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.

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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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tists and too few centres, those rich in science becoming even richer, and those poor, relatively poorer."

When we became free it was clear to us that we needed heavy industry and advanced science-based technology to safeguard our independence and to make us self-reliant. But this did not mean the neglect of small-scale and even village industries. In fact our policy was to encourage these in every way. These different segments are equally necessary and complement one another. Small changes, such as the fitting of tires in bullock carts and the use of biogas plants, can bring immediate relief and efficiency to the rural population. Unfortunately, the tendency of local people is to give greater importance to and press for big industrial units in their areas. I do feel that technological development should be shaped and diversified to suit local conditions and cultural settings, and, as far as possible, use locally available natural and human resources. Obviously we can profit by technology only when we are able to generate it and bring it within our means. The appropriate integration of traditional and emerging technologies, particularly in the fields of microelectronics, biotechnology, and satellite imagery, is an area worthy of your attention. This will help to avoid the often observed adverse impact of new technology on ecology, energy requirement, and the generation of employment.

The union of science and international politics has led us to an anxious state. In spite of all the exertions of developing countries and projects of multilateral and bilateral cooperation, 95 percent of the world's R & D is still confined to the industrialized nations. Almost 60 percent of this is military-oriented and of the rest, a good part of even basic scientific and engineering research is directed to problems specific to advanced economies. Colin Norman writes: "Part of the reason for the current military build-up is the fear of conflict over control of resources, particularly oil. Yet the continued diversion of R & D funds into military coffers makes it more difficult to pursue technologies that will help to ease dependence on finite resources."

In developing countries the emphasis must be on curbing diseases such as gastroenteritis and sleeping sickness, but Max Perutz points out that in the West only the largest firms can now afford to develop new drugs, and that such firms restrict their research to diseases of the affluent, for fear of risking their investment. We must know more about the physiology of reproduction to make family planning effective, about the chemistry of soils and methods of water conservation, and about the genetics of plant species that can improve yields in adverse conditions.

If the world is to be a better place for all, it is important to direct technological changes, both internationally and within countries, toward areas that are economically and socially more backward and at all times to try to avoid, or to balance, the undesirable side effects of such changes.

The gap between people in the industrialized and developing countries is growing, and this is naturally affecting their preoccupations. Those in developing countries have to find their own solutions, but it is not easy for them to forge entirely different paths and, much as we try, our economies are influenced by the trends and policies of the affluent. For instance, modernizing agriculture to increase production is essential, but this consumes vast amounts of energy, so that an energy shortage can cause a shortage of grain.

The resources for India's development have been predominantly our own—more than 90 percent. However, we do need foreign investment, particularly in science. Conceived and implemented as cooperation based on mutual respect, such investment can act as a catalyst and can constitute "superchargers" as Homi Bhabha used to say, to the engine of our own domestic effort. The scope for cooperation is immense. Global conferences end with inspiring and laudable statements, but their commitments are seldom honored.

Carefully selected and well-managed programs of cooperative work in science, in areas unconnected with defense and commercial considerations, can build true links of understanding. The persons involved speak a common language of science. Shared experience can bring succor to millions all over the world. Compared to many other areas, such cooperation does not cost much.

The profusion of international awards garnered by American scientists each year speaks of intellectual vitality, and of the dynamism of U.S. science and technology. These achievements are part of human progress.

The American scientific community is truly international. It includes such persons as Professors S. Chandrasekhar and Hargobind Khorana, who came to the United States from my country. We are proud of the work that Indian scientists are doing here, and are glad that most of them continue their interest in India. Thousands of Indians have proved their worth in American science and technology.

Our satisfaction with the accomplishments of Indian scientists is not unmixed. The exodus of talented young men and women from developing countries has been described as technological assistance in reverse—that is, from the poor to the rich. If they returned to India, they could be a bridge for the transfer of technological ideas and skills. Many do return, and, sometimes the very conditions and lack of grants challenge their creative skills.

There are many rewarding areas in which American and Indian scientists can cooperate. Some of these are:

1) Improvement of food production, especially of grain legumes and oilseeds, and minimization of dependence on mineral fertilizers through biological nitrogen fixation.

2) Biomass production and the application of tissue culture and genetic engineering to produce quick-growing trees that can provide fodder and fuelwood for our vast rural population.

3) Biomedical research to control leprosy, tuberculosis, and waterborne diseases, and to control fertility through immunology and other advanced techniques. As some of you may have heard there are some exciting new developments in India on leprosy control.

4) Materials research to reduce energy consumption and costs.

These are some areas which I hope will be looked into by the joint panel on science and technology which President Reagan and I have agreed to set up.

The most advanced knowledge can be profitably applied to some old problems that form the hard core of underdevelopment. Without solving these problems, mass poverty cannot be overcome. The thrust of most technological advance in Europe and America has been to save labor. Developing countries need technologies that will promote employment but conserve capital and energy. Energy saving is vital even for affluent countries, so work in this area would benefit all.

I share the concern of a growing number about the dangers with which the human species is threatened. Today the responsibility for the future lies with all citizens no less than with those who are in positions of authority, and perhaps most of all with scientists as thinkers and seekers after truth. Nothing is stronger than the mind awakened and the human spirit aroused. Let us harness them to clear goals and high purposes.