sector principle, which is only an inept application and special case of *occupatio*. Therefore, Soviet jurists are incorrect and fail to observe the real nature of effective occupation when they maintain that an additional argument in opposition to the principle of "effective occupation" is the notion that, with regard to occupation of polar areas, it is not justifiable to maintain the demand for effective occupation.[86]

Recent judicial interpretation of the doctrine of *occupatio* corroborates this new approach that effective occupation is distinctly governed by the circumstances of each case.

As Waldock states:

"[T]he three cases cited above [*Eastern Greenland, Palmas* and *Clipperton Island*] mark a change in the concept of effective occupation which has taken place during the past century and especially since the African Conference of Berlin in 1885. The emphasis has shifted from the taking of physical possession of the land and the exclusion of others to the manifestation and exercise of the functions of government over the territory. This change is a natural consequence of the recognition that in modern international law occupation is the acquisition of sovereignty rather than of property." [87]

The basic elements of occupation just discussed can perhaps most succinctly be summarized in the words of the Permanent Court of International Justice in its decision in the *Legal Status of Eastern Greenland:* "[A] claim to sovereignty must be based on two elements: the intention and will to act as a sovereign, and some actual continued display of such authority." [88]

In applying these coefficients of traditional international law to the case of United States sovereignty over Antarctica, it can be seen that the United States is unable to satisfy either. First, it is moot whether or not the United States ever exercised its prerogative by espousing the activities of early United States, discoverers and explorers in a timely manner as needed to satisfy the requirement of state action.[89] Second, even if the requirements were met, it is clear that the United States has never had the *animus occupandi* requisite to any claim of territorial sovereignty, in accordance with the first coefficient in the *Eastern Greenland* case.[90] In fact, it has been the consistent policy of the United States to refrain from making any claims to Antarctica for over half a century.[91] Third, until recent years the United States refrained from fulfilling the second coefficient of the *Eastern Greenland* test—actual display of authority.[92] The first really significant official United States sponsored expedition of any meaningful scope was conducted immediately after the Second World War in an expedition which far outstripped anything that had earlier transpired.[93] However, it is questionable whether such presence actually amounted to the display of authority to which the Permanent Court of International Justice referred. The Court, in referring to the intention and will to act as sovereign, modified that intention with the words "by some actual exercise or display of *such* authority." [94] Thus, the authority exercised must be an exercise of *sovereign* authority. Any state in theory enjoys, by virtue

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of the subjective nationality principle, authority over its own subjects wherever they may be. Thus, United States' assertion of authority over its nationals in Antarctica, without any attempt by the United States to exercise authority over foreign nationals, would in all probability not fulfill the standard enunciated in the *Eastern Greenland* decision. Therefore, the United States practice of "formally reserving such rights as it or its citizens may possess" in Antarctica is an empty reservation.[95]

D. DISPLAY OF AUTHORITY AND RELAXATION OF STANDARDS IN POLAR REGIONS

Closely connected to the issue of effectiveness is that of the display of authority, for display is the tangible expression of effectiveness in sovereignty claims. De Martens has effectively stated the basic nature of the display of authority required:

"[T]he limits of the occupation are determined by the material possibility to cause to be respected the authority of the government throughout the extent of the occupied country. Where the power of the state does not make itself felt there is not an occupation. In order that it may be effective it must receive its entire execution." [96]

Another important factor to bear in mind is that display of authority is a relative and not an absolute concept; that is, the requisite degree depends on the activities of other states in the disputed area. As the Permanent Court of International Justice enunciated in *Eastern Greenland:*

"[I]t is impossible to read the records of the decisions in cases of territorial sovereignty without observing that in many cases the tribunal has been satisfied with very little in the way of the actual exercise of sovereign rights, provided that the other State could not make out a superior claim. This is particularly true in the case of claims to sovereignty over areas in thinly populated or unsettled countries." [97]

The display of authority most often contemplated is that of administration. With regard to *Eastern Greenland,* Smedal wrote:

"[W]hether any of the members of the settlement [in Eastern Greenland] have been vested with Danish police authority, and whether inspection and control is exercised in the territory, we do not know. If, however, we assume that there are persons belonging to the settlement who can be said to represent Danish State authority, and that the surrounding land is regularly under the inspection of these persons, we are of the opinion that Danish sovereignty must be recognized." [98]

Having described the display of sovereignty principle and the elements most associated with it, the issue of exceptions to the general proposition must be further examined. While no one doubts the validity of the fact that exceptions should be made, the question is the degree to which the exceptions should extend, an issue which, in the Antarctic situation particularly, has been the subject of excess and abuse.

"Any attempt to alter the formula of *effective occupation* because of special geographic and climatic conditions can be of only dubious value. It would seem that any territorial title, whether based on original discovery or the "sector principle," in the absence of effective occupation, would tend to widen rather than bridge the gap between reality and law." [99]

Smedal is of the same opinion with regard to polar areas in particular:

"We would at once point out that, in our opinion, it is, broadly speaking, not the case that other rules than those applying to occupation in other parts of the world would apply to occupations in polar regions. When the rules are to be applied in polar regions, however, questions of a special nature may arise."[100]

For perspective, it should be observed that when the issue of sovereign claims in Antarctica first presented itself at the beginning of the present century, the fact that climatic conditions in the continent precluded the possibility of any permanent Antarctic settlement was for many writers conclusive of the issue:

"[A]s the regions of both the North and South Poles are incapable of permanent settlement, they do not appear to be 'territory' susceptible of acquisition by occupation." [101]

In the same year in which Hall rendered the above view, Secretary of State Hughes unwittingly tied the hands of future U.S. policy makers and stated, in agreement with Hall:

"It is the opinion of this Department that the discovery of lands unknown to civilization, even when coupled with a formal taking of possession, does not support a valid claim of sovereignty unless the discovery is followed by an actual settlement of the discovered countries. In the absence of an act of Congress

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assertative in a domestic sense of dominion over Wilkes Land the Department would be reluctant to declare that the United States possessed a right of sovereignty over that territory." [102]

The international thought on the subject, no doubt abetted by the technological advance in explorative techniques and the introduction of aerial navigation to the field in 1926 by Admiral Byrd, was soon to change. As Hayton wrote:

"[S]ubsequently, [to 1924] however, the presence intermittently of official personnel or licensed commercial enterprises, for example, during the summer months, was deemed sufficient . . . . At the same time, less exacting standards were introduced for uninhabited desolate or polar regions. Title could be completed with acts of sovereignty of less frequency and less magnitude. Each case apparently must be judged on its own merits." [103]

Concommitantly, the new approach received its initial judicial approbation internationally in Max Huber's Arbitral Award in the *Island of Palmas:*

"[M]anifestations of territorial sovereignty assume, it is true, different forms, according to conditions of time and place. Although continuous in principle, sovereignty cannot be exercised in fact at every moment on every point of a territory. The intermittence and discontinuity compatible with the maintenance of the right necessarily differ according as inhabited or uninhabited regions are involved, or regions enclosed within territories in which sovereignty is uncontestably displayed, or again regions accessible from, for instance, the high seas.

"If, however, no conventional life of sufficient topographical precision exists, or if there are gaps in the frontiers otherwise established, or if a conventional line leaves room for doubt or if, as for example, in the case of an island situated in the high seas, the question arises whether a title is valid *erga omnes*, the actual continuous and peaceful display of State functions is in case of dispute the sound and natural criterium of territorial sovereignty." [104]

Judge Huber thus was the first to circumscribe the exceptions doctrine by putting relative bounds on it. Hence, exceptions notwithstanding, the minimum degree of effective control required to perfect title with such relaxed standards would be the actual continuous and peaceful display of state functions.

The decision received further judicial endorsement in the *Clipperton Island Arbitral Award:*

"It is beyond doubt that by immemorial usage having the force of law, . . . the actual, and not the nominal, taking of possession is a necessary condition of occupation. This taking of possession consists in the act, . . . by which the occupying state reduces to its possession the territory in question and takes steps to exercise exclusive authority there. Strictly speaking, and in the ordinary cases, that only takes place when the state establishes in the territory itself an organization capable of making its laws respected. But this step is . . . but a means of procedure to the taking of possession, and, therefore, is not identical with the latter. There may aslo be cases where it is unnecessary to have recourse to this method. Thus, if a territory, by virtue of the fact that it was completely uninhabited, is, from the first moment when the occupying state makes its appearance there, at the absolute and undisputed disposition of that state, from that moment the taking of possession must be considered as accomplished, and the occupation is thereby completed." [105]

The arbiter thus prescribed a further condition to the new approach. In addition to Huber's "actual, continous, and peaceful display of State functions," [106] Victor Emmanuel, arbiter in the *Clipper Island Arbitration*, stated that, in the case of *terra nullius*, if the land is "at the absolute and undisputed disposition of that State," [107] then "from that moment the taking of possession must be considered as accomplished, and the occupation thereby complete." [108]

Applying these two judicial criteria to Antarctic history, can any single state claim to have perfected title before entry into force of the treaty regime? The answer would clearly be in the negative. Until the treaty regime, no state was able to assert a continuous display of authority in Antarctica throughout the year, and by the time effective year-long occupation was achieved, its concomitant, peaceful and uncontested display, had been ruled out by competing claims of other states. In applying the *Clipperton* criteria to Antarctica, the dangers inherent in applying formulae developed for a particular geographical entity (such as an island) to another area (such as a continent) must be recognized. While Clipperton Island is completely isolated and uninhabited, small, and capable of effective territorial occupation and administration in its entirely with only a few

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official representatives, the occupation of a continent is not amenable to so cavalier a treatment. In any case it could not be said that Antarctica was ever "at the absolute and undisputed disposition" [109] of any state within the present century, given the many diverse and often simultaneous expeditions mounted there. It therefore fails to fulfill the exceptions enunciated in the *Palmas* and *Clipperton Island* decisions.

The only acceptable "exception", if indeed it can be classified as such, would be the degree of administration which would be found sufficient to perfect title. This was recognized as a varying standard in the *Legal Status of Eastern Greenland* case, the major international decision concerning effective occupation previously discussed. It has been commented that despite the extreme leniency shown by the Permanent Court of International Justice in the *Eastern Greenland* case, authority in the Antarctic must be exercised at least as and when the occasion demands.[110] In formulating this standard, the court endorsed the view maintained by the Allies after the First World War as expressed in the Treaty of St. Germain-en-Laye: that the territories in question, that is, those primarily in the former Austro-Hungarian Empire, "are provided with administrative institutions suitable to the local conditions." [111]

Further support for this position was exhibited by Lindley during the inter-war years:

> "[W]hat is sufficient will depend on all the circumstances. If the territory contains a large population or is one to which a good many traders resort, elaborate administrative machinery may be necessary, If, on the other hand, it is remote or small or incapable of accommodating more than a small or transitory population, a rudimentary organization may be all that is required; while in the case of small islands used merely for the purpose of a particular business, such as the catching or curing of fish or the collecting of guano, the presence of an official or two may be sufficient" [112]

Finally, Smedal specifically endorsed this approach with reference to Antarctica:

> "[F]or occupation in polar regions, there will not at present be any question of using military force. These regions are so sparsely peopled that orderly conditions can be maintained by much more simple measures." [113]

In summary, the only broadly accepted exception to the effective occupation doctrine is effective administration. While it is true that permanent settlement of polar regions is no longer an indispensable adjunct to perfecting sovereign title to territory in those areas, administration must still be adequate under the totality of the circumstances. Although this is not a satisfactory and easily applicable standard on which to conclude, the inherent inability to enunciate a more precise doctrine is evident.

VI. The Sector Principle

The sector principle is the one non-conventional mode of acquisition of territory in international law which is used to support the claims of some states in the Antarctic. However, it is submitted that regardless of the postures assumed by many of the treaty claimants, the sector principle is misapplied to Antarctica. First, it is an unjustified application of an Arctic principle itself misconstrued historically by the original proponents. Second, its modern application is based on what amounts to imperfect application in varying degrees of the *occupatio* mode. Finally, it is misapplied because where the sector principle is based on the continuity, contiguity, or Hinterland principle, these latter modes of claim, while espoused during the nineteenth century, are now rejected as valid principles in international law.

The Soviets have defined polar sectors as:

"[P]olar territories, delimited by definite co-ordinates, while all lands and islands within the sector, clear to the Pole, are considered the territory of the State which claims the sector as its own. The apex of the sector is the Pole, the lateral boundaries [are] determined by longitude (from the pole to the eastern and western borders of the corresponding State), the arc [is] someone's coastline or a certain parallel latitude." [114]

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The supposed historic underpinnings of the sector principle were embodied in the 1825 Treaty between the United States and Russia,[115] the pertinent language of which was reincorporated in article 1 of the 1867 Treaty Concerning the Cession of the Russian Possessions in North America by His Majesty the Emperor of All the Russias to the United States of America.[116] Article 1 of that treaty provides that the eastern limit of Russian territory with that of United States (Alaskan) territory is as described in articles 3 and 4 of the 1825 Convention:

"[C]ommencing from the southernmost point of the island called Prince of Wales Island, which point lies in the parallel of 54 degrees 40 minutes north latitude, and between the 131st and 133rd degree of west longitude (meridian of Greenwich), the said line shall ascend to the north along the channel called the Portland Channel . . . and finally, from the said point of intersection, the said meridian line of the 141st degree, in its prolongation as far as the Frozen Ocean."[117]

Whereas the English text "as far as the Frozen Ocean" is ambiguous in that we do not know the extent of the term "as far as," the French parallel text fortunately leaves no doubt. It provides that the meridian line envisaged at the time did not continue right up to the North Pole through the frozen Arctic, but rather stopped at the ice barrier.[118] It can readily be appreciated that if this is the historical basis of Arctic sector claims, such as those posited by Russia and Canada, the basis is a poor one indeed.[119]

The state responsible for enunciating the sector principle in its modern context was Canada. On February 20, 1907, N. P. Poirier, a Canadian Senator, recommended to the Senate that Canada should declare it had taken possession of the lands and islands lying between its northern coast and the North Pole.[120] This direct reference to the North Pole with respect to area claims of the Arctic led to a proliferation of other claims, including the Russian (Sturmer) Declaration of December 20, 1916,[121] which gave notice to the allied and friendly powers that Russia laid claim to several Arctic islands [122] which formed a northern extension of the Siberian continental mainland.[123]

The British were the first to apply the principle to the Antarctic, promulgating the British declaration on the Falkland Sector of March 28, 1917, which, in Letters Patent of March 28, 1917, stated that the dependencies in question were deemed to include all islands and territories whatsoever between Longitude 20.00° W and 50.00° W, south of Latitude 50.00° S, and between Longitude 50.00° W and 80.00° W, south of Latitude 58.00° S.[124] Great Britain made a further sector decree in 1923, pursuant to Order in Council of July 30, 1923, stating that Ross Sector included all islands and territories between Longitude 160.00° E and 156.00° W, south of Latitude 60.00° S.[125] However, as in the Canadian example, it was stated that "Ross Sea must be considered to be part of the high seas, and it is not necessary to have a concession in order to carry on whaling there." [126]

The Soviets, while not recognizing sector claims in the Antarctic, have consistently maintained their initial claims in the Arctic. They have referred to the British examples already cited in substantiation of their own sector, maintaining that the reaffirmation of 1926 was based on the British, Falkland, and Ross sectors.[127] Lahktine goes equally far in concluding:

"The question, then, of the legal status of the undiscovered arctic territories may be regarded as solved not only as a theory but by positive law. That is to say, *the said lands and islands being still undiscovered are already presumed to belong to the national territory of the adjacent Polar State in the sector of the region of attraction in which they are to be found.*" [128]

Whatever the contentions of the various claimants may be, it must be pointed out that no matter what the purported extent of these several claims may be, a handful of states cannot legally contravene or nullify a well-established principle of law.

Another fundamental must be recognized in using Arctic sectors as a benchmark in comparing them to Antarctic counterparts. First, as pointed out in the earlier discussion, the Arctic is a frozen ice cap without any geologic basement, whereas Antarctica is quite the opposite. Second, and perhaps most significantly, given the true nature of the sector theory, no continental mainland exists at any point near the Antarctic coasts, the nearest one being in South America at the Cape of Good Horn, opposite Palmer Peninsula, many hundreds of sea miles away. Were it not for this fortuitous conjunction of two opposing peninsulas, the nearest continental mainland would be hundreds of miles even further away.

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In comparing the two regions, it is significant to note that a Russian, Molodtsov, stated clearly that "it would be a mistake to anticipate that the sector system should also be extended to the Antarctic."[129] This statement was in large part based on geographic continuity and the socio-economic implication that such proximity naturally entailed:

"[T]hese claims were justified as extensions northward to the pole of continental land masses which already project into the Arctic Circle. . . . In the Antarctic region there is no well-established State with a land mass extending into the Antarctic Circle and no islands offshore which a State could claim unto itself. In the Antarctic there is an isolated continent and each State claiming land there has chosen an area defined by longitudinal lines drawn from the South Pole at an angle sufficiently large to cover the continental territory convered." [130]

Such geographical contiguity was associated with certain natural socio-economic consequences which are completely lacking in the Antarctic example:

"[I]n the north there are narrow "ice" seas . . . close to the population centers, of Europe and America, representing for the coast lands, aside from an economic also a strategic interest. . . . . In the south, there is a special ice-bound unpopulated continent . . . distant from population centers . . . ". [131]

Smedal, in reviewing the facts marshalled above, rejects whatever substantiation there may exist in international law supporting the application of the rationale of Arctic sector claims to sector claims in the Antarctic:

"[T]urning now to the Antarctic regions, we find that no State has a territory continuing so far to the south that it is cut by the polar circle; nor is there, so far to the south, any territory effectively taken possession of by any State. It should therefore not be possible to make a sector claim, if it be based on the same foundation as used in the Arctic regions." [132]

Two other rationales lend support to this conclusion. First is a socio-economic fact earlier enunciated by the Russians in differentiating the two antipodes. Although perhaps no longer valid, it involves the state experience in the Arctic. "The . . . line of reasoning is that only States subjacent to polar regions are sufficiently experienced to be equipped for work in the Arctic." [133] This, of course, would not apply to the Antarctic. The other point is a policy reason, similar to the *occupatio* rationale, which explains why the sector principle should not be accorded status:

"[T]he sector principle is not a legal principle having a title in the law of nations. This is partly admitted by those who uphold it. Nor should the principle be embodied in international law, for one reason because it aims at a monopoly which will doubtless delay, and partly prevent, any exploitation of the polar regions." [134]

It should further be observed that even were the fundamental differences not present, the Antarctic would not be suited to sector claims. For unlike the Arctic, the Antarctic has been, and promises to be, the center of increasing human endeavors of a permanent nature. Such presence would augur ill for states whose claims are not furthered by their effective presence in the continent. Even were sector claims recognized as inchoate titles, the activities of other states would render the later claims null and void. Further, the sectors themselves as presently constituted are contradictory and impractical:

"[I]n the Antarctic regions the basis of sector claims, as previously mentioned, is not clear. If we assume discoveries to be a consistent basis and let the State that can refer to discoveries plot their respective sectors on the map, we shall undoubtedly soon realize that principle is not practical; for the sectors will, in part, cover each other. A territory may lie in more than one sector." [135]

It is equally indefensible that a special sector regime should be established for the polar regions due to their inaccessible nature. Although discussed at some length under special exceptions to *occupatio*, the same exception theory has been utilized as the basis for the sector theory. It should suffice to point out that on no other terrestrial area of the earth have exceptions to the traditional modes of acquisition to territory been forwarded, no matter how inaccessible or inhospitable the area may be. The Sahara and the Himalayas are two excellent examples of this fact. In neither instance has some distant state been able to enter a claim to either area by a watered-down concept of acquisition; rather, the adjacent and surrounding states have asserted sovereignty over them by effective control and by propinquity thereto. The beauty of the inherent flexibility of *occupatio* and its adaptability to such circumstances is yet another reason for its application to Antarctica.

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The two bases underlying all sector claims, no matter what theoretical base may be voiced in their support, is hopefully clear at this juncture. It is simply a recasting of the *occupatio* regime. This apparent fact is emphasized by the later action of sector claimants within their sectors:

"[I]t is of interest to observe how States that claim sovereignty in sector areas nevertheless attempt to take charge of lands lying in those areas by effective occupation. By so doing they show they fully realize that a territorial sovereignty which they may rightfully require to be respected by foreign States must be based on a more solid foundation than the sector principle." [136]

Thus, we can conclude that the sector principle has not achieved the status of a legal principle in international law. However, it is possible that with the passage of time the principle may by custom become an accepted one. But as pointed out earlier, the practice of only a few States of the international community will not create a change in the international legal norm.[137]

VII. Other Related Theories and the Question of Extent

As stated earlier, the sector theory has been based on other independent theories, the principle ones being contiguity, continuity, the *hinterland*, *uti possidetis*, national patrimony, and the "region of attraction." Some are developments of the past century, while others were first enunciated in the present one. Most are in themselves related, and often confused in the minds of their proponents. At times they are used interchangeably. With the exception of *uti possidetis* or national patrimony theories, it is submitted that as in the case of the sector principle, all have as their true basis the effective occupation rationale. For the sake of anaylsis each theory has been treated individually. However, it must be pointed out that much interplay and overlap exists not only among those principles under discussion, but also with the sector principle.

A. CONTIGUITY DOCTRINE

The continguity principle was sired during the colonial period of the past century.[138] When states laid down claims to new lands, as particularly in Africa after the 1880's, they did so initially on the strength of lands on the coasts of the areas claimed. As the security needs of coastal settlements required protection from incursions from adjacent coastal islands, it became a recognized custom among the imperial powers that such islands would be taken as subsumed under the power of the coastal occupying power. This entente was in reality a revival of an earlier practice whereby a discovering state claimed all islands along the coasts of the new land, and 15 is attested to in the colonial charters granted by the English Crown to the American Colonies in the seventeenth and eighteenth centuries.

A perfect example of this trend was an exchange of notes November 2, 1911, between Secretary of State Lansing and Viscount Ishii, Ambassador of Japan:

"The Governments of the United States and Japan recognize that territorial propinquity creates special relations between countries, and consequently, the Government of the United States recognizes that Japan has special interests in China, particularly in the part to which her possessions are contiguous." [139]

However, even in the nineteenth century it was understood as part of the entente that the islands had to be within some reasonable distance from the coast in order to be included within the contiguous area:

"Peru, following a suggestion of Lord Palmerston in 1834, asserted the proximity of the Lobos Islands to Peru would give her a prima facie claim to them, although they were over twenty miles distant. A similar basis was offered by Venezuela as a claim to the Aves Islands, by Haiti to Navassa, and among others, by Spain and later Argentina to the Falklands, although the latter are almost 250 miles from the mainland. All of these claims give rise to considerable controversy, the result of which seems to support Mr. Fish's contention in the *Navassa* case that the utmost to which the argument amounts 'is a claim to a constructive possession, or rather to a right of possession; but in contemplation of international law such claim of a right to a possession is not enough to establish the right of a nation to exclusive territorial sovereignty.' " [140]

Lakhtine offers a second rationale in favor of contiguity. While supporting the theory's application to the Arctic areas, he injected it with a new rationale:

"The first is that no other proper apportionment of the Arctic can effectively be made. The second line of reasoning is that only states subjacent to polar regions are sufficiently experienced to be equipped for work in the Arctic." [141]

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A third, more modern, reason given in justification of the contiguity principle is a socio-economic one: that the contiguous mainland depends on offshore islands for subsistence. However, it would be difficult to make this argument for the Antarctic as Molodtsov indicates:

"[T]he Arctic has also an exclusive . . . economic value: For the population of the Arctic States the Arctic regions represent sources of existence. Therefore, the Arctic territories are inseparable from their base, that is, the territory of the adjoining State. The Antarctic regions, however, do not possess such a base and, therefore, cannot have such economic importance for any one of the world States, which certain regions of the Arctic may have for each of the adjoining contries." [142]

The closest possible argument that could be made would be in favor of Chile and Argentina. However, the Palmer Peninsula is so remote and divorced from any traditional economic connection of any standing with either country as to render any proponent argument almost negligible.

In summation, the contiguity principle should be seen only as an expression of effective occupation, having no intrincis merit *per se*. Van De Heydte, *arguendo*, states:

"[I]f one considers on the contrary the so-called rule of contiguity to be the necessary consequence of a logical interpretation of the very principle of effectiveness and only a special case of applying that general principle, then one cannot regard geographic contiguity as conferring only an inchoate sovereign title. One has to admit that geographic contiguity with an occupied region gives the same full and perfect sovereign rights as any actual occupation." [143]

But in conclusion he states unequivocably:

"The natural boundary lines of any application of the rule of continguity are drawn, precisely, by its very origin from the general principle of effectiveness. Admitting the existence of such a rule, we only assert the existence of an individual case of applying the principle of virtual effectiveness as defined above. It is proper, therefore, to speak of contiguity only as far as one can speak also of virtual effectiveness." [144]

Finally, it must be recognized that an adjacent state's application of the contiguity principle to Antarctica, even were it not to founder on the great distances involved, would be inapposite in that the contiguity principle has traditionally embraced islands with continental coastlines. In the Antarctic example, it is either a projection of a continental coast to a continent or, conceptually worse, a projection from an island or islands to a *continent*. Applying the contiguity principle to the Antarctic would be an unwarranted extension of an already overstretched idea.

The Russians, in their sector decrees already discussed, specifically related their claims to the then undiscovered Arctic Islands. The Russian decree of September 20, 1916, claimed islands north of Siberia because they "formed a northern extension of the Siberian continental upland." [145] With the Russian minority view apart, the contiguity principle has now for all practical purposes fallen into desuetude and has no adherents in modern international law. In the *Palmas Island Arbital Award*, it was stated "the title of contiguity, understood as a basis of territorial sovereignty, has no foundation in international law." [146]

B. CONTINUITY AND HINTERLAND

Continuity and *Hinterland* are nearly identical principles and must be discussed together. They are of all the theories in this section the ones most intimately related to the issue of how far a settlement should extend inward. The only substantial differentiating feature between the two is that one has been applied in a majority of cases to claims in the temperate zones, the other to claims in the polar regions.

Generally speaking, both theories maintain that coastal settlements extend inward for varying reasons whether or not they are occupied. It was contented that when a state took possession of a territory, it obtained sovereignty over the adjacent areas as being of importance for the occupying territories.[147]

The question of penetration of the interior of a new continent arose as early as the American colonial era and the early years of the Republic when the frontier boundaries of the former American colonies were found administratively inadequate to deal with westward expansion.[148] On the basis of estuarine occupation, the former American colonies, having attained independence, claimed sovereignty

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over the entire area in which the rivers, tributaries, and estuaries ran to the watersheds of such rivers, often including areas in the Appalachian and Blue Ridge Mountains several hundred miles inland. In similar manner the United States, in registering territorial claims with Spain after the Louisiana Purchase, forwarded the propositoin that in demarcating portions of the Louisiana boundary, settled coastline areas extended inland up to the watershed of all rivers emptying into the coastline.[149]

As under the contiguity principle, the necessity for defense was also given in justification, as "effective occupation of a territory makes the sovereignty of the possessor extend over the neighbouring territories as far as is necessary for the integrity, security, and defense of the land actually occupied." [150]

The burgeoning of the principle was primarily associated with the last quarter of the nineteenth century, and an examination of its history in these decades is revealing. Again, as with the contiguity principle, the political etiquette of the colonial era dectated the establishment of some parctical norm to govern the post-Berlin Conference land rush. As the interior of the dark continent proved difficult to penetrate, avoidance of rivalries among the occupying Powers gave rise to the emergence of the continuity/Hinterland principle in a meaningful way. As stated by Smedal:

"[W]hen the States, because of the demands for efficient occupation, were prevented from approaching territories which they did not control, it became usual in the nineteenth century to conclude agreements relative to so-called "spheres of influence and interest." Such a sphere means a territory in which a foreign State is politically interested. A contributory cause of the making of such conventions was the desire to evade conflicts. The State, for instance, agreed on dividing an unoccupied territory between themselves in such a way that each of them renounced its exercise of political influence in the part of the territory which was reserved to the other party. Frequently, the territory was situated behind a coast already occupied and it was called *Hinterland*. This term is also used to designate any sphere of interest." [151]

Far from becoming an accepted principle of international law, tacit *compromise* reached by the states in such cases were merely administrative agreements, never elevated to any more encompassing treatment.

The effect of exclusion of the continuity concept from the corpus of the law was evident in the Declaration of the West African Conference of 1885 emanating from the Berlin Congress of the same year:

"The present law, in view of the generally accepted Declaration of the West African Conference of 1885, would seem to justify no claims to territory beyond that effectively controlled, although the adjacent state may justly claim the right of notification, with an option to make good the *constructive* claim by actual occupation." [152]

In another contemporary observation on the "principle," Lord Salisbury, in a dispute between Portugal and Great Britain as to a region of Central Africa between Angola and Mozambique, stated:

"[T]he fact that the act of the Berlin Conference laid down certain conditions in Articles XXXIV and XXXV in relation to new occupations on the coast of Africa, did not in any way affect the well-established principles of international law in regard to the occupation of land in the interior.[153]

Far from being lax in prescribing duties incumbent on the occupying powers, the Conference stated that there was an obligation on the Powers to maintain in regions subject to their jurisdiction an authority and police force sufficient to ensure protection of persons, property and necessary freedom of trade and transit.[154] This clearly refers to the necessity of establishing effective control over the area claimed versus actual occupation, as already discussed. It can thus be inferred that even during its vogue as a governing norm in the nineteenth century, continuity and the *Hinterland* principles were not recognized as such.

Applying both principles to Antarctica, whether independently or in justification of the sector theory, no validity can be accorded them. It should furthermore be observed that several states, including Great Britain, have rejected attempts to apply the *Hinterland* principle in reverse, that is, in lieu of the extension from the discovered coast inland, an extension of the sector seaward from the coast so as to encompass islands in the high seas. Such an application is unwarranted and without precedent, especially given the dubious nature of Antarctic coast settlements themselves.

Footnotes appear at end of article.

C. PATRIMONY AND UTI POSSIDETIS

The patrimony theory, with reference to Antarctica, is confined in practice to several South American states, notably Chile, Argentina, and Brazil. It is the South American version of the *uti possidetis* principle of international law. The "legal" precedents often given for the concept are the Papal bulls "*Inter Caetera*" of 1943 and "*Dudum siquidem*" of 1494.[155] The former divided the new world into two spheres, the line being one hundred leagues west of the Azore and Cape Verde Islands. The latter, elaborating the former, covered all "islands and mainlands whatever, found or to be found . . . in sailing or traveling towards the west and south, whether they be in regions occidental or meridianal, and oriental and of India." John II of Portugal agreed to accept *Inter Caetera* if the line were moved 270 leagues further west, which was agreed to in the Treaty of Toredesillas in 1494.[156]

Chile, relying on more recent history, has maintained that she succeeded to these rights, earlier vested in Spain, by right of "*uti possidetis* of 1810", at the time of the break with Spain.[157] *Uti possidetis* in international law has been defined as "a phrase used to signify that the parties to a treaty are to retain possession of what they have acquired by force during the war." [158] If such is the history and the definition, several problems immediately arise. First, at the time of the break with Spain, neither Spain nor her former colonies even knew of the existence or location of Antarctica, which was first sighted by von Bellingshausen ten years later. It is therefore not possible to maintain that Chile or Argentina obtained any part of Antarctica *vi et armis* as required. Second, under the general theory of state succession:

"Inasmuch as the principle is really a claim of 'succession,' Argentina or Chile cannot succeed to something the parent state did not have in her possession to give. In any case, it is extremely doubtful whether title to all lands held or discovered in the 'general international neighborhood' passes automatically to a freed colony." [159]

Even were such claims to pass automatically, Chile and Argentina would be placed in the position of Spain and thus required to follow the prevailing mode of acquiring title to *terra nullius:* discovery followed by effective occupation.

With regard to the Antarctic, the national patrimony or *uti possidetis* principles should be discounted. As Hayton observed: the thrust of this therefore tries to get away from a *terra nullius* concept and therefore avoid the problems of discovery and occupation, for the patrimonialists traditionally have assumed a low profile in any substantial Antarctic undertaking.[160]

A related hybrid to the patrimonialist doctrine is evident in the current law of the sea negotiations taking place under the auspices of the United Nations in the Third United Nations Conference on the Law of the Sea, in which certain Latin and South American States, in the Santo Domingan Declaration, enunciated the patrimonial sea concept, another vague claim forwarded by the same group of states.

In conclusion, unless the patrimonial claimants color their aspirant titles to Antarctica with the traditional requisite activities, there is little merit and less logic in recognizing any of their claims.

D. REGION OF ATTRACTION

This concept has been voiced only by Soviet jurists, in connection with Soviet sector claims in the Arctic. It is somewhat similar to the spirit behind the guidelines enunciated by the International Court of Justice in the *Anglo-Norwegian Fisheries Case,*[161] in that the theory stresses socio-economic links between the mainland and the offshore islands, and the inter-dependence of the mainland and island areas. Of course, the application of such ideas to undiscovered islands and lands uninhibited by the claimant states' nationals goes a great deal further in its import than the inclusion in the territorial sea of discovered islands inhabited by nationals of adjacent claiming states.

The major proponent of the doctrine, the Soviet jurist Lakhtine, saw it, as did the patrimonialists, as a means of avoiding the otherwise embarrassing requirements of effective occupation. In description and support thereof he states:

Quite independently of this reasoning, the physical conditions and the policy of the Polar States compel this renunciating doctrine. We see indeed, that *regardless of discovery and regardless of effective occupation, the discovered lands and islands*

Footnotes appear at end of article.

belong as a matter of fact to States in the region of attraction in which they are situated.

Hence, the third conclusion is inevitable, namely that *the doctrine of occupation of Polar territories must be replaced by the doctrine of region of attraction.*[162]

Hayton, in commenting on the theory, discounts its validity both as to the Arctic and to the Antarctic:

"It cannot be presumed that the rest of the international community has given up to states which are accidentally the closest all rights to unoccupied lands of possible strategic importance, whether or not currently susceptible of settlement or exploitation. Therefore severe limitations must be placed on the use in international law of any concept involving "region of attraction," propinquity or contiguity. As an obvious consequence of the decentralized, semi-anarchical conditions of nation-state life, each state is concerned defensively, economically and otherwise with the area (land or sea) adjacent to its present territory. But if applied generally, the absurdity, even the impossibility of such a principle *in law*, seems clear. Argentina or Chile cannot claim Antarctic territories *merely* for reasons of "attraction." If the territory in question is *terra nullius*, then the ordinary mode of acquisition must be employed, though the *motivation* for prosecuting such acquisition may well reflect strategic considerations. If it is not *terra nullius*, the sovereign is not displaced because of another's contiguity. "Attraction" of itself yields no title to the Antarctic or elsewhere." [163]

VIII. Concluding Remarks

The Eighth Antarctic Treaty Consultative Meeting, to be held in Oslo in 1975, shall address as an agenda item the question of mineral resource exploration and exploitation in the continent.[164] As a consequence of the curtailment of Near East oil shipments to the West and the artificial rise in cost to the developed and industrialized states occasioned by the reduced supply, Antarctic treaty partners shall seriously address the resources issue for the first time since 1959. The 1975 session of the Third United Nations Conference on the Law of the Sea shall give added impetus to the treaty partners to find a practicable interim, if not long range, solution to the resources problem. Most probably the political desire to arrive at a workable solution will lead to the resolution of the issue in a political, if not strictly legal, manner. Given the fact that it would in all probability be more advantageous for the treaty partners to preserve the treaty regime and find a solution to the issue within its confines rather than risk the chance of opening a heretofore virtually closed frontier to the law of the sea arena and to possible eventual administration and control under the auspices of the United Nations, the partners will find themselves in accord. But ultimate long-range agreement can only be predicated upon a careful and traditional interpretation and understanding of the basis of sovereignty in Antarctica. Failure to reach such an agreement might well lead to the eclipse of a viable treaty regime, the demise of the *status quo*, and the application of the nascent "common heritage of mankind" concept to all of the last remaining frontier on earth.

FOOTNOTES

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[1] The Antarctic Treaty, December 1, 1959 [1961] 1 U.S.T. 794, T.I.A.S. No. 4780, 42 U.N.T.S. 71 (entered into force for U.S. June 23, 1961).

[2] This term refers to the unknown land in the south.

[3] Encyclopaedia Britannica, 1 Macropaedia 947 (1974).

[4] *Id.*

[5] *Id.*

[6] *Id.*

[7] *Id.*

[8] *Id.*

[9] Observers have written: "[I]t may be seen that with the exception of Roosevelt Island near Little America Station, and the high spot centered around latitude 82 degrees south, longitude 105 degrees west, the region between the Sentinel, Horlick and Queen Maud Mountains to the south and Kola Executive Committee and Edsel Ford Ranges to the north, is below sea level, most of it at least 500 meters below. This discovery together with that of a large channel in Marie Byrd Land has disclosed that West Antarctica consists, in fact, of a great southward extension of the Palmer Peninsula together with a mountainous island or, more probably, series of islands, comprising the coastal ranges of Marie Byrd Land." Bentley, Crary, Ostenso, & Thiel, Structure of Western Antarctica, 131 Science 131, 133 (1960).

FOOTNOTES—Continued

[10] Webster's New World Dictionary of the English Language (College ed., 1960).
[11] The Antarctic Treaty, *supra* note 1.
[12] L. Oppenheim, International Law 585 (8th ed. 1955) [hereinafter cited as Oppenheim].
[13] This trend was primarily influenced by C. Bynkershoek, De Dominio Maris (1702).
[14] *See* Camden, *Annales* 225, in C. Colombos, Int'l Law of the Sea 83–4 (5th ed. 1962): "[S]he [Queen Elizabeth I to Mendoza, Ambassador of Phillip II to England] refused to admit that Spain had any right to debar British subjects from trade or from freely sailing that vast ocean, seeing that the use of the sea and air is common to all; neither can any title to the ocean belong to any people and private man for as much as neither nature or regard of the public use permitted any possession thereof."
[15] Balch, *The Arctic and Antarctic Region and the Law of Nations*, 4 Am. J. Int'l L. 265 (1910).
[16] *See generally* H. Grotius, Mare Liberum (1609) [hereinafter cited as Grotius]. See also J. Brierly, Law of Nations 305 (6th ed. 1963) [hereinafter cited as Brierly].
[17] J. Selden, Of the Dominion, Or, Ownership of the Sea (Mare Clausum (Nedham 1972).
[18] C. Colombos, International Law of the Sea 53 (5th ed. 1962).
[19] Oppenheim, *supra* note 12, at 593–94.
[20] N. Bowditch, American Practical Navigation 747–48 (1962).
[21] Oppenheim, *supra* note 12, at 587 (footnotes omitted).
[22] *Id.*
[23] *Id.*
[24] Lakhtine, *Rights Over the Arctic*, 24 Am. J. Int'l L. 703, 712 (1930) [hereinafter cited as Lakhtine].
[25] *See* Balch, *supra* note 15, at 266. *See also Waultrin, Le problème de la souveraineté des poles*, XVI Rev. Gen. de Droit Int. Plblique 649–60, *passim* (1909).
[26] L. Rolland, *Alaska: Maison de jeu établie sur les glâces au dêlà de la limite des eaux territoriales*, XI Rev. Gen. de Droit Int. Publique 340–42 (1904).
[27] 1 G. Hackworth, Digest of International Law 452 (1940) [hereinafter cited as Hackworth].
[28] *Id.*
[29] Lakhtine, *supra* note 24, at 712.
[30] G. Smedal, Acquisition of Sovereignty Over Polar Regions 30–31 (1931) [hereinafter cited as Smedal]. *See also* D. Pharand, The Law of the Sea of the Arctic with Special Reference to Canada 86 (1973) [hereinafter cited as Pharand]: "[A]s long as those huge ice tongues are joined to the land [referring to Ellesmere] and the glaciers which produced them—in other words, as long as they remain ice shelves—they are generally considered as land since their thickness and immobility make them as effective a barrier to navigation as land itself."
[31] See C. Hayes, Antarctica. A Treatise on the Southern Continent, at 54 (1928).
[32] O. Svarlien, An Introduction to the Law of Nations 182 (1955).
[33] Pharand, *supra* note 30, at 84.
[34] Balch, *supra* note 15.
[35] *See* text accompanying notes 2 through 9, *supra*.
[36] T. Hatherton, Antarctica 282 (1965) [hereinafter cited as Hatherton].
[37] *Id.* at 281.
[38] Time. Dec. 23, 1957, at 26a.
[39] Hayton, *Polar Problems in International Law*, 52 Am. J. Int'l L. 746, 761 (1958). *Cf.* Hayton, *The Antarctic Settlement of 1959*, 54 Am. J. Int'l L. 349, states: "A more or less land-locked ice-cap in firm union with the bedrock beneath is, because of its origin, probably made up chiefly of frozen fresh water, or compressed and transformed snow, not frozen salt water. . . . Whether certain portions of Antarctic are shown to be only islands. . . ." *Id.*, at 360 n. 36.
[40] The Antarctic Treaty, *supra* note 1, art. VI.
[41] This phrase translates: "out of abundant caution." Black's Law Dictionary 659 (4th ed. 1951).
[42] The Antarctic Treaty, *supra* note 1, art. VI.
[43] Cole, Claims of Sovereignty over the Antarctic, at 11 (unpublshed thesis on file with the Judge Advocate General School of Charlottesville, Virginia). He continues: "In appearance it resembles a land territory rather than a sea territory. At the barrier edge all navigation obviously ceases. In this instance it is difficult to plead the considerations that have formed as a rule that the sea cannot be made subject to the sovereignty of a state. We are, therefore, of the opinion that good reasons favor the view that the Ross Barrier should be regarded as land and can be the object of sovereignty. . . . What has been said above of the question of sovereignty in respect of Ross Barrier applies also to other barriers resembling the Ross Sea." *Id.*
[44] 1958 Convention on the Territorial Sea and Contiguous Zone, 15 U.S.T. 1606, T.I.A.S. 5639, 516 U.N.T.S. 205, XIV (6).
[45] The Antarctic Treaty, *supra* note 1, art. XII 2.(a).
[46] The Antarctic Treaty, *supra* note 1, arts XII 1.(a); XII 2.(c).
[47] Especially given the host of conflicting national claims to Antarctica during the 1959 Conference and the dormant claims still voiced in the more sensational irredentist-inspired legal publications by certain contracting parties.
[48] The Antarctic Treaty, *supra* note 1, art. IV.
[49] *Id.*, art. IV(b) (emphasis added).
[50] This interpretation is validated by referring to the parallel French text, which reads *"qui pourrait résulter de ses propres activitiés ou celles de ses ressortissants dans l'Antarctique."* The use of the conditional tense is more closely linked with the future tense than with the present.
[51] Vienna Convention on the Law of Treaties, May 23, 1969, art. 43, 63 Am. J. Int'l L. 875 (1969) at 889.
[52] *Id.*, art. 70, at 897.
[53] L. McNair, The Law of Treaties 531–32 (1961) [hereinafter cited as McNair].
[54] *Id.*

FOOTNOTES—Continued

[55] *Id.*

[56] If the existence of bases cannot be gainsaid, and if the right to such bases can be said to inure to any state, the logical recipient of such a right would perforce be the building and occupying state. And as the Treaty was *ab initio* but a temporary arrangement, it would be irrational to presume that any state would consent upon signing the Treaty to surrendering the investments of the "Treaty years" upon termination of that instrument.

[57] McNair, *supra* note 53, at 532–33.

[58] *Id.*, n. 4 at 532.

[59] *See* Black's Law Dictionary 1558 (3d ed. 1933).

[60] It is more reasonable to maintain that such activities are executed in nature. None could state that the erection of a permanent installation (apart from the activities which are of a continuing nature, although there is no obligation on the administering State to continue them) is executory in nature. If the law of treaties recognizes that there are but two forms of obligations, executed and executory, and if, as stated, the activity in question is not executory, it can be but executed.

[61] Brierly, *supra* note 16, at 163.

[62] *See* discussion in text accompanying notes 21–24, *supra*.

[63] *See* text accompanying notes 82–87, *infra*.

[64] Encyclopedia Britannica, 1 Macropaedia 961 (1974).

[65] *Id.*

[66] *Id.*

[67] *Id.*

[68] *Id.*

[69] *Id.* at 962.

[70] *Id.* at 962–63.

[71] *Id.* at 963.

[72] Vattel, Le Droit des Gens, at 98 (Pitty transl.), *Accord*, Bluntschli, Le Droit International Codifié, at 281 (Landy transl.): "[N]o state has the right to incorporate with itself more territory uninhabited or inhabited by barbarous tribes, than it can civilize, or that it can organize politically. The sovereignty of the State exists only if it is exercised as a fact."

[73] Smedal, *supra* note 30, at 64. *See* Oppenheim, *supra* note 70, at 544–63, which continues to concede in the law no exception to the "sole occupation" test.

[74] This Bull, and other issued during the period, may be found in The Carnegie Institution, European Treaties Bearing on the History of the United States and Its Dependencies (F. Davenport ed. 1917).

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[79] . . .

[80] P. Fauchille, 1 Traité de Droit International Publique 720–71 (1925).

[81] P. Toma, *Soviet Attitude Towards the Acquisition of Territorial Sovereignty in Antarctic*, 50 Am. J. Int'l L. 611, 616–17 (1956) [hereinafter cited as Toma] (footnote omitted).

[82] This term refers to the intent to occupy.

[83] H. Grotius, Mare Liberum II 52 (1911).

[84] Von der Heydte, *Discovery, Symbolic Annexation and Virtual Effectiveness in International Law*, 29 Am. J. Int'l L. 448, 463 (1963).

[85] *Id.*

[86] Toma, *supra* note 81, at 618.

[87] Waldock, *Disputed Sovereignty in the Falkland Island Dependencies*, 25 Brit. Y. B. Int'l L. 311, 317 (1948) [hereinafter cited as Waldock] (parentheticals added).

[88] Legal Status of Eastern Greenland [1933], P.C.I.J. ser. A/B No. 53, cited in Green, Int'l Law Through the Cases 128 (2d ed. 1959).

[89] *See* text accompanying notes 76 through 19, *supra*.

[90] Legal Status of Eastern Greenland, [1933] P.C.I.J. ser A/B No. 53, at 46.

[91] For example, Acting Secretary of State Welles, in a letter dated August 8, 1939, to the diplomatic officers in the American Republics, stated: "The Government of the United States has in the past asserted no claim of its own to sovereignty over areas in the Antarctic region, although the activities and explorations of its citizens date back considerably more than a century. On the other hand, the United States Government has not recognized the Antarctic sovereignty claims of any other nation and has made formal reservation of such rights as it or its citizens may possess in that region." 2 M. Whiteman, Digest of International Law 1247 (1963). Secretary of State Hughes earlier stated: "It is the opinion of the Department that the discovery of lands unknown to civilization, even when coupled with a formal taking of possession, does not support a valid claim of sovereignty unless the discovery is followed by an actual settlement of the discovered country. In the absence of an act of Congress assertative in a domestic sense of dominion over Wilkes Land this Department would be reluctant to declare that the United States possessed a right of sovereignty over that territory." 1 G. Hackworth, Digest of International Law 399 (1940). *Cf.* Hayton, *The 'American' Antarctic* 50 Am. J. Int'l L. 583 (1958) [hereinafter cited as Hayton]: "At first, ability to perfect title in the polar regions was denied altogether by some writers. These latitudes were judged completely unsuitable for the settlement believed required for 'effective occupation.' This remains despite occasional or recent signs of vacillation, part of the official United States position." *Id.* at 599 (footnote omitted).

[92] Legal Status of Eastern Greenland, [1933] P.C.I.J. ser A/B No. 53, at 46.

[93] This refers to the United States Naval Antarctic Developments Project of 1947. *See* 2 M. Whiteman, Digest of International Law 1248, 1429 (1963).

[94] Legal Status of Eastern Greenland, [1933] P.C.I.J. ser A/B No. 53, at 46.

[95] *See* Lissitzyn, *The American Position on Outer Space and Antarctica*, 53 Am. J. Int'l L. 126 (1959).

[96] E. De Martens, 1 Traité de Droit International 463 (Alfred Leo transl. 1802).

FOOTNOTES—Continued

[97] Legal Status of Eastern Greenland [1933], P.C.I.J ser. A/B No. 53 at 46. Brierly, in commenting on this decision, states: "On this they pointed out [the Court] that the absence of any competing claim by another State (and until 1931 no State other than Denmark had ever claimed title to Greenland) is an important consideration; a relatively slight exercise of authority will suffice when no state can show a superior claim. They held, too, that the character of the country must be regarded; the arctic and inaccessible nature of the uncolonized parts of Greenland made it unreasonable to look for a continuous or intensive exercise of authority." Brierly, *supra* note 16, at 164.

[98] Smedal, *supra* note 30, at 127. *Cf.* Hayton, *supra* note 91, at 590: "Argentina fully realizes that administrative organization of territory is considered a major act of sovereignty in the perfection and maintenance of titles."

[99] Hayton, *supra* note 91, at 606. (Quoting Svarlien) (emphasis in original).

[100] Smedal, *supra* note 30, at 68. *Cf.* G. Jeze, Etude théorique sur L'Occupation comme Mode d'Acquérir les territoires en Droit International (1896): "[W]hen, therefore, effective possession is rightly demanded also in polar regions as a condition of occupation, it should be realized that the remedies necessary for submitting a limit onto the control of a State will not be the same in all cases."

[101] W. Hall, A Treatise on International Law, 103 n.1 (7th ed. 1924); *Cf* 1 L. Oppenheim, International Law 450 (4th ed. 1928) who states that the taking of possession with the intention of acquiring sovereignty can only be done by a settlement on the territory.

[102] I G. Ackworth, A Digest of International Law 399 (1940); Letter from Secretary of State Hughes to A. W. Prescott, May 13, 1934, Department of State file 811.014/101.

[103] Hayton, *supra* note 91, at 599.

[104] Island of Palmas Case, Hague Court Reports 2d (Scott), 83, at 92, 94 (Perm Ct. Arb.), 2 U.N.R.I.A.A. 829 (1928).

[105] Clipperton Island Arbitral Award (Italy v. Clipperton Island) (1931) in 26 Am. J. Int'l L. 390, 393–94 (1932).

[106] Island of Palmas Case, Hague Court Reports 2d (Scott), 83, at 94 (Perm. Ct. Arb.), 2 U.N.R.I.A.A. 829 (1928).

[107] Clipperton Island Arbitral Award (Italy v. Clipperton Island) (1931) in 26 Am. J. Int'l L. 390, 394 (1932).

[108] *Id.* at 394.

[109] *Id.*

[110] Waldock, *supra* note 87, at 334 et seq. The only authority who has rejected the necessity of administration as a manifestation of effective occupation and necessary means of perfecting title to polar territories has been Toma (and to some extent Lakhtine): "An additional argument in opposition to the principle of 'effective occupation,' advanced by the Soviet jurists, is the notion that, with regard to occupation of polar areas, it is not justifiable to maintain the demand for effective possession." Toma, *supra* note 81, at 618 (citing Molodtsov).

[111] Société des Nations. VIII Recueuil des Traités 267 (1922), Armistice with Austria-Hungary. 42 Stat. 106 (1919).

[112] Waldock, *supra* note 87, at 336 (citing Lindley).

[113] Smedal, *supra* note 30, at 34.

[114] Mezhdunarodnoe Pravo Gosudarstvennoe Iedatel'stuo Yuridicheskoi Literatury, International Law 269 (1951).

[115] Convention as to the Pacific Ocean and Northwest Coast of America, *signed* April 17, 1824, 8 Stat. 302, T.S. 298 (effective January 11, 1825).

[116] Convention ceding Alaska, *signed* March 30, 1867, 15 Stat. 539, T.S. 301 (effective June 29, 1867).

[117] Convention as to the Pacific Ocean and Northwest Coast of America, *signed* April 17, 1824, 8 Stat. 302, T.S. 298, art. 3, 4 (effective January 11, 1825).

[118] The French text states, "et finalement du dit point d'intersection la même ligne meridienne du 141ème degré formera, dans son prolongement jusqu'à la mer glaciale. . . ." (emphasis added). Taking the primary meaning of the French "jusqu'à" as "up to" rather than "as far as," the meaning of the phrase becomes clear.

[119] Smedal indicates that such is indeed the case: "[A]s a special argument in favor of the sector claim of the Soviet Union, reference has been made to the Treaty between the United States and Russia of 1876. In this Treaty it was stipulated that the boundary between the two States shall be the aforesaid meridian . . . and it is stated with regard to the boundary that it '. . . remonte en ligne direct [sic] sans limitation, vers le Nord jusqu'à ce qu'elle perde dans la Mer Glacial. [sic]'"

Smedal, *supra* note 30, at 80. The French text cited by Smedal re-emphasizes the earlier conclusion as to meaning of "jusqu'à" for a meridan which "loses itself" or "disappears" when it reaches the "frozen seas" is hardly to be construed as one intended in the minds of its drafters as ending in the North Pole. *Cf.* Smedal, *supra* note 30, at 66–7:

"[I]n favor of the Canadian sector claim, a special reason has been stated which does not apply to sector claims generally. Reference has been made to the Treaty between Russia and Great Britain of 1825 relating to the boundary line between Alaska and Canada, where the expression is used that the meridian 141 degrees west shall be the boundary line 'right up to the Arctic' (jusqu'à) la Mer Glacial). Whether this term means 'to where the Arctic begins,' or, 'as far as the Arctic extends,' is perhaps not quite clear, but the former interpretation seems to be the right one. If the term is understood to mean that a division of the Arctic regions was made by the Treaty, the division was in that event a matter between Great Britain and Russia which foreign States are not bound to respect if they have not consented to it."

Although not discussed in the article, it is clear that Smedal's last observation would weaken the historic argument even further by any application or construction of the principle *res inter alios acta*. See also Pharand, *supra* note 30, at 87:

"More specifically, is the sector theory, invoked by Senator Pascal Poirier in 1907 in support of Canada's claim to Arctic Islands north of the mainland, to be relied upon now to claim sovereignty right up to the Pole? On this point it might be recalled that Prime Minister Trudeau stated in reply to a question in the House of Commons on March 10, 1969, that in his opinion, the sector theory did not apply to the waters or ice. This opinion is quite sound, considering the physical realities of the Arctic Ocean (footnote omitted)."

FOOTNOTES—Continued

[120] [1906–07] Debates of the Senate of the Dominion of Canada, 226–73 (1907).
[121] *See* Lahktine, *supra* note 24, at 708.
[122] *E.g.*, Wilkitski, Czar Nicholas II, Tsarevich Alexsi Island, Starokademski and Novopashenni Islands and Henrietta, Jeannette, Bennett, Herald and Ouiedinenie, New Sibera and Wrangel.
[123] *See* Lahktnie, *supra* note 24, at 708. A claim reasserted by the Russian Soviet Federated Socialist Republic by a Special Memorandum of November 4, 1924 (both as to the above islands and as to the eastern boundaries of the 1867 Convention). The Soviet Decree of April 15, 1926, used similar language as its predecessors stating: "toutes terras et fles découvertes ou qui pourraient être découvertes àl'avenir." *Id.* at 711.
[124] Smedal, *supra* note 30, at 75.
[125] *Id.*
[126] *Id.*
[127] Breitfuss Die Territoriale Sektoreneinverteilung der Arktis im Zusammenhang mit dem zu erwartenden Transantarktischen Luftverkher, at 28 (1928). See also Toma, *supra* note 81, at 620.
[128] Lakhtine, *supra* note 24, at 711.
[129] Toma, *supra* note 81, at 619 (cting Molodstov) (footnote omitted).
[130] *Id.*
[131] V. Durdenevsky, The Problem of the Legal Status in the Polar Regions, 111–114 (Moscow University, July 1950).
[132] Smedal, *supra* note 30, at 58.
[133] Paracouziok, Soviets in the Arctic 323 (1928) (citing Lakhtine).
[134] Smedal, *supra* note 30, at 64.
[135] *Id.* at 62–3.
[136] *Cf.* Dundee Courier and Advertiser, April 6, 1929, cited in Smedal, *supra* note 30, at 74.
[137] *Cf.* Hayton, *supra* note 91, at 606–07. *But see* Waldock, *supra* note 87, at 338; Reeves Antarctic Sectors, 33 Am. J. Int'l L. 519 (1939): "Whatever may be the economic and strategic factors ultimately to be disclosed, the adoption of the sector principle may assist greatly in the regulation and preservation of the whale industries. The United States has shown its interests in the matter by its ratification of the temporary treaty for the regulation of whaling. One may assert that the sector principle as applied at least to Antarctica is now a part of the accepted international legal order." *Id.* at 521.
[138] See notes 139 and 140, *infra.*
[139] Wright, *Territorial Propinquity,* 12 Am. J. Int'l L. 519 (1918) [hereinafter cited as Wright]. And further: "In its recognition of territorial propinquity, the Lansing-Ishii agreement does not stand alone. An inspection of the cases shows then that they may be classified according as geographic proximity has been mentioned to justify (1) the annexation of territory, (2) the enjoyment of special economic privileges, (3) the exercise of extraterritorial jurisdiction, or (4) the protection of special political interests." *Id.*
[140] *Id. Cf.* Cole, *supra* note 43, at 40: "[D]uring the period when the colonial powers recognized the creation of sovereignty by discovery and symbolic annexation, it was considered sufficient to claim an entire continuous region by symbolic annexation, by symbolic acts performed at some place along the coast of the new territory. Even after the need for effective occupation and settlement appeared the practice of States evolved various doctrines of constructive occupation of new areas based on the idea that extension of sovereignty to surrounding territory was incidental to the natural development of the settlement and was necessary for its military protection. This is known as the doctrine of continuity; where the same principle was applied to the islands offshore but beyond the territorial waters the doctrine was contiguity."
[141] Toma, *supra* note 81, at 620 (citing Lahktine).
[142] S. Molodtsov, Souremennoe Mezhdunarodno-Pravovoe Polozhenie Antarktiki (Contemporary International Legal Status of the Antarctic) 36–7 (1954).
[143] Van de Heydte, *supra* note 84, at 470.
[144] *Id.* See his earlier comment, *id.* at 468. "Yet to a more thorough observation, the so-called rule of contiguity (*Grundsatz der Geographischen Enheit*) is in no way opposed to the general principle of effectiveness, but it is on the contrary the logical consequence and natural application of that very principle in its intrinsic sense."
[145] Lakhtine, *supra* note 24, at 708.
[146] Palmas (Miangas) Island Arbital Award (22 Am. J. Int'l L. 867 (1928).
[147] Smedal, *supra* note 30, at 43. See also the definition of "Hinterland" by Toma, *supra* note 81, at 620: "Hinterland is generally understood to mean the land behind a coast, and not areas stretching from the continent towards the sea."
[148] Smedal, *supra* note 30, at 43.
[149] 1 L. Oppenheim, International Law 511–512 (7th ed. 1948).
[150] *Id.* at 512.
[151] Smedal, *supra* note 30, at 44.
[152] Wright, *supra* note 140, at 522 (footnote omitted).
[153] M. Lindley, The Acquistion and Government of Backward Territory Under International Law 151 (1926).
[154] *Id.*
[155] *See* note 74, *supra; see also* 1 C. Hyde, International Law 165 (1922).
[156] *Id.*
[157] Hayton, *supra*, note 91 at 585.
[158] H. Wheaton, International Law 627 (7th ed. 1944). *And see* Hayton *supra* note 91, at 585, who provides a broad description of the Argentine claim, "[A]rgentine sovereignty . . . is based, among other reasons, on the aggregate of the historical antecedence of its title . . . maintained firmly in all circumstances by the Argentine Government [and] spiritually identified with the feeling of the nation's entire population; in the insuperable geographical position of the Republic; in the geological continuity of its land with the Antarctic lands; and the climatological influence that the neighboring polar zones exercise over its territory; and the rights of first occupancy; and the pertinent diplomatic measures; and, finally, in its uninterrupted activity in the same Antarctic terrain."

FOOTNOTES—Continued

[159] *Id.* at 601 (footnote omitted).
[160] *See generally id.*
[161] [1951] I.C.J. 116.
[162] Lakhtine, *supra* note 24, at 17. It should be noted, however, that the Soviets do not apply the principle to the Antarctic.
[163] Hayton, *supra* note 157, at 604 (footnote omitted).
[164] State agenda as Adopted at Preparatory Conference to the VIII Antarctic Treaty (1974).

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