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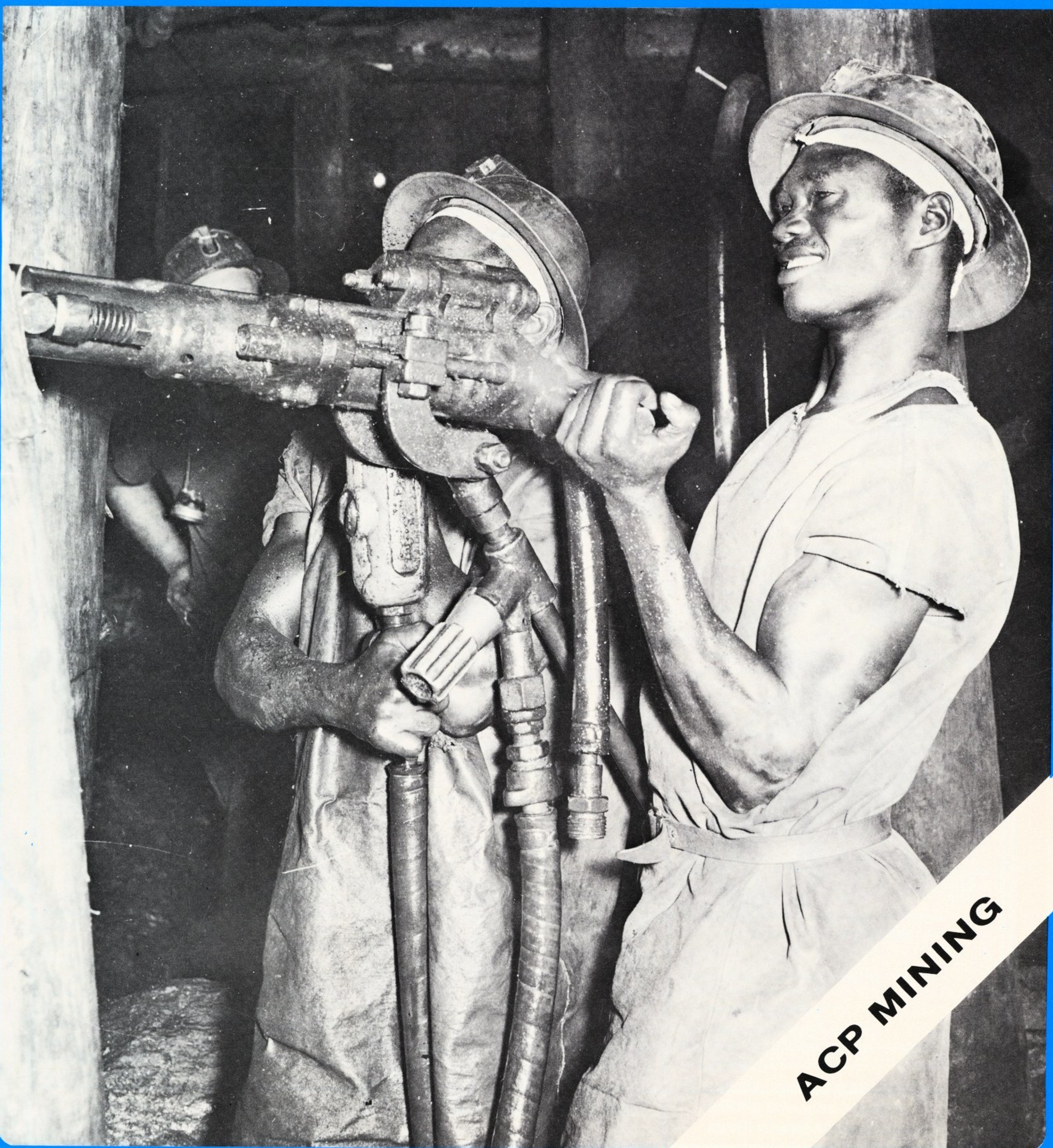

ACP MINING

Sharing the mineral wealth of the sea

by Elisabeth MANN BORGESE(*)

Ocean mining, especially the extraction of salt from sea water and of coal from the continental shelf, goes back to ancient times. It is only with the advance of modern technology, however, that the extraction of minerals and metals from the sea is assuming critical importance in the economy of nations and in the world economy as a whole. We may in fact be on the verge of a revolution in the mining industry, with a major shift from land-based to ocean-based resources. The consequences, in economic as well as in political terms, might be quite considerable.

Today by far the most important offshore mineral resource is still oil. Since the first offshore rig was built off the coast of California in 1894, the industry has expanded by leaps and bounds. Today almost 20% of the total world production comes from offshore. The value of offshore oil resources last year was estimated as $1.610 billion. To this should be added another $350 billion for offshore gas. There is more oil under the ocean than there is on land. As new areas are discovered — the North Sea, the China Seas, etc — and technological development permits ever deeper drilling, more than 50% of world production may come from offshore by the end of the century.

The sea bottom resources

Gold and platinum, mercury and chromium have been mined from the oceans. The Australians recently found gold deposits estimated to be worth about $100 million near their coast. Chromite and rutile, barite and ilmenite are extracted from the continental shelf. About 95% of the world's reserves of rutile, located on the continental platform of eastern Australia, is mined at the rate of about 450000 tons a year.

Tin ores have been mined for many years in Malaysia, from a depth of fifty metres. But in 1971 an American firm experimented successfully with a hydraulic dredge which worked at a depth of 1000 metres. And the Japanese have developed a tin-ore dredge that scrapes the ocean bottom at depths up to 4000 metres. Aboard ship the ore is automatically separated from the sand and mud, which are then returned to the oceans.

The Russians have reported large tin reserves in the Yakut Autonomous Soviet Socialist Republic and in the Japan Sea. They have also initiated a programme for the large-scale extraction of diamonds, platinum and gold from the Lena River, the Sea of Okhotsk, and along the coasts of the Kamchatka Peninsula.

The economic potential of the muds which are deposited on the ocean floor as a result of erosion and from alluvial accumulation is considerable. There are two kinds of mud, the calcareous and the red. Calcareous muds originate from shell deposits and occupy about 35% of the ocean floor at depths anywhere from 700 to 6000 metres. These sediments are, on average, 400 metres thick. They contain calcium, potassium and barite, and can be used for the production of whitewash and fertilizers. Red muds contain aluminum, iron, copper, nickel, cobalt and vanadium. They are believed to cover half the floor of the Pacific Ocean and about a quarter of the Atlantic seabed, at an average depth of 3000 metres.

In 1970, the total value of worldwide production of mineral resources from the sea was estimated as $ 1 billion. Of this amount, coal production yielded about $335 million, salt $ 173 million, sand and gravel $150 million, magnesium $335 million, tin $24 million, heavy minerals (ilmenite, rutile, etc) $13 million, diamonds $9 million and iron sands $3 million.

In 1965 a sensational discovery was made in the middle of the Red Sea. There are pools filled with very hot, very salty brines and at the bottom of those pools rich deposits of metal have accumulated, especially of iron, manganese, zinc and copper. Some of these deposits are 300 feet thick. According to recent calculations, the minerals deposited in one of these pools, the so-called Atlantis II Deep, have a value of $2.3 billion, including $780 million in zinc, $1.1 billion in copper, $280 million in silver and $50 million in gold. These minerals are being explored and exploited by the German AMR consortium, in joint venture with Saudi Arabia under leases granted by the Sudanese government.

The famous nodules

A second, much discussed and dramatic development in ocean mining is that of the extraction of manganese nodules from the deep ocean floor of the Pacific. The richest deposits occur in a narrow band, perhaps 125 miles across and 1000 miles long, running roughly east-west along the southern edge of the equatorial belt at a depth of about 5000 to 12000 feet in the Pacific, Atlantic and Indian Oceans. They contain, in various concentrations, iron, nickel, copper, cobalt, and traces of two dozen other metals in addition to manganese. Rich beds contain about 10 kilos of nodules per square mile of ocean floor. They vary in composition, shape and size. Many look like potatoes, and there are trillions of tons of them scattered on the seabed — 1.5 trillion tons in the Pacific alone.

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There are two basic methods by which the nodules can be dredged up. One is the so-called continuous line bucket (CLB) developed by the Japanese. It consists of a long loop of cable to which buckets are attached at intervals. A traction drive moves the cable so that the buckets dive into the deep, drag across the seabed to scoop up nodules, and come up again to empty their load. The second method, developed by Americans and Germans, is hydraulic. The nodules are sucked up, through a long, flexible steel pipe: a sort of huge vacuum cleaner.

Although manganese nodule mining is still at an experimental stage, there are many problems yet to be solved, and the current steel and copper crisis is not encouraging large investments in seabed mining. Some experts (e.g. *Science* magazine in the US) anticipate that seabed mining will be considerably cheaper than the extraction of minerals on land. Compared with mining on land, where $9 of capital may produce $1 a year, $1 of capital will return at least $3 from ocean mining. John Mero, a pioneer in the nodule mining industry, predicts that massive production of minerals at one-fifth or one-tenth of land prices will signal the end of mining on land.

Measuring the oxygen consumption of coral in the Caribbean off the Bahamas

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Not only the continental shelves, the ocean floor and its subsoil, however, contain vast mineral resources. The water of the oceans itself can be considered a liquid mine, containing at least 60 useful elements in stunning quantities, such as 10 million tons of gold, over 15 billion tons of manganese, and at least 20 billion tons of uranium. But they are diluted in billions of tons of water. Their extraction might become economically possible only if technology were able to produce inexhaustible, renewable energy, either solar or thermonuclear. But even when this becomes possible, the application of energy on such a vast scale would create problems of heat waste or thermal pollution.

Minerals from the liquid ocean mine might also be extracted by biological systems; that is, we might use animals or plants to do the job for us. For instance, the ascidian, a sea worm, concentrates vanadium into itself; the lobster extracts copper from sea water; and T.F. Gaskell pointed out that "many sea animals have perfected ways of concentrating minerals ... Research into this problem may soon lead to the devising of man-made equipment for performing the extraction under controlled conditions..." Certain algae concentrate uranium, and can be genetically improved so that this concentration is even higher than in nature. Algologists are presently working on experimental "uranium farms" where uranium is concentrated by algae and extracted from them, with a side production of methane and fertilizer. Ocean mining thus takes us to the frontier of scientific and cultural development.

Very few countries at present have the scientific and technological capability to realize the potential of ocean mining. Some of them are major importers of these minerals and metals. They invest in the new technologies to increase their independence from other countries who are exporters of these minerals and metals.

Many of the developing countries are exporters. The export of minerals and metals provides a large share of their income. Their earnings may be reduced or lost if ocean mining becomes a major competitive factor.

But this need not be the case. In spite of the present trend towards the nationalization of ocean space, the oceans remain a medium recalcitrant to fixed boundaries and national management. Considering that the oceans are one ecological whole and that all parts of it and all uses of it are interdependent, the XXV General Assembly of the United Nations made a beginning by declaring the seabed, the ocean floor and the subsoil thereof, and its resources, to be the common heritage of mankind.

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Science can be scenic; but most mineral wealth is in deeper and darker waters

which cannot be appropriated by any nation or person; which must be managed by cooperation of all countries, for the benefit of all, with special regard for the needs of developing countries; which can be used for peaceful purposes only and must be conserved for future generations.

This is a revolutionary new concept, transcending and transforming those of sovereignty and ownership and fundamentally changing the relations between rich and poor countries: the latter, under this concept, are to share in a common heritage, not to depend on foreign aid.

A new type of international Institution for the sea bottoms

To embody this new concept, the Third UN Conference on the Law of the Sea is to create a new type of international institution, the International Seabed Authority, to begin with, for the management of the production of nodules from the seabed beyond the limits of national jurisdiction. This may be the prototype for a number of other international resource management authorities.

The difficulties of creating such a radically new type of institution are obviously enormous, and they are far from having been solved. There are, however, technological and ecological imperatives pushing in the direction of a solution.

If there are international resource management authorities, they will not compete with developing exporting countries. These, instead, will participate in ocean mining and directly benefit from such participation. Such benefits will include short-cuts in technological development, through immediate access to the most sophisticated and advanced ocean mining technologies. They will also include financial benefits, enabling these countries to diversify and industrialize at a much more rapid pace than has been possible under the present system which divides countries into producer and consumer nations and, for all practical purposes, continues a post-colonial extraction economy which, as the history of these last 30 years all too clearly indicates, is not conducive to development.

The internationalization of resource management, while becoming an ecological and economic necessity, will interlink important sectors of the world economy in such a way that major wars between countries so linked will become increasingly impossible. The merger of the coal and steel industries of western Europe under the Schuman Plan has set a precedent for such developments. The establishment of the International Seabed Authority thus would be a major break-through advancing both development and peace.

Effective participation by developing countries in the activities of the Authority is of utmost and immediate importance. The Authority, as it is emerging from the ongoing negotiations at the Law of the Sea Conference, will have a number of organs — an Assembly, a Council, an Economic Planning Commission, a Technical Commission, an Enterprise system, a Dispute Settlement system, among others — which call for experts and civil servants of an entirely new type. Their experience must comprise the oceanographic sciences as well as mining technology and economy, resource management, environmental sciences, and international law. Some of these experiences are not easy to acquire in developing countries. An international programme for comprehensive training in these new, interdisciplinary skills should be initiated at once. Only thus can developing countries realize the potential of the ongoing marine revolution. ☐

E.M.B.