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1st July 1983

Professor E. MannBorgese
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Elisabeth—
A nice visit with Werner Gocht and Alfred Wolf in Aachen who mentioned you—
Ocean Mining 82 a very useful factual piece, and await to see Ocean Min. 83.

Dear Professor MannBorgese,

I just thought that I would let you know that the book is out at last. I hope that you are as pleased with it as I am. In case this is something for your library I am sending you a prospect.

I will be continuing my stay in Sussex, near London, and would look forward to seeing you should you be in the area.

I'm trying to locate salient characteristics of EEZs & other zones— geological and mineral as well as legal, and find that Pruger's paper is a good place to start. I hope to see you during one of your European visits.

Sincerely yours,

Alexandra M. Post

AP/jb

# Wirtschaftlicher Teil

## The implications of change in mining finance and participation

Alexandra M. Post

In this paper attention is focused on the legal and financial structure of large-scale international mining projects. The author starts with the traditional concession, the classical arrangement between mining companies and local sovereign governments. Then major variations entailed by that formal and financial structure are considered: New patterns of participation, e.g. the service contract, the production-sharing contract, the managing contract and the turnkey contract, and new trends in mining finance: the private commercial lending and the project financing. There is a trend toward more government involvement.

● **Wandlungen und neue Tendenzen in der internationalen Bergbaubeteiligung und -finanzierung.** In den letzten 20 Jahren erfuhr die internationale Bergbauindustrie starke Veränderungen in technischer, rechtlicher und finanzieller Hinsicht. Die Umstrukturierungen können sowohl im Bereich der Lizensierung, der finanziellen Beteiligung, als auch bei den Eigentumsrechten beobachtet werden. Die Wandlungen sind nicht nur eine Folge der neuen politischen Ziele der Entwicklungsländer, sondern sie berücksichtigen auch stärker die größeren technischen und wirtschaftlichen Risiken, die mehr und mehr mit internationalen Großprojekten verbunden sind. Diese Entwicklung hat langfristige Konsequenzen bei der weiteren Umstrukturierung, deren Richtung und Gewicht sowie deren kausale Beziehungen es klarzustellen gilt. Allgemein ist eine stärkere staatliche Beteiligung zu beobachten.

● **Financement et gestion de projets minières: suites des tendances actuelles**

● **Las modificaciones y nuevas, tendencias en la participación y fincanciamiento internacionales de la minería**

Dr. rer. pol. *Alexandra M. Post*, The University of Sussex, Arts Building, Falmer, Brighton BN1 90 N (England).

### 1 Introduction

During the last twenty years and especially since 1973, major transitions have occurred in resource extraction, finance and law. Some of the general repercussions of the technical, financial and legal overhaul of the mining industry are well-known, although the causalities and consequences remain unclear. The availability of resources has always been central to the prosperity of an economic order; one needs only refer to:
- that brand of resource network termed colonialism;
- the protracted struggle for control of the iron-rich Alsace-Lorraine;
- the Japanese attempt to establish a resource foothold in mainland China during World War II;
- the financial impact of rising oil prices during the 1970s, and
- the current geopolitical importance of mineralized sources in the "3 Z's" - Zaire, Zambia, Zimbabwe - and South Africa.

The development of so-called "new international economic orders" is also in large part resource-determined, i.e., contingent upon given patterns of raw material procurement and distribution. A clear understanding of the dynamics of the global resource base is thus important at a time of at least perceived "strategic" resource scarcities and consequent political and economic alignments.

To clarify the nature of resource determinants, the technical, financial, fiscal and market mechanisms of the minerals sector may be causally described. In this paper attention is focused on the financial and legal structure of large-scale international mining projects. We start with the traditional concession, the classical format for mining agreements between companies and local sovereign governments. We then consider major variations that have emerged from this financial and legal structure which predominated until the 1960s. Finally, some of the implications of financial and legal change in mining are considered.

### 2 The traditional concession

The legal concept of concession can be found as early as 1158 in the Roncaglian Constitution of Friedrich Barbarossa [1]. According to this early use of the concessionary form, a local ruler disposed of absolute ownership and exploitation rights over certain minerals (gold, silver, salt) by "royal prerogative". This prerogative and the rights associated with it were transferable to third parties, similar to concessionary agreements [2].

The development of the concession concept received sharp impetus in the colonial era - a period that in itself is essentially defined by the attempt of European metropolitan interests to ensure a steady supply of raw materials and wealth thereof from non-European "periphery" supply sources. This process transpired through the founding of commensurate political and financial regimes, or "colonies". After discovery of vast resources in the Americas in the 15th and 16th centuries for example, the British Crown awarded land tracts to those favoured by the throne through a system of royal grants.

Another example, - in order to raise monies to become Emperor of the Reich, Charles V declared the mineral resources of Latin America to be the exclusive property of the Royal Spanish Crown. "Vassals" were granted concessions for the exploitation of these resources [3]. A royalty, or a certain portion of the income derived from these land grants, was paid to the Crown. However, taxes payable to local jurisdictions were non-existent or minimal. The lack of local jurisdictional participation in minerals revenue was a major cause of revolutionary independence movements.

The concession agreement, however, remained the predominant form between often European and North American

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based companies, on the one hand, and third world host governments, on the other, until well into the 20th century [4]. These agreements were relatively simple, providing the concessionaire with almost exclusive rights (access, exploration, exploitation, marketing) over vast land areas and their resources. Contract periods were also usually long – 50 years or more. Moreover, the status of extra-territoriality granted partial or total exemption from local law. This fact added to the enclave nature of many mining communities, already often located in geographically remote areas, and to the insulation of foreign communities in general [5].

The mining company was normally granted free rein over local operations. Typically the local government imposed a nominal land tax only, frequently linked with a nominal royalty on the value or quantity of goods produced or shipped (e.g., 5 US cents per ton on Liberian iron ore shipped, 1 US cent per stem of bananas harvested by the United Fruit Company) [6].

In general, the advantage of the per unit royalty payment for the host government is that it constitutes a relatively easy type of levy to administer, requiring mere physical count, and providing regular income to the local government regardless of market trends, as long as the company continues to produce and sell. Furthermore, the royalty payment method is less prone to company book manipulation and tax evasion. The limited involvement of local private and public parties in mining operations preceded an awakening of national economic self-conciousness in the newly independent nations and subsequent claims for so-called "permanent sovereignty" over resources.

From the traditional concessionary format emerged the modern transnational mining corporation. This evolution was spurred by vertical integration within the mining sector, and through lateral integration, or conglomeration, outside mining. One example in the oil sector is the emergence of the so-called "major". Consolidation has also notably taken place in nickel and aluminium. Local jurisdictions became more concerned about the relatively unfettered power of these large-scale international concerns as their visibility increased. As a result, government regulation augmented as well as government participation in ownership and management. This trend ultimately led to anti-trust measures in some cases, and to outright state expropriation in others.

In recent decades state control over local mining has progressively increased. This has occurred not only along project life as mining investment capital is firmly committed; in general, government measures have become more stringent concerning higher levels of local employment, local participation in ownership and management, taxation and other revenue-sharing methods which often now automatically adjust to the level of gross earnings. Government demands for local – and often public – participation have particularly intensified. State participation sometimes takes the form of total state ownership through expropriation or the formation of new public enterprises. States may also participate through joint ventures or service contracts with private companies, or, more recently, with other state enterprises. The motivation for increased state participation may be largely ideological, but government leverage in large-scale, capital-intensive projects in the risk-prone minerals industries has also provided a level of security.

At the same time, the number of mining bonanzas or "easy" deposits has diminished, necessitating the exploitation of ever more remote ore bodies with lower grades, often in areas of high political instability. This trend has been associated with higher costs, longer lead times, lower rates of return, and higher risks. Rising costs have been aggravated by price inflation of material inputs and by increased interest rates for project loans.

These factors have strained the financial resources of mining corporations. In this regard, the application by local governments of "automatic adjustors" that reconcile the tax burden with different levels of corporate earnings, means that profits from good years are no longer as readily available to the mining company to cover bad years, or current losses at other weaker subsidiaries.

Futhermore, as industrial economies reach maturity, there tends to be a saturation effect in metal consumption, i.e., a slowdown in metals use. Therefore, metal consumption in the growing economies of the third world will increasingly gain in market importance. This matter is complicated by the cyclic and unpredictable demand (in turn triggered by the business cycle) and by longer-term, often incompatible, shifts in supply. In order to increase the certainty of future sales and of future access to minerals supplies, producers, consumers, as well as producing and consuming nations have implemented stockholding systems. Stockpiling is often undertaken for strategic rather than economic reasons, increasing susceptibility to price distortions and political manoeuvring. This in turn introduces uncertainty to corporate investment decision-making.

The above trends have led companies to rely more on debt financing, and thus on the exigencies of debt servicing. Thus, mining corporations have been increasingly subject to bank control and more stringent lending conditions. In order to spread the risks of long-term, large-scale mining development, banks have lateralized lending activity through group-syndicated lending and bound underwriting activity. Simultaneously, new forms of guarantees, insurance and re-insurance schemes have emerged (see Fig. 1).

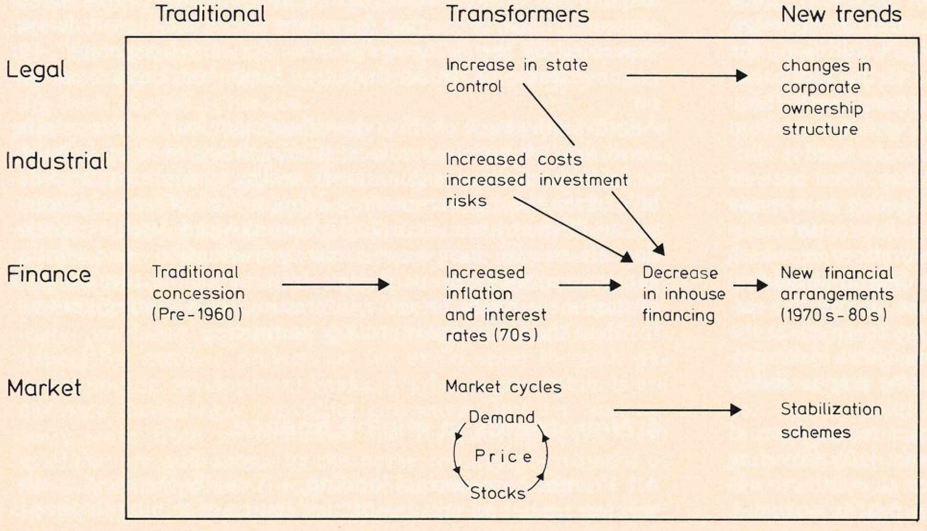


Fig. 1. Transformation of mining and ownership: Macrotrends

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Brussels
10 JANUARY 82

Dear Elisabeth

I've just finished right this minute a book on ocean mining and am taking it tomorrow to the publishers. It centers in on exploitation rights, resource policy and financing. One way of improving political covariance through the structuring of the financial package for ocean mining is proposed. After this long and arduous effort, I would like to grab papers in hand and head to Committee One next March. I would be so very happy if you could help me work out an official capacity at the Conference. The NGOs and the Secretariat have been recommended. It is very hard to observe without being a part of actual activities.

Wolfgang seems very happy and very successful at the University of Tübingen. He has made me promise to send copies of your German articles and other comments. A conference of like-minded states just terminated here in Brussels. The American delegation appeared adamently uncompromising on the terms of the reciprocating state regime, but then became more flexible. Everyone is now waiting for the letter opening on January 24th to witness how much overlapping there is proposed mine sites. I'm off to London to talk with minerals experts and will return to Munich in mid-Febrary. I would be very thankful to hear from you concerning the above at that time. How are the dogs?

Best regards, Alexandra

# OCEAN MINING

BY

ALEXANDRA MERLE POST

1982

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## CONCLUSION: THE LEGAL ROUTE TO THE SEA

Up until the middle of the twentieth century, the legal framework provided by admiralty and maritime law sufficed for the most part to control activities at sea beyond territorial waters. The five-sevenths of the earth's surface which is covered by water has been ruled by an overlapping labyrinth of domestic laws and international treaties patched together by the principle of the freedom of the seas. Sea use had been traditionally confined to fishing, shipping and passenger services, naval activity, adventuring and pleasure yachting, and piracy. The ratio of sea activity to total resources was small enough to provide abundance and to permit a free access regime.

However, due to the development of naval, maritime and fishing technologies, especially during and after World War II, sea use has expanded enormously in traditional sectors as well as in new areas such as communications, waste disposal, air traffic, and resource exploitation. Problems such as congestion, accidents, pollution, exhaustion of living resources, underwater espionage and the threat of submarine nuclear deployment, and rights associated with the installation of marine scientific research facilities became chronic. Furthermore, advanced technology enabled coastal states to extend national jurisdictions farther and farther out to sea, and to claim and exploit oil and other resources in and above continental shelves. Moreover, the possibilities improved of commercially recovering a potentially vast new source of minerals - polymetallic nodules - lying for the most part on distant parts of the ocean floor beyond the grasp of national jurisdictions. The existing maritime legal order was no longer perceived as sufficient for regulating the great explosion in sea use. Bilateral and regional agreements incremented by national law did not seem adequate for dealing with global problems in a comprehensive manner. The stage was set for the coordination of existing maritime laws and principles into a new comprehensive codified sea law. This is the task of the Third United Nations Conference on the Law of the Sea, which held its first session in 1973 in New York.

Perhaps the one most critical aspect of conference negotiations to date has been the legal interpolation of the concept of access, or the determination of which parties and under what conditions can control and use different sea resources. The defining of access applies to the use of sea lanes for the transport of critical resources and for the conduct of naval operations, to the control and exploitation of oil and other resources of continental shelves, and to the rights of recovery and the revenue and technological benefits associated with ocean mining.

Although passage rights and continental shelf exploitation rights are much more significant in real terms, it is the recovery of nodules from areas that has caught conferance attention. Ocean mining has become the battle cry of various interest groups and the focal point of conference debate.

Yet in geological terms, the availability of adequate concentrations of nodules on sufficiently smooth portions of the ocean floor remains uncertain. Economically, vis-a-vis costs, existing supplies and market prices, nodule mining is not attractive, at least in the short and medium term. To the contrary, ocean mining technology development has entailed high costs and has generated many uncertainties, especially concerning processing the the availability of a sufficiently low-cost energy supply. Political uncertainty remains high because of the failure to define common interests and to anticipate common losses. In this regard the burden of risk has not been distributed amongst all potential benefactors.

The major reasons for undertaking ocean mining once again confront the matter of access - not only to a steady and ensured supply of nodule minerals, but also to the control of resource exploitation, and to the income, technologies, and markets for technologies created thereof. In this regard, ocean mining is a strong reflection of recent legal and financial trends in international minerals development. The International Seabed Authority (ISBA) that would be formed by the conference prescribed seabed mining regime and its operating body, the Enterprise, are exemplary of the increase of government participation and intervention in mining

operations. This has occured through increased regulatory measures, heavier taxation, and the more direct involvement of states in minerals exploitation. New contractual and financial forms have been developed to harmonize the production norms of state and private operating entities, examples of which are service, turnkey and production sharing agreements supplemented by financial syndication and project finance. This significant trend signals a transition in the basic business format - or rules of economic endeavor - and a weakening of the polarization between private and centrally planned economies.

There has also been a decrease in the number of mining bonanzas, necessitating the exploitation of remote ore bodies with lower ore contents, such as the ocean floor, often in areas of political instability. Both these trends have generated a tendency towards higher costs, more medium rates of return, and higher associated risks. As a response, new financial vehicles have been developed to aggregate capital from a wide variety of funding sources and spread risk amongst a number of financial participants. This possibility remains to be explored for ocean mining. Intrinsic to this financial trend has been the spreading of management control and, in some cases, of ownership. Finally, an increase has occurred in discretionary interference with the market price system by producers, producer governments, and by interfirm and intergovernmental groups. This is reflected in ISBA controls on entry and production and provisions for the ISBA to enter into international commodity agreements under the banner of new international economic ordering (NIEO).

Additionally, as a new brand of institution, the International Seabed Authority as proposed by the Draft Convention on the Law of the Seas is a precedent setter in many regards. First, although quasi-precedents have been established by the European Community and other regional organizations, the bringing into force of a Seabed Authority would constitute the first time that an intergovernmental organization associated with the United Nations would have the competence to levy taxes. Besides representing a substantial turnover of fiscal control

and revenue generating power, the creation of an international taxing competence poses special problems in dealing with double taxation. Since the ISBA would be an international entity and not a state, current rules of tax exemption would not be called into account.

Second, a mini-government is being created for the deepsea area with assembly, council, judiciary organs, a mining regulatory authority, and an operating branch. The instigation of an ocean mining Enterprise would be the first time that an intergovernmental, UN-affiliated organization would engage in production activity on its own account. This international enterprise would not only be guaranteed mining sites and tax allowances, but would also be granted the competences to loan, make guarantees, issue securities, accept requisite contributions from state ratifiers of a law of the sea treaty, and to enter joint ventures, service contracts, and other joint arrangements. Furthermore, the ISBA is granted regulatory competences in the form of controls over the entry of competing private entities and over levels of production. Finally, like a state, the ISBA is granted the authority to enter into international commodity agreements. In sum, an intergovernmental entity has been blueprinted with potentially vast political and economic power.

A critical remaining question is which states, or groups of states, will control this power. This issue is a major impediment to conference negotiations. In the business of engineering new institutions for ocean mining, it remains to be considered in depth how conflict potential can be reduced through the qualification of generally held interests in ocean mining, and by introducing financial and contractual modes that spread political and economic risks amongst all participants so that mutual covariance is created. A model in this respect is brought forth in the last chapter of this study.

July 9, 1981

EMB

Dr. Alexandra Merle Post
5118 De Longpre Avenue
Los Angeles, CA 90027

Dear Alexandra:

Elisabeth Borgese sent me a copy of her letter to you of June 28, presumably in response to an inquiry from you about various pieces of information and the whereabouts of people.

I do agree with Elisabeth that the notion of a "breathing spell" as a result of America delaying action, although widely held, is misplaced. The result of the delay almost certainly will be to greatly diminish the momentum generated by the negotiations for a Draft Convention thus far, and the result quite possibly may be no Convention at all. This would be a pity.

In any event, the whole question of how the enterprise might work and become involved in joint ventures and a dual system of exploration, etc. is extremely important and well worth writing about. We would like very much to have your contribution, then, whenever you can get it in shape.

I hope this finds you well. Let us keep in touch.

Sincerely,

Norton Ginsburg
Professor and Chairman

cc: Daniel Dzurek
E. M. Borgese

NG:gv

5118 De Longpre Ave.
Los Angeles 90027

8 June 81

Dear Elisabeth,

Perhaps you recall our dinner encounter in Vienna with Norton Ginsberg.I am presently in Los Angeles preparing a forthcoming publication on deepsea mining. This effort not only reviews pertinent conference negotiations and outcomes, but considers other alternatives that still remain in question. It is useful in this regard to consider proposals to date that were NOT finally included in the draft text, not only to provide more perspective on plausible future developments, but also to chronicle (time, space and information access permitting) the types of considerations that have historically stood behind conference-approved texts.

I have been studying some of your proposals in Ocean Yearbook I, in the San Diego Law Review Symposia, and would like to inquire if you could advise me in locating the folloiwng major proposals that you referred to, as well as other proposals that should not be overlooked.

Mexican Ambassador Castenada proposal (Evensen group) of March 76.

The Pinto paper at the Pacem in Maribus in Algiers, 28 Oct 76, and proceedings for the same ( I have the NIEO AND THE LOS publication, if that is basically the same ).

Dan Ibekwe of Nigeria's proposal of 17 Dep 76, submitted by Amb. Wolf of Austria on 28 Apr 77 to a working session of the Evensen Group

The McCloskey Bill of 1976/77, etc.

The John Lowe-Nepal proposals.

Proposals by S. Oda of the ICJ.

Schreiber (?)'s proposal to the LOS in 1972 to model the deepsea mining authority on the model fo a Peruvian state mining agency.

Netherland proposal
German Fed

Furthermore, Norton Ginsberg reviewed a paper of mine for consideration for publication in Ocean Yearbook and asked me to update it. Perhaps you have received an outline in this regard. Enclosed is an "update of an update", which I hope you will find is easier to follow; it is also open to comment.

I wonder if the breathing space provided so abruptly by the US delegation provides sufficient opportunity for a re-think of some of the more unworkable aspects of a deepsea mining authority as it now stands. This will be my major preoccupation in the next weeks and I would of course look forward to knowing your views.

Very best regards. Are you still considering a drive about Brazil from top to toe? The idea is provocative. Perhaps I could suggest some aides de camp.

Alexandra

Dr. Alexandra Merle Post

PROPOSED ARTICLE

# DEEPSEA MINING: SOME OUTSTANDING ISSUES

Alexandra Post

Whatever the future holds in store...a treaty or non-treaty world...a a UN-prescribed "interim" regime...or an enclosed, reciprocally recognized "interim" regime created by national legislation...a need will still persist for international management beyond, and perhaps to a certain extent within, delimited national zones. For, in spite of lengthy negotiations aimed at creating a new sea order...and despite national efforts to partially create order by national enclosure of increasingly large portions of ocean space, the six causes of concerned expressed by Pardo as early as 1967 still persist, namely: 1. Increased sea use disturbs marine ecosystems; 2. ocean space is subject to balkanization by coastal states; 3. Military escalation is occurring due to the increase in scope of naval activity; 4. New forms of exploitation of marine resources pose a threat to land-based production; 5. Extended sea use exacerbates the fissure between rich and poor; 6. A new comprehensive regulatory mechanism is required.

Other questions related to the prevailing issue of international regulation also persist. One of the most important concerns the necessity of determining much more precisely than ICNT/Rev. 3 provisions presently do the exact nature of ocean mining contracts. This matter is particularly important because of its precedent-setting value.

The proposed article (basically a summary of current studies) confronts some of these questions by comparing recent developments in resource financing with different proposals for incorporating deepsea mining entities. Proposals considered include the ICNT model (Part XI and Annexes 3 and 4) and other major alternatives. It is believed that this exercise is meaningful not only for treaty internment, but also for the instance of treaty ratification and pursuant ramification of the nature of deepsea mining contracting by the proposed Preparatory Commission. Furthermore, the issue of international resource management is considered vis-à-vis the feasibility of international organizational solutions to problems arising from increased technology and sea use.

The paper is presented in three parts as follows:

1. Recent Trends in the Incorporation of Mining Entities
   - 1.1 The Changing Nature of Minerals Contracting
   - 1.2 The Real Control of Mining

2. Options in Formulating a Deepsea Mining Contract
   - 2.1 Licensing - The Traditional Concession
   - 2.2 "Contract for Services" - The Service Contract Option
   - 2.3 Multi-party Arrangements - The Joint Venture
   - 2.4 A Unitary Enterprise - The State Monopoly
   - 2.5 The UN Regulatory Agency - The State Mining Agency

3. International Resource Management as a Proper Function of a Seabed Authority

After close scrutiny, the fact of the matter is that the ICNT revised provisions are so vague, and provide so many options from a contractual and financial standpoint, that it is very difficult to say just what kind of a deepsea mining regime would actually be created in practical terms. The scope of options could provide a forthcoming treaty with the flexibility necessary to provide longevity for deepsea mining agreements. On the other hand, there may be so many ambiguities that treaty provisions would be circumvented, if not manipulated, by contracting parties and regulatory authorities alike.

Due to political cleavages at this time, it would seem more likely that mining interests will attempt to circumvent ICNT stipulations due to a lack of guarantees on acceptable investment returns. However, if future UNCLOS negotiations reflect a spirit of mutual conciliation and interest in successful mining operations, rather than a coerced transfer of power concerning mining control, then the generalized nature of treaty terms would prove a bonus by providing the treaty with adaptability to changing circumstance over time.

cc NSG

Box 4716
Santa Barbara, California 93103

Pacem in Maribus

May 1, 1977.

Mr. T.V.R. Pillay
Aquaculture
FAO
Terme di Caracalla
Rome, Italy.

Dear Dr. Pillay:

I am just back from the trip around the world to study sea farming and aquaculture projects. It was marvelously rewarding. The contacts you suggested all functioned admirably, and I am ever so grateful for your advice and collaboration. Without this help we we never could have done the job. We came home with almost four thousand pictures and heaps of material and first-hand impressions. Now all I have to do is to write the book....

Thank you also very much for your contribution to the Ocean Yearbook. It is in production, but I found a copy here in Santa Barbara.

I probably will be bothering you several more times before the Seafarm book is finished. Please forgive me.

With all good wishes,

Yours cordially,

Elisabeth Mann Borgese

Elisabeth Mann Borgese.

ORGANISATION DES NATIONS UNIES POUR
L'ALIMENTATION ET L'AGRICULTURE

ORGANIZACION DE LAS NACIONES UNIDAS
PARA LA AGRICULTURA Y LA ALIMENTACION

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

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Ref. DP 9/1 INT 76/016

6 DEC. 1977

Dear Mrs. Mann Borgese,

Thank you for your letter of 14 November which must have crossed my cable of the same date informing you of my inability to attend the conference.

I greatly regret this because the programme you have developed for the conference appears an extremely interesting one. I look forward to receiving a copy of the proceedings when it is available.

With best personal regards,

Yours sincerely,

Ramu Pillay

T.V.R. Pillay
Programme Leader
Aquaculture Development and
Coordination Programme
Fisheries Department

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# PROGRESS OF AQUACULTURE

by

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Partly based on a paper entitled: "State of Aquaculture 1976", presented at the FAO Technical Conference on Aquaculture held in Kyoto, Japan, 26 May-2 June 1976.

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## 1. INTRODUCTION

Aquaculture or the culture of aquatic animals and plants in fresh, brackish and marine waters is an ancient occupation in some parts of the world, whereas in others it is a relatively new means of food production. In the last decade there has been a world-wide recognition of the need to adopt on a large scale methods of husbandry to meet the world's future requirements of many aquatic products. In a number of industrially advanced countries substantial support for scientific research in this field became available and many marine and freshwater biological institutions utilized this opportunity to initiate significant investigations, particularly on problems related to marine aquaculture. The volume of literature on the subject has shown a marked increase and national and international aquaculture meetings have become frequent. An increasing number of private companies especially in western countries have invested in aquaculture enterprises, although a number of them are still only in the research and development phase. This general upsurge of interest in aquaculture has made some of the developing countries realize that they have been neglecting a traditional means of food production that has a great potential. Its rôle in integrated rural development, generation of employment and saving of foreign exchange, is being increasingly appreciated. The impending changes of the Law of the Sea have given an urgency to the need for developing alternate or additional sources of fishery production and means of employment for surplus fishermen even in some of the industrially advanced distant-water fishing countries. As a result of this, aquaculture has come to be accepted as of high priority in the national economic plans in at least some countries and consequently some notable expansion of the industry has occurred.

## 2. AQUACULTURE PRODUCTION

Although there has been a worldwide expansion of aquaculture activities, only a few countries have established suitable systems for the collection and compilation of aquaculture statistics. The highly dispersed location of production units, lack of specialized enumerators for data collection and the unwillingness of producers to provide detailed statistics have all contributed to this. However, the task of estimating production has become slightly easier in most countries, as some of the basic information is now available for making estimates, in contrast to the situation in 1966-67, when the production of fish through culture could be calculated only on a rough percentage basis. It was then estimated to be about 7 percent of the world catch of freshwater fish or 1 million tons annually (President's Science Advisory Committee, 1967). In 1970, a partial estimate was made on the basis of information collected from 36 countries: the total fish production through aquaculture amounted to 2.6 million tons (Pillay, 1972). A more comprehensive but again rough estimate was made in 1973 (Pillay, 1973) which showed that the production of fish was about 3.7 million tons and together with the production of crustaceans, molluscs and seaweeds, amounted to about 5 million tons.

The estimates of production in 1975, based on data provided by different countries, are given in Table I, which shows that the world production through aquaculture has now risen to over 6 million tons. Of this, 66 percent consists of freshwater, brackishwater and marine fish, about 16.2 percent of molluscs, 17.5 percent of seaweeds, and 0.3 percent of crustaceans.

Owing to the incompleteness of the previous and, indeed, even the current data, one hesitates to make comparisons. Certainly better estimates are now available for some of the countries and the coverage has also increased.

However, by also using associated information, one can determine where production is increasing or declining. Although the percentage increase varies considerably, in almost all the countries there has been an increase in production during the last decade and also since the 1973 estimate. As is only to be expected, percentage increases are the highest in countries where aquaculture has been newly introduced or a new system has been adopted. The major increases have occurred in countries where sufficient importance has been given to this industry in national economic development plans and the essential investment and support services have been at least partially provided. For example, the production of farmed fish rose almost five times in a period of seven years in Japan (Japan Fish Association, 1975). In the Philippines it increased 32 percent in a period of about three years. In Poland it has increased about four times and in Romania over two times in the same period. Increase in seaweed production in the Republic of Korea has been over 14 times in the last five years and in Japan over two times in that period. Except in a small number of localized cases, there have been no major problems of domestic marketing of aquaculture products, because of sustained demand. Stricter quality controls imposed by importing countries have, however, affected somewhat the export of products, such as oysters and trout, but this has led to greater attention to the environmental conditions under which culture operations are carried out and the sanitary quality of products.

It is fairly well known that, despite the loud pronouncements of interest in aqua-farming, only a few countries have so far implemented a well balanced development programme with adequate financial and technical support. Considering this, the increase in production now reported is certainly encouraging and justifies guarded optimism in the achievement of further increases.

Table I

Estimated world production through aquaculture in 1975

| FINFISH | Tons | | Tons |
|---|---|---|---|
| China - all provinces excluding Taiwan Province | 2 200 000 | Zaire | 5 000 |
| Taiwan, Province of China | 81 236 | Cuba | 4 500 |
| India | 490 000 | Hong Kong | 4 019 |
| U.S.S.R. | 210 000 | Norway | 3 500 |
| Japan | 147 291 | Austria | 2 500 |
| Indonesia | 139 840 | United Kingdom | 2 000 |
| The Philippines | 124 000 | Finland | 1 940 |
| Thailand | 80 000 | Belgium | 1 800 |
| Bangladesh | 76 485 | Tanzania | 1 500 |
| Nigeria | 75 000 | Burma | 1 500 |
| Poland | 38 400 | El Salvador | 1 208 |
| Vietnam, Republic of | 30 000 | Canada | 1 103 |
| Yugoslavia | 27 000 | Greece | 900 |
| Romania | 25 000 | Chile | 800 |
| Hungary | 23 515 | Uganda | 700 |
| U.S.A. | 22 333 | Singapore | 680 |
| Italy | 20 500 | Kenya | 400 |
| Madagascar | 17 392 | Nepal | 400 |
| Germany, Democratic Republic of | 16 000 | Venezuela | 332 |
| France | 15 000 | Switzerland | 300 |
| Czechoslovakia | 12 222 | Ireland | 207 |
| Israel | 12 169 | Korea, Republic of | 169 |
| Denmark | 12 120 | The Netherlands | 129 |
| Brazil | 12 000 | Ecuador | 90 |
| Germany, Federal Republic of | 8 900 | Central African Empire | 43 |
| Sri Lanka | 7 659 | Cyprus | 40 |
| Egypt | 7 000 | Ghana | 40 |
| Mexico | 7 000 | Zambia | 29 |
| Malaysia | 6 559 | Paraguay | 23 |
| | | Ivory Coast | 10 |
| | | Puerto Rico | 9 |
| | | Total | 3 980 492 |

Table I (continued)

| SHRIMPS AND PRAWNS | Tons |
|---|---|
| India | 4 000 |
| Indonesia | 4 000 |
| Thailand | 3 300 |
| Japan | 2 779 |
| Ecuador | 900 |
| Taiwan, Province of China | 549 |
| Singapore | 105 |
| Korea, Republic of | 30 |
| | 15 663 |

| OYSTERS | |
|---|---|
| Japan | 229 899 |
| U.S.A. | 129 060 |
| France | 71 448 |
| Korea, Republic of | 56 008 |
| Mexico | 45 000 |
| Thailand | 23 000 |
| Taiwan, Province of China | 13 359 |
| Australia | 9 200 |
| Canada | 5 080 |
| United Kingdom | 3 000 |
| Spain | 2 289 |
| The Netherlands | 1 500 |
| Chile | 870 |
| The Philippines | 782 |
| New Zealand | 700 |
| Senegal | 191 |
| | 591 386 |

| MUSSELS | |
|---|---|
| Spain | 160 000 |
| Italy | 30 000 |
| France | 17 000 |
| Germany, Federal Republic of | 14 000 |
| The Netherlands | 100 000 |
| Korea, Republic of | 5 578 |
| Chile | 1 260 |
| Yugoslavia | 287 |
| The Philippines | 182 |
| New Zealand | 150 |
| Tunisia | 60 |
| | 328 517 |

| CLAMS | Tons |
|---|---|
| Korea, Republic of | 24 920 |
| Taiwan, Province of China | 13 898 |
| The Philippines | 33 |
| | 38 851 |

| SCALLOPS | |
|---|---|
| Japan | 62 600 |
| | 62 600 |

| COCKLES AND OTHER MOLLUSCS | |
|---|---|
| Malaysia (cockles) | 28 000 |
| Taiwan, Province of China | 1 243 |
| Korea, Republic of | 733 |
| The Philippines | 11 |
| | 29 987 |

| SEAWEEDS | |
|---|---|
| Japan | 502 651 |
| China - all provinces excluding Taiwan Province | 300 000 |
| Taiwan, Province of China | 7 347 |
| Korea, Republic of | 244 795 |
| | 1 054 793 |

| | |
|---|---|
| GRAND TOTAL | 6 102 289 |

Some significant changes have occurred in the general concept of aquaculture. Traditional practices being largely governed by local conditions and needs, the farmers seldom felt the need to intensify operations. Low-density culture with minimum inputs and low production per unit area has often been more economical than intensive farming which involves the rearing of dense populations and heavy inputs. Due to various reasons, this is changing fast and many countries are now turning to intensive and semi-intensive systems. For example, in Israel, fishponds producing less than 2.5 tons/ha are no longer profitable (Sarig, 1974). Even in some of the eastern European countries that have fish farms with ponds too large for intensive culture, higher overall productivity and profits are achieved through the combination of duck-raising with fish farming.

Aquaculturists now try to exercise greater control over the environment and stocks in their farms, even in what are called "trap-ponds". They seek to produce seed by artificial propagation and resort in most cases to at least supplemental feeding. Even in culture systems where natural food, such as algae or plankton, is raised through fertilization, improved systems of management are adopted to intensify production.

Several projections of future aquaculture production potentials have been made, one often quoted is a five- to ten-fold increase in two to three decades. As part of the preparatory activities of the FAO/UNDP Aquaculture Development and Coordination Programme, representatives of some 34 developing countries have been assisted through regional workshops in Asia, Africa and Latin America to prepare ten-year aquaculture development plans, setting out targets of production based on existing and proven systems of culture (FAO/UNDP, 1975, 1976 and 1976a). These targets, together with the production increases from other countries

are expected to contribute to a doubling of world production through aquaculture in ten years. Based on the present world production, this would amount to nearly 12 million tons by the end of 1985 and, if this pace of increase is maintained, it may be reasonable to expect that at least a five-fold increase by the end of this century will be attained.

In considering the present and future production through aquaculture, it may be interesting to examine some of the factors that have affected the industry in recent years. At least three of these have served to focus renewed attention on aquaculture in the last few years. One is the increased cost of fishing due to steep increases in fuel cost; second, the fear of decrease in fishery production by countries that depend on fishing in foreign waters as a result of new laws of the sea; and third, the need in some countries for relocating and finding alternate or additional employment for large numbers of excess fishermen or underemployed farmers. The continued high demand in developed countries for high-valued species, like shrimps and prawns, has also served to promote interest in aquaculture in countries that wish to increase foreign exchange earnings. On the other hand, the steep increases in the cost of some of the essential inputs, particularly feed, have hit the intensive culture systems, as for catfish (Ictalurus spp.) and rainbow trout (Salmo gairdneri). This was largely due to the increase in the cost of fishmeal, a major ingredient in most fish feeds. Similar increase in price and indeed even of availability has occurred also for widely used larval food, the brine shrimp (Artemia). The situation regarding feed prices has eased somewhat recently, although it still remains a major element in the cost of production. This has led to a search for cheap substitutes and some progress has already been reported in this direction. The shortage of fertilizers in developing countries and the allocation of all the production for agricultural purposes has also been an adverse factor.

Even though the prevailing environmental concern has resulted in increased interest in protecting the aquatic environment and has, in many cases, helped aquaculture, in some countries it had the reverse effect. Aquaculture has been classed as a polluter and waste discharge regulations meant for terrestrial animal production have been made applicable also to aquaculture. This has greatly hampered the expansion of the industry.

Water pollution has affected aquaculture production in coastal waters in some countries; for example, oyster production has remained more or less at a stagnant level since 1965 in Japan and in the United States there has been marked decrease in oyster production due to the closure of polluted oyster beds. Large-scale mortality of oysters, due to known and unknown causes in important culture areas like the French coast, has resulted in serious decline of production.

The absence of a legal framework under which aquaculture enterprises could be established and operated has also stood in the way of the development of the industry, particularly in industrially-advanced countries. Some of the problems faced by entrepreneurs in getting the necessary permits from different, only peripherally interested, agencies and the need to conform to regulations not relevant to aquaculture have been revealed in recent discussions on the subject (Loftas, 1974; Pillay, 1975).

Although there has been considerable interest in the private sector in investing in aquaculture, this is largely confined to the culture of exportable products and, in many cases, the technologies for such types of culture are still under development. Only a small percentage of the present aquaculture production relates to such high-valued exportable products and, therefore, the investment support for aquaculture as a whole remains at a very low level.

These, together with a general lack of appreciation of the economic viability of aquaculture, have stood in the way of a speedier development of the industry. The inevitable failure of some badly conceived enterprises has also contributed to give some credibility to arguments of the detractors of aquaculture.

## 3. TECHNOLOGICAL ADVANCES

During the last decade, a number of technical advances have been made in the field of aquaculture and some new technologies developed. Some of the research done during this period has been extremely valuable in understanding the scientific bases of certain traditional practices and enabled the improvement and modernization of old technologies. Cage and enclosure/pen culture are outstanding examples of this. Though such forms of culture have existed for many years, particularly in Asia and the Far East, they were not very suited for application elsewhere. Modifications or changes in the design, building materials, installation and operation, together with the preparation of suitable feeds, including floating pellets, have made these into technologies capable of being applied in other regions. Cage culture of catfish, salmon (Salmo salar and Oncorhynchus spp.), trout and yellowtail (Seriola spp.) and enclosure/pen culture of salmon and milkfish (Chanos chanos) have achieved the level of commercial-scale operations in some countries, particularly in the United States, Norway, the Federal Republic of Germany, the Philippines, and Japan. Several types of cages have been designed for use under different hydrological conditions. The marked increase in the production of trout and salmon in Norway is due to the introduction of cage and enclosure culture. Cage culture accounts for a very high proportion of the present-day production of yellowtail in Japan. In a period of about five years over 5 000 ha of fish pens have been established in Laguna de Bay in the Philippines, producing 7 500-10 000 tons of milkfish annually.

Similarly, polyculture of fish is an ancient technology in Asia, especially China and India. Experimental work in recent years has given a fuller understanding of the significance and value of the system. This is becoming an accepted practice in the culture of Chinese and Indian carps (Ctenopharyngodon idella, Hypophthalmichthys molitrix, Aristichthys nobilis and Catla catla, Labeo rohita, Cirrhina mrigala), especially because of the increasing need for the adoption of low-energy systems. In fact, a system of combined culture of these groups of carps along with the common carp (Cyprinus carpio) has been developed in India yielding up to 8 500 kg/ha with only modest supplemental feeding. Polyculture of common carp and tilapia (Tilapia spp.) has served to increase average production in Israel and provide an additional crop, which is of special importance from the point of view of marketing in the country, because of the ceilings imposed on the production of common carp.

Catfish farming in the U.S.A. is a good example of the development of new technologies to keep up with rapid expansion of production requirements. Little was known about catfish farming until 1960. Research and promotional efforts were effective in developing new techniques of production and creating a demand for cultured catfish. Consequently, a considerable increase in production took place in the late sixties and early seventies. From 1966 to 1975 the area under catfish culture increased more than ten-fold; so did the production (50 223 tons valued at U.S.$ 40 millions). The many advances in catfish culture techniques, including breeding and fry production, feeding, pond management, disease control, and harvesting have served to develop a well advanced technology that has the potential for transfer to other areas.

Pond culture of tilapia has existed in tropical countries, particularly those in Africa, for many years. However, the problem of overpopulation of ponds and consequent stunting due to frequent breeding of this fish made tilapia culture generally unattractive. Two broad systems of culture have evolved in recent years which make culture of tilapia viable and capable of being practised on a commercial scale. One consists of the use of selected species, such as Tilapia nilotica, which grow fast and attain a fairly large size, and feeding them with suitable pelleted or other feeds so that the majority of the stock will attain marketable size before large-scale breeding occurs, i.e., within three to five months (FAO/UNDP, 1973). The second is by the use of hybrids, which are all or mainly males and thus reduces breeding and overpopulation of ponds. Although neither of these systems is entirely satisfactory in overcoming the problem of prolific breeding, they do serve to raise up to 5 000 kg/ha of marketable fish a year and provide a fair return on investment. Further work on hybridization may succeed in consistently producing all male hybrids, but in the meanwhile it has been shown that, if tilapia were cultured in suspended cages, breeding of the stock could be eliminated.

Although traditional systems of extensive shrimp and prawn farming have existed in Asia for many years, it was only in the sixties that intensive culture based on hatchery-produced larvae and juveniles was developed in Japan. Because of the high demand for shrimps in world markets and the inability of natural fisheries to meet the demand, an almost worldwide interest in their culture has developed in the last ten years. Initial attempts were to transfer the Japanese technology but this has not generally been successful. Significant advances have, however, been made in a number of countries, notably the United States, Republic of Korea, Taiwan Province of China, The Philippines, Indonesia, France (and Tahiti)

and the United Kingdom in establishing successful methods of artificial propagation and hatchery production of juveniles of a number of Penaeus species. Development of techniques for the maturation of penaeid shrimps, such as Penaeus merguiensis and P. monodon (FAO, 1975; Alikunhi et al., 1975) has added to the efficiency of seed production. However, large-scale intensive monoculture of shrimps to marketable size on an economically viable basis has not yet developed outside of Japan with the probable exception of Taiwan Province of China. Improvements and intensification of traditional practices in some of the southeast Asian countries, particularly Indonesia, have led to better yields in polyculture with brackishwater fishes, mainly the milkfish (Padlan, Ranoemihardjo and Hanami, 1975).

The culture of the freshwater prawn Macrobrachium rosenbergii on a very small scale existed in Asia, but the interest in commercial farming of this species developed as a result of the very high demand for shrimps and prawns in the world market, and the methods devised in 1961-69 for the propagation of this species which has the advantage of a shorter life history than penaeid shrimps (Ling, 1969). Many improvements have been brought about in the technique of mass rearing of their larvae (Fujimura and Okamoto, 1972). There are now a large number of institutions, agencies and private companies worldwide engaged in research and development activities related to Macrobrachium. In the United States alone there were at least 25 of them in 1974 (Goodwin and Hanson, 1975). While the hatchery technology and procedures are considered adequate, high-density commercial farming techniques have yet to be perfected. Most commercial enterprises use earth ponds for production purposes and, where physical and economic conditions are favourable, some operations have been profitable. Further technological advances are needed, however, to bring prawn farming to the level of large-scale commercial ventures.

The "hanging method" of oyster culture (in which oysters are suspended from rafts, longlines or racks), is not really a new system, but it has during the last decade been adopted on a much wider scale in many countries and has undergone modification and adaptation. This system permits high production rates per unit area and reduces losses from predation. The use of nylon netbags for holding oysters and mussels for rearing is becoming common in some European countries.

A system of aquaculture that has received worldwide attention in recent years is the culture of eels (Anguilla spp.) in stagnant or flowing water ponds or in net enclosures. Although the technique of eel culture originated many years ago, it is only in the last decade that it received wide attention, largely as a result of the expansion of Japanese eel culture and a rapid increase in demand for the product. The culture technology has undergone considerable improvement, particularly in the production of satisfactory feeds which, to a large extent, accounts for the expansion of the industry in Japan. However, the culture is still based on elvers caught from the wild, and a shortage of elvers in Japan resulted in a worldwide search for new sources and the establishment of a sizeable export trade for elvers in many countries, particularly in Europe.

Use of domestic and farm wastes for fish culture is an age-old practice in Asia, especially in China, Malaysia and Indonesia, but it is only recently that this practice has attracted wider attention as a means of recycling wastes to protect the environment and, at the same time, contribute to food production. This had led, on the one hand, to wider use of human and animal wastes in aquaculture and, on the other, critical studies on the benefits and risks involved. Many developing countries are adopting the system of fish farming in association with duck, pig or cattle raising so as to utilize the wastes for fertilizing

fishponds. The area of sewage-fed fishponds in India has expanded to over 12 000 ha. Duck-cum-fish farming, which is an efficient means of recycling duck droppings, has become widespread in eastern Europe (Czechoslovakia, Hungary, Poland and Romania) and has now been introduced in the Central African Empire and Nepal. Experimental studies on the use of domestic sewage have been undertaken in some countries and the results of these are in many respects encouraging. It has been conclusively shown that productivity in aquaculture of fish or shellfish can be significantly increased by the controlled use of treated sewage for increased production of plankton.

Experiments in the culture of shellfish fed on algae raised in sewage effluents in Woods Hole, U.S.A. have provided the basis for a "pilot-plant" multiple-production system (Ryther, 1975). Simpler systems suited for rural communities, in which animal and domestic wastes are conditioned for use in aquaculture and also generated by-products, such as methane for use as fuel, algae as animal feed and fertilizer, have been successfully used in some of the South Pacific Islands (Chan, 1974).

Another type of waste recycling in aquaculture developed in recent years and already being used on a production scale in temperate and sub-tropical climates is the use of waste heat. Extension of growing period, better feed conversions, acclimatization of organisms that cannot withstand lower temperature, and earlier attainment of marketable size or maturity have been possible through this practice.

A new technology that has developed at a rapid pace during the last decade is the reconditioning and reuse of water for aquaculture. The availability of water will become a limiting factor for aquaculture development in

an increasing number of countries in the future and the cost of pre- or post-treatment may sometimes be prohibitive. These and the restrictions that are imposed on discharges from aquaculture installations have given an added significance to this technology in so far as aquaculture is concerned. As a result, several systems of water reconditioning for reuse have been developed. All of them are not equally economical, but the use of reconditioned water has become a fairly common practice in hatcheries especially in the United States.

During recent years "sea-ranching", "aqua-range farming" or "artificial recruitment", as it is variously described, has become an accepted technology in aquaculture. Some years ago attempts to improve fish populations with hatchery-reared fish were generally considered unsuccessful. This concept has undergone considerable change with improvements in the methods adopted, particularly feeding, release of adequate numbers of hatchery-reared animals after they have been grown to a size when they can fend for themselves, and the recapture of a satisfactory percentage of the released fish to make the operations viable. Anadromous fish are obviously best suited for such aqua-range farming and it is estimated that over 2 000 million juvenile anadromous fishes are artificially produced annually and released into the fresh and marine waters of the world, mainly from government hatcheries. Privately-owned sea-ranching has already made a beginning. According to recent studies in North America, for every dollar spent for the hatchery rearing and release of coho salmon (Oncorhynchus kisutch) smolts, the return has been seven dollars, and for chinook salmon (O. tshawytscha) three and a half dollars. Large-scale release of hatchery-reared Penaeus japonicus in the Inland Sea of Japan is believed to have resulted in substantial improvement in the local shrimp fishery with a cost benefit ratio between 2:5 and 2:20. Appropriate and adequate stocking operations have led to the improvement of fishery resources of many inland reservoirs and natural lakes.

When considering the techniques *per se* two major problem areas have received special attention during recent years: the controlled reproduction of cultivated animals; and the formulation and manufacture of artificial feeds. The Chinese carps, Indian carps, and the grey mullet (*Mugil* spp.), which do not generally breed in confined waters of culture installations, have been induced to breed by the administration of pituitary hormones. Induced breeding by pituitary injections or adjustment of photoperiod has become a recognized practice in fish culture and a number of cultivated and cultivable species have been bred experimentally. Methods of mass rearing of fish larvae have also been developed and these are now being employed by culturists in the case of Chinese and Indian carps. One of the early advances in shrimp culture technology was their artificial propagation based on gravid females collected from the wild. Collection of adequate number of breeders at the required time is often expensive and difficult. Consequently the successful maturation of shrimps in captivity in the laboratory by eyestalk ablation is a breakthrough of considerable significance, but much more remains to be done to perfect this technique for large-scale application (FAO, 1974; Alikunhi *et al.*, 1975). Similarly, the controlled reproduction of oysters and hatchery production of oyster seed is a development of considerable significance in oyster farming, particularly because the supply of seed oysters from natural reproduction is decreasing due to environmental degradation and imported seed has become quite expensive. These circumstances contribute to making hatchery production of seed economically viable in countries like the United States. Controlled reproduction has also helped in genetic selection of strains for special qualities, such as resistance to diseases.

With the expansion or introduction of aquaculture in wider geographical areas, international exchange of cultivated species has become widespread. This has given rise to considerable controversy about the introduction of non-indigenous species; some considering it unavoidable for rapid expansion of aquaculture; others being terrified by the possible adverse effect of introductions on local fauna and flora. While introductions into certain countries or areas have been totally banned, indiscriminate introductions continue in others. Though appropriate and adequate guidelines are still lacking, scientists and many aquaculturists accept the need for extreme care and critical study of all relevant environmental and behavioural information before deciding on such introductions. Recognition of the dangers of transmission of communicable diseases through shipments of live organisms has led to the consideration of an international convention to control the spread of communicable fish diseases (Dill, 1972; FAO, 1974a) and a draft convention is now under consideration by interested countries.

## 4. ORGANIZATION OF AQUACULTURE

A good proportion of current fish production through aquaculture comes from China and the socialist countries of Europe. In these countries fish culture is undertaken on State farms, communes or through cooperatives and, because of its rôle in communal welfare, the industry seems to receive special attention. In others, particularly industrially-advanced countries, aquaculture production is largely undertaken by the private sector. Individual farmers dominate the scene, but many small and large companies have, in recent years, become interested and involved in research and development activities or commercial production. An incomplete survey in 1975 revealed the existence of some 833 companies in 26 countries, the majority of which are in North America, Japan and western

Europe. In developing countries most of the production is still in the hands of small-scale operators or subsistence level farmers, although there are also some instances of involvement by large commercial firms. They are in most cases dependent on the government agencies for support services, including technical and financial assistance. Only in some exceptional cases have the governments been sufficiently responsive to the needs of the aquaculture industry. The anomalous legal status of aquaculture - not being recognized as an agricultural, animal husbandry, or truly fishery activity in the legal sense to be eligible for governmental support and other incentives - the aquaculturists face formidable problems in establishing or operating their enterprises. Nevertheless, restrictive legal provisions designed and relevant only for other industries, are readily applied to aquaculture, as for example the application of waste disposal and disease control regulations meant for animal husbandry to aquaculture. Although in some countries, such as the U.S.A. and the U.K., aquafarmers are organizing themselves and attempting to influence governmental policies, in most others they do not have the political or social clout to force governmental action necessary to solve the problems of the industry.

In governmental organizations aquaculture forms part of the fishery sector. The tertiary phase of aquaculture industry has close similarity with that of the fishing industry but since the production phase is more allied to agriculture and animal production, there is a large body of opinion favouring better linkage with these forms of food production, in order to benefit from allied experience and from the many incentives offered for their promotion by governments. With increasing public interest and the modest increases in investments, a distinctly negative attitude and rivalry appear to be developing between aquaculture and conventional fisheries interest. This is an unfortunate and unnecessary

situation, as at least in the foreseeable future there is little likelihood of aquaculture supplanting conventional fishing. On the other hand, the world demand for fishery products is increasing steadily and it is generally accepted that it will not be possible to meet the demand by conventional fishing alone. Changes that may be brought about in the marketing and price structure due to enchanced production through aquaculture has to be accepted as a healthy development and through proper integration of production and marketing, stability can be ensured in both sectors.

Research and extension are two major support services required to be provided by governments in most countries. There has undoubtedly been considerable interest in aquaculture research in many developing and developed countries. The number of experimental stations in developing countries has certainly increased, though very few of them have adequate research personnel, equipment and other necessary facilities. In many developed countries, research on aquaculture problems has expanded due to financial support available from funding agencies. It has generally been recognized that close coordination of research, which is highly diffused at present, is essential to obtain maximum benefit from the investment and effort expended. The multidisciplinary nature of aquaculture science and the need for teamwork to undertake systems-oriented research to improve or develop new aquaculture systems is gradually being understood.

One of the weakest areas of aquaculture activities at present is extension services, which creates serious problems in the implementation of development programmes. This is very much connected with the shortage of adequately trained and experienced field personnel who have the ability and knowledge to assist aquafarmers. The large majority of aquaculture personnel employed in government

organizations and in senior positions even in the industry, are those who developed their knowledge of the subject through specialized research and then tried it in the field, often learning by trial and error. This is no doubt a costly and slow means of acquiring expertise for large-scale development programmes. Recognizing this, some of the countries have established extension training centres. There is an urgent need to upgrade the facilities for well balanced theoretical and practical training in these centres to meet the requirements for extension personnel. The regional symposia and workshops organized by FAO during the last ten years have emphasized the need for accelerated cooperative efforts in establishing multidisciplinary research programmes and training of core personnel including extension staff.

Information exchange has a vital rôle in a developing science like aquaculture, particularly since the industry has to depend to a large extent on transfer of technology for its expansion. During the last decade, a number of periodicals including "Aquaculture", "FAO Aquaculture Bulletin", "The Commercial Fish Farmer and Aquaculture News", and "Fish Farming International" have come into being. While these, together with a number of recent books represent significant progress, they only fulfill a small part of the information needs. The National Aquaculture Information System (NAIS) sponsored by the Sea Grant Program in the U.S.A., which has started a computerized file of information on the subject, is a good beginning in information collection, storage and dissemination.

## 5. REGIONAL AND INTER-REGIONAL COOPERATION

In a field such as aquaculture where future developments would involve transfer of technology on a large scale, regional and inter-regional cooperation assume special significance. During the last ten years the regional fishery

bodies of FAO, especially the Indo-Pacific Fisheries Council (IPFC), the General Fisheries Council for the Mediterranean (GFCM) and the European Inland Fisheries Advisory Commission (EIFAC) have been actively engaged in promoting regional cooperation in aquaculture development with particular reference to the assessment of available sites, evaluation of the economics of different types of operations, effect of environmental pollution, and control of communicable fish diseases. Regional Symposia organized by these three bodies as well as by the newly-formed Committee on Inland Fisheries of Africa (CIFA) led to the identification of high-priority problems for research in the respective regions. Efforts were made to organize programmes of research through voluntary cooperation of national research institutions, viz., IPFC, GFCM and EIFAC Cooperative Programmes of Research on Aquaculture. As is only to be expected, the progress of investigations through such voluntary efforts without adequate financial or technical backing has been extremely slow. The establishment of a sub-regional institution for aquaculture research, viz. the Aquaculture Department of Southeast Asian Fisheries Development Center (SEAFDEC) in the Philippines in 1973 is an important attempt in bringing about cooperation in aquaculture research and training.

A Working Group on Aquaculture appointed by the Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR) which met in Spoleto, Italy, 4-8 February 1973 made a detailed review of research needs in aquaculture in developing countries (TAC, 1973). Later a TAC subcommittee on Aquaculture (TAC, 1974) prepared specific proposals for the establishment of coordinated regional networks of research centres in Asia, Africa and Latin America to undertake systems-oriented interdisciplinary research to solve the problems faced in the large-scale application of selected technologies. The FAO/UNDP Aquaculture Development and Coordination Programme organized a series

of planning workshops in 1975 (FAO/UNDP, 1975, 1976 and 1976a), which inter alia considered the needs for regional and inter-regional cooperation to implement national aquaculture development plans. In view of the investments involved in terms of scientific man-power, equipment and facilities, they recommended that long-term research in this field, as also training of senior aquaculture personnel, should be organized on a regional basis. This proposal was strongly endorsed by the FAO Technical Conference on Aquaculture held in Kyoto, Japan, May/June 1976 and the FAO/UNDP Aquaculture Development and Coordination Programme has subsequently initiated action for the establishment of regional research and training centres in Africa and Latin America.

The emergence of the World Mariculture Society (established in 1970) as a truly international professional association and the decision to organize an International Aquaculture Federation through affiliation of national and regional societies is a significant recent development that could contribute to world-wide cooperation of the scientific community and industry in this important field.

## 6. OUTLOOK FOR THE FUTURE

As indicated earlier, available production estimates show steady increases in many countries. Areas under aquaculture are expanding and improvements in technology are making it possible to intensify production and obtain higher yields. The fact that annual yields range between a few hundred kilogrammes/hectare and over over 20 tons/hectare shows what improved technology and provision of essential inputs could achieve in terms of increased production. New systems of culture to be developed through research and experimentation will also contribute to increased production in the future. Even using the existing technology it is expected that a doubling of world production can be achieved in the next ten years.

The area under aquaculture now is estimated to be in the order of three to four million hectares. A ten-fold expansion of this area of considered feasible if the necessary investment becomes available. Improvement of techniques has already shown the possibility of increasing average production at least two to three times per unit area or unit volume of water in a relatively short period of time. One can, therefore, be reasonably optimistic about global increases in production, even though the rate of increase in individual countries or through individual systems of culture may vary considerably. Such an expansion of aquaculture is bound to increase the availability of acceptable animal protein foods to the people. Whether it will be equally available and within the reach of all segments of the population will largely depend on national policies rather than aquaculture technology.

There are species and systems of culture to produce aquafoods at prices that the "common man" - if that species can be identified - can afford. There are also high-valued species and systems of culture to meet the needs of the luxury market and for export to earn foreign exchange. It could become a major element in integrated rural development and serve to generate employment for a good number of the un- and underemployed people in the rural areas of developing countries, and thus help to arrest the drift of populations to urban areas and mitigate the problems faced in the cities due to this. Wider application of aquaculture techniques for artificial recruitment and transplantations could help to build up new fishery resources or enhance existing stocks, giving rise to what is referred to by some as "farmed fish fisheries". It can contribute to the development of sport fisheries and baitfish production for commercial or sport fishing. Mention should also be made of the possibility for the expansion or introduction of pearl culture in many countries. Greater use of inland and coastal waters for

aquaculture would also inevitably involve effective measures for protecting the aquatic environment. It could provide efficient means of recycling agricultural and domestic wastes and thus help in general waste disposal and environmental protection. Besides all these benefits, it is well worth recognizing that aquaculture denotes a step in man's evolution from a hunter to a herdsman and husbandman. Aquaculture, therefore, deserves to be considered from a wider angle than that of only the increased production of animal protein or the creation of economically viable enterprises.

The planned doubling of production in the next ten years or the five- to ten-fold increase in three decades will need accelerated transfer of technology, massive financial investments, suitable legislation, intensive research, manpower training and development of institutions and other essential infrastructures. If these are left to evolve through the inner pressures of an emerging industry, much valuable time will be lost and it will take many more years for the industry to fulfill its potentials. Recognizing this the FAO Technical Conference on Aquaculture adopted the following Declaration on Aquaculture to serve as a policy instrument reflecting the determination of governments and the world community to elevate aquaculture to an appropriate level in national and international priorities.

"Kyoto Declaration on Aquaculture

The FAO Technical Conference on Aquaculture, assembled in Kyoto, Japan, on 2 June 1976, after a week-long review of present status, problems, opportunities and potential for the culture of fish, crustaceans, molluscs and seaweeds, declares:

(1) That aquaculture has made encouraging progress in the past decade, producing significant quantities of food, income and employment; that realistic estimates place future yields of food at twice the present level in ten years, and five times the present level in 30 years if adequate support is provided.

(2) That aquaculture, imaginatively planned and intelligently applied, provides a means of revitalizing rural life and of supplying products of high nutritional value, and that aquaculture, in its various forms, can be practised in most countries, coastal and landlocked, developed and developing.

(3) That aquaculture has a unique potential contribution to make to the enhancement and maintenance of wild aquatic stocks and thereby to the improvement of capture fisheries, both commercial and recreational.

(4) That aquaculture forms an efficient means of recycling and upgrading low-grade food materials and waste products into high-grade protein-rich food.

(5) That aquaculture can, in many circumstances, be combined with agriculture and animal husbandry with mutual advantage, and contribute substantially to integrated rural development.

(6) That aquaculture provides intellectual challenge to skilled professionals of many disciplines, and a rewarding activity for farmers and other workers at many levels of skill and education.

(7) That aquaculture provides now, and will continue to provide, options for sound investment of money, materials, labour and skills.

(8) That aquaculture merits the fullest possible support and attention by national authorities for integration into comprehensive renewable resource, energy, land and water use policies and programmes, and for ensuring that the natural resources on which it is based are enchanced and not impaired.

(9) That aquaculture could benefit greatly from support and assistance from international agencies, which should include the transfer of technology actively planned and executed, with research carried out in centres representative of various regions concerned".

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Princeton University Press PRINCETON, NEW JERSEY 08540 (TEL. 609-452-4900)



March 19, 1975

Ms. Elisabeth Mann Borgese
International Ocean Institute
Box 4068
Santa Barbara, California 93103

Dear Ms. Borgese:

Thank you for writing to inquire about our interest in publishing a collection of Arvid Pardo's writings. I am afraid that at the moment given the pressures on our publishing program, we could not consider such a project, but we do want to thank you for thinking of us and wish you success in finding a suitable publisher for the book in this country. Have you yet tried Oceana Publications in Dobbs Ferry, New York? If not, I suggest you direct your next inquiry there.

Yours sincerely,

Sanford G. Thatcher

Sanford G. Thatcher
Social Science Editor

SGT:gt

The Center for the Study of Democratic Institutions/The Fund for the Republic, Inc.

July 23, 1976.

Mr. O.S. Plue
Rt 1, Box 199AA
Berrien Springs, Mich. 49103.

Dear Mr. Plue:

Your thoughtful letter of June 3 reached me with great delay. I was out of the country, for most of the time.

Let me confess: I do believe in evolution and am fascinated by the continuity and contiguity of life, in its physical as well as in its intellectual or even spiritual aspects. But, of course, I do understand your point of view.

With regard to my syntax you have a point too, of course. I am myself quite language-conscious, and it is not out of sloppiness that I omit verbs once in a while. I really do it only when I want to convey a certain mood, which may be impressionistic, or loosely associative, for instance. I think this is quite permissible today, even if it was not a hundred years ago. Language, just like art and music, has undoubtedly been going through a process of loosening the rules.

With all good wishes, and thanks again,
Yours cordially,

Elisabeth Mann Borgese

Elisabeth Mann Borgese.

Box 4068, Santa Barbara, California 93103/Telephone: (805) 969-3281/Cable: CENTER SANTABARBARA (CALIF)

Rt 1, Box 199AA
Berrien Springs, Mich. 49103
June 3, 1976

Ms. Elizabeth Mann Borgese
Henry N. Abrahams Incorporated
110 E. 59th Street
New York, New York 10022

Dear Ms. Borgese:

The volume, "The Drama of the Oceans", is indeed fascinating. I ascertain thus far that your basic premise, scientifically, is that the theory of evolution is acceptable to you. I have prodded beneath the surface of human learning in depth, ancient histories, especially eastern culture, theology, and philology and am not convinced there is a sound basis for this theory. My confidence adheres to ancient Semitic and Christian cultural concepts of the origins of life and matter.

And again, I question the editorial policy relative to sentence structure. My linguistic background has been achieved from various scholars .... University of Southern California, University of Michigan, Andrews University, et. al. . . . . but I don't ascribe respect to the "cute" tricks of the "mod-age" editorial concept of this staccato type of journalism ----- a short "sentence" without the finite verb in serious, scholastic literature. Page 25, lines 13, 14, 15, 27 contain examples of this questioned structure. If qualified editorial policy condones such, that's another issue. I'll be appreciative to learn about all this from you.

I await reply.

Most sincerely

O. S. Plue

OSP:p

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Telephone (416) 293-3621
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July 5, 1976

Ms. Elizabeth Mann Borgese
P. O. Box 4069
Santa Barbara, California
193103, U.S.A.

Dear Ms. Borgese:

Enclosed please find the cheque owing to you for $27.00.

Unfortunately, this cheque was held up in getting to you as there was a mix up in sending the chque out. You may have by now received a cheque addressed to Development Publications, which I sent to you by mistake, if youhave received this cheque, please return it to my attention at the above address.

Sorry for the unnecessary delay in getting this cheque to you, I hope this has not caused you any inconvenience.

Yours truly,

Judy Bunting

Judy Bunting (Mrs.)
Advertising & Sales Promotion

cc
Lena Tabori

Encl.

/jb

Thanks very much!
We have not received the
Cheque addressed to Development
Publications.
Cordially
E. M. B.

Box 4716
Santa Barbara, California 93103

Pacem in Maribus

June 4, 1976

Ms. Josiane Bontron
Les Presses de la Cite
8, rue Garanciere, 8
Paris 6
F R A N C E

Dear Ms. Bontron,

Mrs. Borgese is now in Europe until August. Meanwhile, I have referred your letter to our publisher, Harry N. Abrams, Inc. 110 East 59th Street, New York, N.Y. 10022. Ms. Marian Schacher will forward you a copy of The Drama of the Oceans.

With best wishes,

Yours sincerely,

Jean de Muller

Jean de Muller
Assistant to Mrs. Borgese

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Paris, le Ier juin 1976

Madame Elizabeth MANN BORGHESE
Box 4068

SANTA BARBARA, CAL.

Chère Madame,

Nous sommes très intéressés par votre ouvrage THE DRAMA OF THE OCEANS pour une éventuelle publication en langue française.

Pourriez-vous nous en adresser un exemplaire en lecture afin que notre Comité de Lecture puisse l'examiner ?

Avec tous nos remerciements,

Nous vous prions d'agréer, chère Madame, l'expression de tous nos meilleurs sentiments.

J Bontron

Josiane BONTRON

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13 APR
1976


Center Magazine
2056 Eucalyptus Hill Rd.
Santa Barbara,
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To whom it may concern: In order to document some research I'm doing on Women in the U.S., I need to verify the year of Birth of ELISABETH MANN BORGESE and some Biographical info. If you have this information, please send it to the return address indicated on this card. If not, would you be so kind as to forward this card to Ms. Borgese? As this information is to be included in a book to be published this Fall, I'd appreciate your immediate attention. Thanks you very much.

Sincerely, Paula Gray for Elaine Partnow.

sent

PRAEGER PUBLISHERS, INC./111 FOURTH AVENUE, NEW YORK, NEW YORK 10003/(212) 254-4100

December 8, 1975

Mr. Don Walsh, Director
Institute for Marine and Coastal Studies
University of Southern California
University Park
Los Angeles, California 90007

Dear Don:

Yes, the "famous" picture did arrive, and I am most appreciative.

Your proposal of November 25th is most attractive but I would avoid "thoughts" in the title as it greatly underplays the "hard" nature of the information apparently dispensed by your contributors. "Policy issues," "rational use," and "ocean space" are better phrases, I think. Please send an outline and sample chapter. On that basis I believe we can offer a contract.

Sincerely yours,

Richard C. Rowson
President

TOLL FREE CALL: (800) 221-2224/7 TELEX: USA-125166, INT'L-422448 CABLE: PRABOOKS

The Secretary-General

Box 4068
Santa Barbara, California 93103

Pacem in Maribus

February 10, 1975

Mr. Herbert S. Bailey, Jr.
Director
Princeton University Press
Princeton, New Jersey 08540

Dear Mr. Bailey:

I should like to bring to your attention a book that might be of possible interest to you. It is Arvid Pardo's The Common Heritage -- Selected Papers on Oceans and World Order. I have put together 27 of his speeches and written statements, plus the major draft articles and resolutions for which he is responsible. I have also written an introduction.

I am sure you are familiar with Arvid Pardo's work. He has been Malta's Ambassador to the United Nations during all the years of the U.N. Sea-Bed Committee. It is indeed he who initiated the entire development leading up to the U.N. Conference on the Law of the Sea, the greatest international conference in modern history. He is by far the world's expert on this whole matter.

The book is rather monumental, and, I believe, a must for all law libraries and classes in international relations. We are publishing a limited edition of 500 copies, offset from the typed pages, at the University of Malta Press, in order to have them available for the coming Geneva session of the U.N. Conference on the Law of the Sea. But this will definitely not be enough. There must be an American, or an American/English editon.

Since Pardo has been in Princeton repeatedly, and I know he has many friends there, I thought of you first. Would you be interested?

The Mexican Government is interested in publishing a Spanish edition. To give you an idea of the scope of the work, I am enclosing the introduction and the table of contents. The whole MS is at your disposal. It is rather big!

I would be very grateful if you could let me know as soon as possible.

With all good wishes,

Sincerely yours,

Elisabeth Mann Borgese

Elisabeth Mann Borgese
Chairman, Planning Council
International Ocean Institute
Senior Fellow, Center for the
Study of Democratic Institutions

Encls.

il Giornale NUOVO

PIOVENE

Milano, 5 febbraio 1975

Mia cara Elisabeth

Tu non puoi sapere quante volte abbiamo parlato di te con Guido negli ultimi tempi. Eravamo entrambi molto meravigliati del tuo lungo silenzio e Guido non se ne spiegava la ragione. La tua lettera dell'8 dicembre 1974 che ho ricevuto pochi giorni fa me ne dà le ragioni. La nostra vecchia amicizia continua e continuerà.
Forse non hai saputo che uno degli ultimi articoli di Guido era dedicato a Borgese per la nuova edizione del Rubè: se non l'hai visto te le farò mandare perchè è un pezzo di eccezionale bellezza.

Io rimango a Milano in Piazza Belgioioso n.2: se verrai sarò felice di vederti.
Ti abbraccio con affetto

Mimy

Mimy

M.R.S. Elisabeth Borgese Mann
The Center the Fund for the Republic,
Inc for the Study of Democratic

Box 4068, Santa Barbara, California 93103
U.S.A.

PHP Institute, Inc.
ROI ROPPONGI BLDG., SUITE 903
5-5-1 ROPPONGI
MINATO-KU, TOKYO
106 JAPAN

POST CARD


AIR MAIL

Ms. Elisabeth Mann Borgese
International Ocean Institute
MALTA

Trg 0007

Try University of Malta

July 17, 1975

Dear Ms. Borgese:



Thank you for sending back the questionnaire to us. We read your response to it with much interest. We appreciate your interest in PHP. We are doing our best to make the magazine more interesting and enjoyable.

Thank you again for your kind cooperation.

Sincerely yours,

Toshio Matsuoka

Toshio Matsuoka
Editor, PHP