selected by injecting syngeneic C57BL/6N mice intravenously with parent tumor cells. After 2 to 3 weeks, grossly visible pigmented lung tumor colonies were removed, and the tumor cells were adapted to tissue culture. The B16 cells that grew in culture after the first selection in vivo were established as a continuous line and were designated B16-F1. Cells from this line were reinjected into new syngeneic animals, and 3 weeks later a new group of lung tumor colonies was removed and cultured to yield B16-F2. With each succeeding cycle in vivo the ability of the selected B16 lines to implant, survive, and form lung tumors increased [I. J. Fidler, *Nature (London)* **242**, 148 (1973); *Cancer Res.* **35**, 218 (1975)]. After ten such selections the B16-F10 tumor line was obtained. This cell line forms significantly more gross lung tumors per input of cells than the B16-F1 tumor after intravenous or intracardiac injection into syngeneic C57BL/6 mice [I. J. Fidler and G. L. Nicolson, *J. Natl. Cancer Inst.* **57**, 1199 (1976)].
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54. We thank K. Bivens, V. Koogle, and J. McLellan for assistance in preparation of this manuscript. This research was sponsored by the National Cancer Institute, DHHS, under contract No. N01-CO-75380 with Litton Bionetics, Inc.

How the Law of the Sea Treaty Will Affect U.S. Marine Science

David A. Ross and John A. Knauss

Negotiations concerning marine science and other issues at the third United Nations Conference on the Law of the Sea (UNCLOS III) began in 1974. On 30 April 1982 a Law of the Sea Treaty (*1*) was approved by a vote of 130 to 4—the United States, Venezuela, Turkey, and Israel voted against it and there were 17 abstentions. Eventually 60 nations must ratify the treaty for it to enter into force. The United States, in spite of its negative vote, can still eventually sign and later ratify the treaty, but the present Reagan Administration seems to be firmly against this option. U.S. marine scientists must understand, however, that once the treaty enters into effect, coastal states which have ratified it can, and probably will, enforce its regulations on all those who wish to do marine scientific research in their waters. The new regime for the ocean resulting from these negotiations will change markedly the way in which marine scientists and marine scientific research operate. If the treaty enters into force, the marine science articles will restrict many activities of U.S. marine scientists, as well as offer certain opportunities, whether or not this country signs or ratifies the treaty.

The history of marine science negotiations during UNCLOS III has already been discussed (*2*). Most countries supported restrictions on marine research. Its staunchest supporters were the United States, the Soviet Union (until 1976), West Germany, the Netherlands, and occasionally Japan (*3*).

The Law of the Sea Treaty

The treaty recognizes several distinct juridical regions of ocean space including internal waters, territorial seas, straits used for international navigation, archipelagic waters, exclusive economic

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0036-8075/82/0910-1003$01.00/0

zones, the continental shelf beyond 200 miles, a region called simply "the area," and the high seas. It establishes boundaries between the juridical regions (or at least defines the method by which such boundaries are to be determined), the mix of coastal state and flag state jurisdiction within each region, rules of conduct, and methods by which disputes about the interpretation of the treaty will be considered. Several jurisdictions, such as the territorial seas and the high seas, have been recognized in international law for many years (Fig. 1), but others such as the exclusive economic zone, archipelagic waters, and "the area" are completely new (*4*). Broadly speaking there is more restriction as you move from the open ocean toward the coast, from complete freedom on the high seas to absolute coastal state jurisdiction over foreign research in a coastal nation's internal waters.

Summary. The Law of the Sea treaty will clearly affect the way U.S. marine scientists operate in about 40 percent of the ocean. The matter will be made even more complex by the apparent intention of the Reagan Administration to remain outside the treaty.

In the treaty the term "marine scientific research" is not defined. The treaty does say that "marine scientific research shall be conducted exclusively for peaceful purposes; . . . shall be conducted with appropriate scientific methods . . ., [and] shall not unjustifiably interfere with other legitimate uses of the sea" (Article 240). Likewise, "states and competent international organizations shall promote and facilitate the development and conduct of marine scientific research in accordance with this Convention" (Article 239). In addition, coastal states "shall endeavour to adopt reasonable rules, regulations and procedures to promote and facilitate marine scientific research . . . beyond their territorial sea and to facilitate . . . access to their harbours and promote assistance for marine scientific research vessels" (Article 255). Although these articles, except 240, seem supportive, they are nonbinding.

Internal waters. Internal waters include rivers, bays, lakes, and other areas on the landward side of the base line from which the territorial sea is delineated. As in the 1958 Convention on the Territorial Sea and Contiguous Zone the coastal state exercises complete jurisdiction over who shall enter its internal waters to conduct marine scientific research and under what conditions.

Territorial sea. The treaty proposes the establishment of a territorial sea of up to 12 nautical miles from shore. Within the territorial sea the coastal state has "the exclusive right to regulate, authorize and conduct marine scientific research, . . . [which] shall be conducted only with the express consent of and under the conditions set forth by the coastal State" (Article 245). These provisions are already accepted practices under international law, set out in the 1958 Convention on the Territorial Sea and the Contiguous Zone; the new aspect is a clear definition of the 12-mile width of the territorial sea. There is no mention of the mechanisms to be used to get permission to conduct research in a country's territorial sea or the conditions that a coastal state can impose on a researching state or institution. As of May 1981, 80 states claim a 12-mile territorial sea, 25 claim more than 12 miles (14 claim 200 miles), and only 28 claim less than 12 miles (*5*). The treaty should eliminate claims of more than 12 miles for a territorial sea.

Although coastal states have sovereignty over the territorial sea, there is the right of innocent passage. However, Article 19 [paragraph 2(j)] eliminates "the carrying out of research or survey activities" as an accepted activity under innocent passage.

Straits used for international navigation. The definition and acceptance of a territorial sea 12 nautical miles wide will have an important effect on 116 straits (*6*) that are more than 6 but less than 24 miles wide, such as Bab el Mandeb and the Strait of Gibraltar; these would be included within the territorial seas of the adjacent states. Article 40 states that "foreign ships, including marine scientific research and hydrographic survey ships, may not carry out any research or survey activities without prior authorization of the States bordering straits." Thus for purposes of marine scientific research, international straits less than 24 miles wide are treated as territorial seas (Fig. 2).

Archipelagic waters. The waters around the Philippine Islands were claimed by that government in 1955, and Indonesia made a similar claim a few years later, but neither action was given wide recognition until UNCLOS III. A series of articles in the treaty will permit archipelagic states to define base lines for archipelagic waters. The actual extent of these waters is not clear, although the treaty defines the rules by which they will be determined. An archipelagic state is one formed by one or more archipelagos, such as Indonesia and the Philippines. The United States cannot claim archipelagic status for Hawaii, nor can Equador for the Galápagos Islands. An archipelagic state may draw straight base lines joining the outermost points of the outermost islands provided that the ratio of water to land of the area encompassed does not exceed nine to one. The archipelagic state exercises the same jurisdiction over marine scientific research in its archipelagic waters as it does over such research in its territorial sea.

Exclusive economic zone. The exclusive economic zone is another new concept and presents major problems for marine science. This zone extends 200 nautical miles (370 kilometers) from the baseline from which the territorial sea is measured (Fig. 1B). Consequently, it includes most of the world's coastal waters and most of the continental shelves, in a geological sense. (The treaty, however, does not seem to apply to the Antarctic continent.) Altogether, the territorial sea, archipelagic waters, and exclusive economic zone include about 32 percent of the ocean (*7*). The conditions for marine scientific research in a foreign country's exclusive economic zone (or on the continental shelf within the zone) are a consent regime with a strong set of requirements. There are six important conditions.

1) Consent is necessary and shall "in normal circumstances" be granted (Article 246, paragraph 3). Consent can be denied if the project (i) "is of direct significance for the exploration and exploitation of natural resources, whether living or non-living"; (ii) "involves drilling into the continental shelf, the use of explosives or the introduction of harmful substances into the marine environment"; (iii) "involves the construction, operation or use of artificial islands . . .;" or (iv) if the request of consent contains inaccurate information "or if the researching State or competent international organization has outstanding obligations to the coastal State from a prior research project" (Article 246, paragraph 5). A coastal state's decision based on these four provisions is not reviewable by a third party (Article 297, paragraph 2).

2) Specific information must be supplied not less than 6 months before the start of the project. Research states or international organizations must provide

descriptions of (i) "the nature and objectives of the project"; (ii) "the method and means to be used, including name, tonnage, type and class of vessels and a description of scientific equipment"; (iii) "the precise geographical areas in which the project is to be conducted"; (iv) "the expected date of first appearance and final departure of the research vessels, or deployment of the equipment and its removal, as appropriate"; (v) "the name of the sponsoring institution, its director, and the person in charge of the project"; and (vi) "the extent to which it is considered that the coastal state should be able to participate or to be represented in the project" (Article 248).

3) Specific conditions must be met. Applicants for consent to conduct research must (i) "ensure the right of the coastal state, if it so desires, to participate or be represented in the marine scientific research project, especially on board research vessels . . .;" (ii) provide preliminary and final reports, if the coastal state so requests; (iii) provide access for the coastal state to all data and samples for the project and "furnish it with data which may be copied and samples which may be divided without detriment to their scientific value"; (iv) provide, if requested, "an assessment of such data, samples and research results or provide assistance in their assessment or interpretation"; (v) ensure "that research results are made internationally available through appropriate national or international channels"; and (vi) "inform the coastal state immediately of any major change in the research programme" (Article 249).

4) "Communications concerning the marine scientific research projects shall be made through appropriate official channels unless otherwise agreed" (Article 250). These official channels will probably be foreign ministries and the U.S. Department of State. This requirement may lessen the role of scientist-to-scientist relationships that so often have been successful in developing projects. On the other hand, this provision might lessen the ambiguity concerning foreign responsibility for granting the permission, a point which has been troublesome at times.

5) Coastal states can suspend research activities (i) if they are "not being conducted in accordance with the information communicated" (that is, the information requested in Article 248), or if the conditions specified in Article 249 are not met; or (ii) if there is a major change in the research project or activities (Article 253). Coastal states may require the cessation of marine scientific research activities if such problems or changes "are not rectified within a reasonable period of time" (Article 253).

6) After permission to conduct research is granted, "land-locked and geographically disadvantaged States" may request to receive the information provided under Articles 248 and 249. These states may also participate when feasible in the project through qualified experts, although the coastal state may object to the choice of experts (Article 254).

Notwithstanding the six conditions, consent is implied, and a researching state or competent international organization could begin research 6 months after submitting its request if the coastal state has not denied consent within 4 months after receiving the information specified in Articles 248 and 249. However, it should be appreciated that the coastal state could still ask for additional information and effectively postpone a decision (Article 252).

The issue of publication of scientific results is not always clear. The treaty encourages publication and the flow of scientific data (Article 244, paragraphs 1 and 2). However, with respect to the regime of marine scientific research in the exclusive economic zone and in the continental shelf, Article 249 (paragraph 2) requires "prior agreement for making internationally available the research results of a project of direct significance for the exploration and exploitation of natural resources." Thus if a coastal state determines that the research program for which it gives permission under Article 246 (paragraph 5a) is "of direct significance for the exploration and exploitation of natural resources, whether

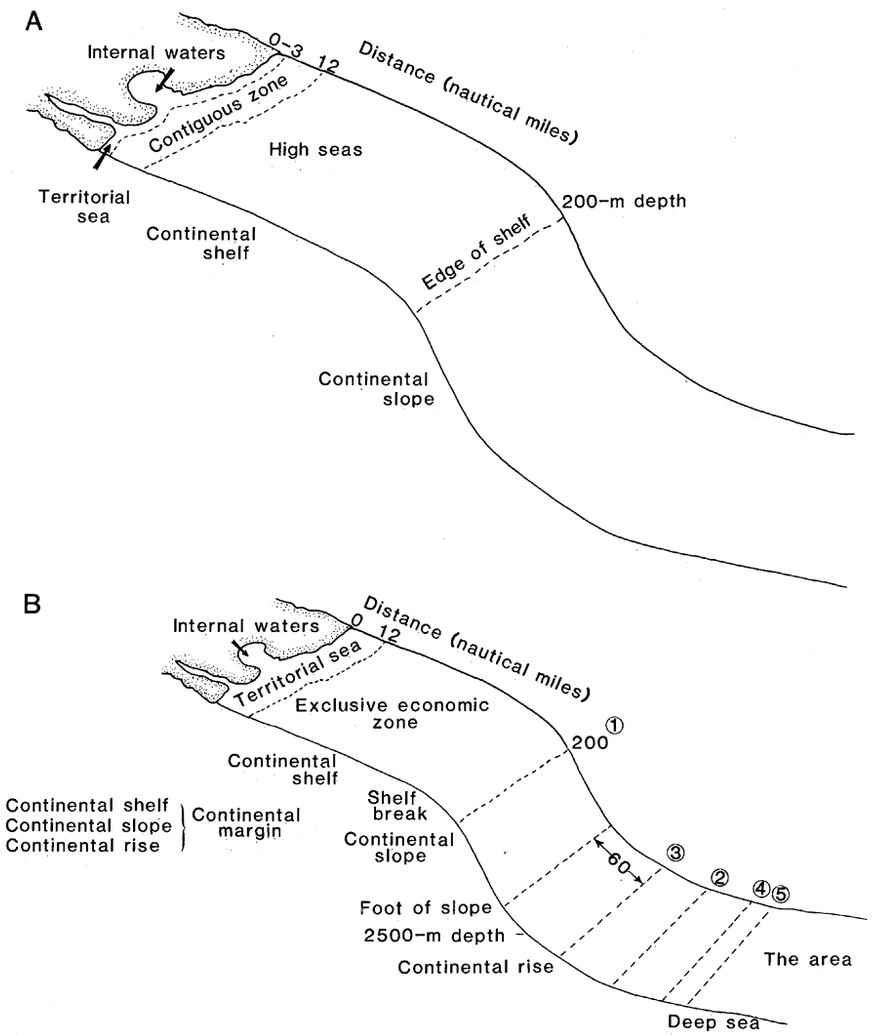

Fig. 1. The major divisions of the ocean (A) under the various 1958 conventions and (B) under the treaty (*4*). The numbers in (B) refer to possible definitions of the continental shelf: (1, to 200 miles if the continental shelf is ≤ 200 miles; 2, sediment thickness ≥ 1 percent of the distance to the base of the continental slope; 3, 60 nautical miles from the foot of the continental slope; 4, 100 nautical miles from the 2500-meter isobath; and 5, not more than 350 nautical miles from the inner boundary of the territorial sea. Note that the relative position of 2, 3, and 4 can vary depending on the characteristics of the sea floor. (Horizontal distances are not accurately drawn.)

living or non-living," it can also control publication of such results. Presumably any restrictions on publication should be agreed upon at the time that permission is granted for the research.

Continental shelf beyond 200 miles. The continental shelf has a complex, nonscientific definition (Fig. 1B). The outer edge of the juridical continental shelf sometimes roughly corresponds to the outer edge of the geological continental margin. For all coastal states the juridical continental shelf extends at least 200 nautical miles to the edge of the exclusive economic zone. The requirements for marine scientific research on the continental shelf within the exclusive economic zone are the same as those for the latter. If the continental margin (shelf, slope, and rise in the geological sense) extends beyond 200 nautical miles, the outer edge is determined by the foot of the continental slope or the thickness of the sedimentary rocks (how this thickness is determined is not stated) (Article 76, paragraph 4); in any case, the outer edge of the shelf shall not exceed 350 nautical miles from the territorial sea base line or 100 nautical miles from the 2500-meter isobath (Article 76, paragraph 5) unless the plateau, rise, cap, bank, or spur extends beyond 350 miles (Article 76, paragraph 6). A Commission on the Limits of the Continental Shelf is to be established to help coastal states sort all this out. The exact areal extent of this region cannot be determined at this time, but some unofficial estimates put it at about 8 to 10 percent of the ocean (*7*). The provision concerning sediment thickness (Article 76, paragraphs 4 and 6) is bound to cause confusion and allow for excessive claims.

The same conditions described for the exclusive economic zone apply to research on the continental shelf except that a coastal state may withhold consent only in areas it has publicly designated as subject to exploitation or detailed exploratory operations within a reasonable period of time (Article 246, paragraph 6). Research in the water column above the continental shelf and beyond the limits of the exclusive economic zone is not considered research on the continental shelf. For purposes of marine scientific research this area is the high seas.

The 1958 Continental Shelf Convention states that "consent shall be obtained in respect of any research concerning the Continental Shelf and undertaken there" (Article 5). The edge of the shelf was defined under that treaty as being "outside the area of the territorial sea and [at] a depth of 200 meters or beyond that limit to where the depth of superadjacent waters admit of the exploration of the mineral resources of the said area." At present this definition is better than the one in the treaty because few countries, if any, are exploiting beyond 200 miles or will do so in the near future. However, until a country is prepared to begin development of its continental shelf beyond 200 miles, Article 246 (paragraph 6) of the treaty, states that the coastal state cannot withhold its consent.

"The area." The seabed beyond coastal state jurisdiction (that is, beyond the continental shelf) is defined in the treaty as "the area." There are no significant restrictions in the treaty concerning marine scientific research in "the area" and "States' parties may carry out marine scientific research in the area" (Articles 87, 143, and 256). In addition, states "shall promote international cooperation in marine scientific research" (Article 143). A Deep Seabed Authority, established by the treaty, may carry out research either directly or through contract and is charged with promoting and encouraging marine research as well as disseminating scientific knowledge.

High seas. High seas freedom of scientific research is one of six "freedoms" explicitly listed for the high seas (Article 87). The high seas are that part of the ocean water column that excludes internal waters, territorial seas, archipelagic waters, and exclusive economic zones. This region covers approximately 69 percent of the 362 million square kilometers of the ocean. Freedom of research was not an explicit freedom of the seas in the 1958 Convention on the High Seas.

Dispute Settlement

Part XV and annexes V, VI, VII, and VIII of the treaty contain articles outlining in some detail how disputes arising from this convention are to be settled. With three important exceptions all disputes concerning marine scientific research are subject to compulsory dispute settlement. These exceptions are the right of the coastal state to withhold consent for marine scientific research in the exclusive economic zone and on the continental shelf beyond 200 miles and to order suspension or cessation of such research.

Thus the articles in the treaty that are most likely to generate disagreement are subject to conciliation but not to compulsory dispute settlement. Because the dispute settlement procedures are lengthy and expensive, it is also not likely that they will be used often for marine scientific research issues, and even if they are, it is doubtful that the results would be sufficiently timely to save the specific project that generated the dispute. One can hope, however, that the threat of evoking the dispute settlement clauses will minimize arbitrary or capricious actions by coastal states and that for those cases where there are honest differences of opinion the dispute settlement provisions may eventually provide some interpretative flesh to what are often ambiguously worded articles.

Implications

The restrictions imposed by coastal states on marine scientific research have been increasing rapidly since at least 1964 with the entering into force of the 1958 Convention on the Continental Shelf, and they are not likely to diminish (*8*), even if this treaty is not ultimately ratified. But if the treaty enters into force and is widely subscribed to, U.S. scientists wishing to work in jurisdictions claimed by other nations under the treaty will certainly be expected to comply with the treaty provisions. The provisions affecting marine scientific research clearly require changes in the way that U.S. scientists, institutions, and funding organizations operate when the proposed research is in another nation's territorial sea, exclusive economic zone, or continental shelf. A foreign country that wants to refuse or delay a project will have no trouble in finding a justification to do so, although the dispute settlement provisions may provide some limited help. On the other hand, if a country is supportive of the research effort, or at least neutral, the detailed requirements of the treaty may to a large degree become merely administrative tasks, and in some instances the detailed provisions may reduce misunderstandings.

One result of the treaty may be an increase in international programs and special bilateral arrangements. The treaty encourages development of bilateral and multilateral agreements "to create favorable conditions for the conduct of marine scientific research" (Article 243). Such agreements have already been used by the National Oceanic and Atmospheric Administration and are discussed in a recent report on the general objectives of U.S. bilateral marine science agreements (*9*).

Oceanographers may have to be prepared to play a more active role in organizations such as the Intergovernmental Oceanographic Commission (IOC) and the World Meteorological Organization

(WMO). The importance of participating in international organizations stems from Article 247, which provides a mechanism by which organizations may gain consent for projects in the waters of member states. However, in the case of the IOC, this will require a more scientific focus than has been common within this organization. To develop foreign programs will require frequent meetings between U.S. and foreign scientists and administrators. Support for such meetings, before programs are in place, may require the establishment of a separate funding source that can be used to explore and discuss possibilities for foreign efforts.

All participants (scientists and administrators) interested in working in foreign waters must understand the implications of the treaty. Journal articles, meetings at individual institutions, or discussions at scientific meetings will help, but the learning process probably will be lengthy and often painful. In 1978 recommendations were proposed for a complex series of operating procedures that would be necessary for U.S. institutions and scientists to use to operate under the draft treaty at that time (*10*). The report covers many of the details necessary for working in the new regime and should be read by any marine scientist interested in research in foreign waters.

Although a more knowledgeable group of marine scientists is necessary, more still will be required. Funding organizations and research institutions should be aware of the new conditions on marine research and should recognize that training, data evaluation, and the like will be needed. Such activities may divert scientists from their prime objectives, but the scientists should not be penalized because of time spent on them. Oceanographic institutions, either individually or jointly, perhaps through the University National Oceanographic Laboratory System (UNOLS) or the Joint Oceanographic Institutions, Inc. (JOI) should consider establishing a "foreign office" that can help scientists, administrators, and funding agencies develop and keep track of foreign activities. It would be naïve to think that most scientists will be able to wander through a maze of regulations imposed by the treaty and prepare, even many years later, an administratively, scientifically, legally, and internationally satisfactory program.

All scientists will have to see to it that their colleagues and institutions act responsibly, since coastal states can refuse to allow further research in an area if past responsibilities and obligations have not been fulfilled. Nongovernmental organizations such as UNOLS or JOI may be able to play a role in ensuring that individual members abide by the provisions of the treaty. The treaty puts the burden of compliance on the researching state, not the private scientist or his institution. Since a coastal state can deny a research request from a country if there are outstanding obligations against a previous project conducted by that country, how and when the obligations from a previous research project are terminated should be clearly defined in initial negotiations if possible. The threat to publication rights for research of direct significance for the exploration and exploitation of natural resources should also be considered in early stages of negotiation.

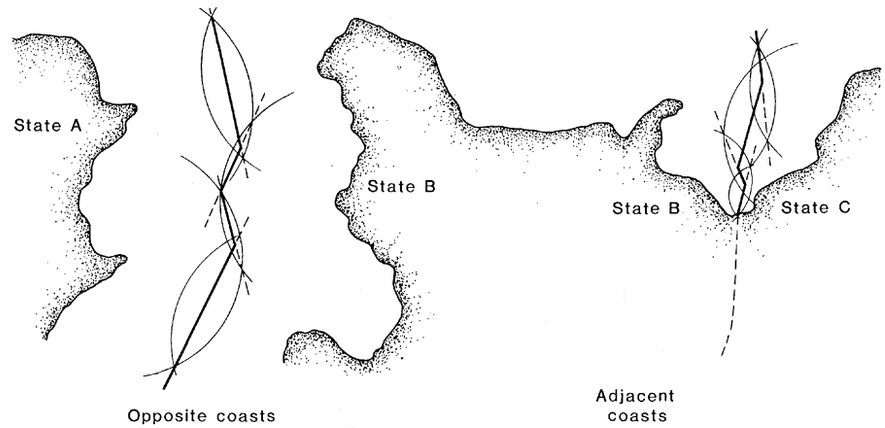

Fig. 2. Techniques of delimitation of the territorial sea between states with opposite or adjacent coasts. The situation shown for opposite coasts is that covering straits less than 24 miles wide.

For U.S. marine science and marine scientists to be able to continue their activities in the world ocean will require additional administrative and funding considerations. For example, foreign participation in the research and the sharing of data may add costs beyond those of "just doing science." Also, the development of foreign programs will require more lead time and may impose additional costs. The necessity of having at least a 6-month lead time to get permission to conduct research has implications for the funding cycle in organizations such as the National Science Foundation and the Office of Naval Research, which tend to operate on a 1- or 2-year financial calendar.

Even when marine scientists and funding agencies exercise great care in living up to the provisions of the treaty, problems may often arise—for example, research activities can be suspended if there is a major change in a project. If coastal states interpret "major change" as a delay due to ship breakdown, or weather, or a change in plans because of loss of equipment or adjustment of a ship track in accordance with information gained during the cruise, then marine scientists will soon stop asking for permission to work these areas. For these and other reasons marine scientists may avoid working specific areas because of anticipated or past difficulties in conducting research. Perhaps this can already be seen in general avoidance of marine research in such areas under the jurisdiction of Trinidad and Tobago, the Soviet Union, and India. However, by systematic avoidance of such areas the worst fears about the treaty may be realized. Marine scientists should be prepared to test and if necessary challenge strict or arbitrary interpretations, and the U.S. government must be prepared to support their efforts.

In the Interim

As difficult as it may be to live with the provisions of the treaty, the situation during the next few years may be even more difficult, depending at least in part on the final U.S. position with respect to a treaty. There are a range of possibilities. One, albeit remote, is for the treaty not to gain the necessary 60 adherents to enter into force. In this instance, marine scientists would be faced with varying unilateral claims of coastal states. As of May 1981, 69 nations have either specifically or indirectly claimed jurisdiction over marine scientific research in their 200-mile zones (*11*). Because of these claims marine scientists should expect regulations in the 200-mile zones to be at least as restrictive as those in the treaty. The second possibility is for the treaty to enter into force but with the major maritime powers refusing to sign it. Under this condition it is difficult to prejudge the extent to which the provisions of the

treaty, including those on marine scientific research, would eventually gain the status of "customary international law."

A third possibility is for the treaty to gain wide adherence with the United States being the only significant holdout. If this should occur, the United States has several options. It could enact national legislation embodying the essential provisions of the consent regime for the exclusive economic zone or adopt such provisions by administrative order, if such is possible. Either way, the United States would be providing tacit agreement to that part of the treaty pertaining to marine scientific research and presumably would recognize similar claims by other nations. At the other extreme, the United States could ignore the marine scientific provisions of the treaty. Then U.S. marine scientists wishing to work in foreign waters might find themselves in a Catch-22 situation since the Department of State would not process their requests as required by the treaty, and coastal states would not honor requests from the United States that did not come "through appropriate channels." In the absence of a specific bilateral arrangement, U.S. marine scientists who wanted to work in another nation's 200-mile zone would be forced either to send a research vessel into the zone without permission or to find some face-saving way for the United States to seek permission, such as asking to work in the coastal state's 3-mile territorial sea, a jurisdiction that the United States does recognize.

In any event, the legal problems facing those marine scientists who plan to work in foreign waters during the next few years may be as complex and as difficult to resolve as the scientific problems that they intend to attack. One disturbing consequence of the U.S. decision to reject the treaty is that insofar as other nations believe that a U.S. decision to reject the treaty is not in their best interests, they may be prepared to extract a price from the U.S. marine scientific community by making it increasingly difficult to work in their 200-mile zones. As outlined in this article, they have a number of ways to do so under the provisions of the Law of the Sea treaty.

References and Notes

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12. We thank our colleagues on the Ocean Policy Committee and its Freedom of Ocean Science Task Group for valuable discussions. In particular, we wish to acknowledge W. T. Burke, J. V. Byrne, J. P. Craven, P. M. Fye, M. H. Katsouros, E. L. Miles, R. Revelle, M. Talwani, and W. S. Wooster. This work was supported by the Pew Memorial Trust and the National Oceanic and Atmospheric Administration Office of Sea Grant under grant NA80AA-D-00077 (E/L-1). Contribution No. 5068, Woods Hole Oceanographic Institution.

Scientific Endeavor in India

Indira Gandhi

I am delighted to have this opportunity of being in such a distinguished gathering. In India I meet representatives of your Association every year at our own Science Congress.

The development of a country with 700 million people has to be an endogenous effort, relevant to our needs and concerns. India is just too vast to be bailed out by any country or group of countries.

Scientific endeavor, as success in any other walk of life, instills confidence in a society and leads it to a higher sense of achievement and fulfillment. Apart from the raising of traditional skills and techniques, using available materials in agriculture and rural crafts, our efforts in science cover a wide spectrum, encompassing work in some frontier areas of atomic energy, space science, oceanography, electronics, and fundamental research in mathematics, particle physics, molecular biology, and so on.

Why should India, which is still wrestling with the more obvious of basic needs, concern itself with such advanced areas? Scientists are aware that new knowledge is often the best way of dealing with old problems. We see our space effort as relevant for national integration, education, communication, and the fuller understanding of the vagaries of the monsoon which rules our economic life. Mapping from the sky also gives information about natural resources. Oceanography augments food and mineral supplies. Modern genetics open out vast possibilities. Home-grown expertise has helped our oil exploration. Had we been wholly dependent on foreign experts, we would not be producing 16 million tonnes of petroleum a year.

Knowledge cannot be fragmented. How can one say which kind of knowledge is immediately applicable? Basic research has led to much of applied science. Also, can we compel our scientists to be content with repeating the work of others? Our national Science Policy Resolution says: "It is an inherent obligation of a great country like India, with its traditions of scholarship and original thinking and its great cultural heritage, to participate fully in the march of science, which is probably mankind's greatest enterprise today."

Hence for India, science is essential for development and no less for the intellectual self-reliance and creativity of our people. Years ago, Cecil Powell pointed out: "In the long run, it is most painful, and very expensive, to have only a derivative culture and not one's own, with all that it implies in independence in thought, self-confidence and technical mastery. If we left the development of science in the world to the free play of economic factors alone, there would inevitably result a most undesirable concentration of science and scien-

During her state visit to the United States, India's Prime Minister Indira Gandhi was invited to address members and guests of the AAAS in Washington, D.C., on 30 July 1982. This is the text of her address.

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