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INTERNATIONAL CONTROL OF MARINE POLLUTION†

Michael Hardy††

When people speak of the law they usually mean existing law, and they think of the lawyer's function as being an advisor with respect to the law in force. This is, of course, the lawyer's most habitual and primary task. But the matter is not always so simple and clear cut, and the question of what the law should be often closely follows a statement of what the law is. Thus, in international as in municipal affairs, the standards and procedures applicable to particular activities may have to be examined from time to time and decisions made as to what modifications are needed. This happens most obviously when a development takes place in technology—the civil application of atomic energy and outer space activities are cases in point. However, it may also occur, usually with greater difficulty, when a series of different factors converge requiring a fresh look at the basic approach underlying existing law, and an assessment of the extent of the need to change that approach, together with its accompanying procedures and institutions (or the lack of them). Whatever the precise blend of old and new which may result, the process of determining what kind of change to make is more protracted and uncertain in the international setting than within a national framework. The means of collecting information, relating it to current interests and current law, and then deciding whether to take action, are less developed and operate under distinctly greater handicaps in the loosely organized society of sovereign States than they do within a given country with an established division of functions. In consequence, the international lawyer is more likely than his municipal colleague to be drawn into the task of considering what new arrangements should be made, and in order to do so, he is required to assess, or at least to understand, the factual and extra-legal elements which form the basis upon which the existing law should, or might be modified. By reason of the nature of the situation, this task may well proceed while the establishment of the extra-legal data is continuing, as part of the total process by which policy and future law are determined. Accordingly, this article deals, if only briefly, with non-

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legal considerations (in a narrow sense), even though not all the scientific information required to make a conclusive evaluation of the problem of marine pollution is yet available.¹ By the same token, although it would be possible to deal at greater length with any one of the main forms of pollution considered below, the present stage is one at which an effort has to be made—if only on a preliminary basis—to distinguish the principal dangers and sources, and beyond that, to consider whether the problem should be looked at as a whole, in order to understand its nature and to provide a series of effective solutions. The purpose of the present article is not therefore to give a detailed analysis of every possible legal contingency, but to provide essentially an overall survey, in which the various elements are examined and shown in relation to their general setting, so as to indicate the boundaries of such arrangements as may be adopted for the future.

The past ten to twenty years have seen a revolution in scientific knowledge of the sea-bed and of its formation.² Not only is the geological nature of the area now understood, but there has also been a rapid increase in technical command over the use of the sea and its resources. This has taken place with respect to virtually every marine activity: the construction of giant oil tankers and other carriers, a stupendous growth in the fishing industry,³ the development of submarines and submersibles able to descend to the abyssal depths, and an increasing ability to extract minerals from the sea-bed and sub-soil. This redoubling of the means of using the seas has been accompanied, as cause and effect, by a rise in world population (largely

1. As a necessary, but essentially secondary, qualification, it may be said that there is fully enough scientific evidence available that marine pollution is occurring. What is not yet known is the full and precise effect of particular pollutants, nor is adequate institutional machinery yet in operation to establish such effects. The discussion on the part of various specialized bodies [in particular the Intergovernmental Oceanographic Commission (IOC) and the Joint IMCO/FAO/UNESCO/WMO/WHO/IAEA Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), and at the FAO Technical Conference on Marine Pollution and its Effects on Living Resources and Fishing (hereinafter cited as FAO Technical Conference), held in December 1970], regarding methods of ocean monitoring and surveillance, has been directed to filling this gap in scientific knowledge and co-operation. It will then be easier to determine what degree of control and what specific measures should be introduced in particular instances.

2. "The study of marine geology has unlocked the history of the oceans, and it seems likely to make intelligible the history of the continents as well. We are in the middle of a rejuvenating process in geology comparable to the one that physics experienced in the 1890's and to the one that is now in process in molecular biology." Bullard, *The Origins of the Oceans*, 221 *Scientific American* 66, No. 3 (Sept. 1969).

3. The 1968 total world fishing catch was 64,000,000 metric tons, almost double the 1958 total of 33,000,000 metric tons: 1968 Yearbook of Fishery Statistics (Commodities), FAO, (1970). There was, however, a two per cent drop in 1969, and catches of certain species or in certain areas have fallen appreciably: 1969 Yearbook of Fishery Statistics, FAO, (1970).

concentrated in coastal areas) and a demand for higher living standards, as well as by an increase in the scale and sources of marine pollution.

The task of establishing suitable means for the prevention and control of marine pollution may be regarded as part of the wider problem of balancing two general objectives: the need on the one hand to keep the oceans relatively unsullied, as a valuable part of the environment, both for our own and for future generations, and on the other, to permit more intensive and diversified use of the sea and its resources as soon as possible. Even regarded purely as a scientific and technical problem (without regard for political, economic or legal considerations), the task of isolating the extent and consequences of marine pollution is considerably difficult and complex. The seas are immensely vast, covering seventy per cent of the world's surface and having an average depth of more than two miles (the greatest depth is 35,000 feet or approximately seven miles). The bottom of the sea-bed is the least explored part of the world, and the deep oceans are the least known part of the seas. Because they occupy the hollows of the earth, the seas have, by a divine arrangement of geography, always received the waste disposed of by the land, not merely that produced by human activity, but also the silt and water volume carried by rivers and streams and material transported by wind and rain. Sea water itself contains, in solution, all naturally occurring chemical compounds and a wide range of more complex carbon compounds, whilst suspended in it are particulate organic material, insoluble organic compounds and living organisms. The fact that it is the result of a continuous series of different chemical reactions has rendered sea water itself relatively immune from permanent changes of composition. The ceaseless mixing of sea water, moreover, caused by tides, currents and the effect of the wind, further increases the sea's capacity to assimilate foreign material. The objects living in the seas, the marine flora and fauna, generally speaking, lack the security consciousness and the capacity for change shown by organisms living on land—the comfort and relative constancy of the seas, appropriately regarded as one of the great feminine symbols, has protected them. The various parts of the marine ecosystem, moreover, are closely interlocked, no constituent being able to continue without the support of the others. The cycle is complete, from floating plants (phytoplankton) upon which planktonic animals are nourished and which in turn sustain larger fish, which upon death are decomposed by bacteria into the nutrients required by the plants. Harm to one link affects the rest of the chain.

These basic facts regarding the environment indicate why it is difficult to specify from the outset, simply and categorically, what constitutes pollution. The task involves the alignment of a complex series of natural phenomena with different acts of human intervention (deliberate or accidental), and legal, political and economic considerations. The need that all these factors be taken into account can be seen by examining the most authoritative definition of marine pollution so far put forward, namely, that adopted by the Intergovernmental Oceanographic Commission (IOC) for the purpose of its Long-Term and Expanded Program of Oceanographic Research, and accepted by the Joint IMCO/FAO/UNESCO/WMO/WHO/IAEA Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP). This definition specifies marine pollution as being the

Introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazard to human health, hindrance to marine activities including fishing, impairment of quality for use of sea water and reduction of amenities.⁴

Although these organizations had an obvious need to provide guidelines and a common basis for their deliberations, it is evident that the definition chosen is in fact no more purely "scientific" than it is "legal." Pollution may take physical, chemical or biological forms, but there is no physical, chemical or biological process of "pollution" as such, in the sense that there is of nuclear fission, of the formation of acids under specified conditions, or of photosynthesis by plants. Nor does the definition have any immediate legal value. While it would be possible to conclude a general multilateral convention with this definition as its basis and making it an obligation for States not to commit acts falling under the definition, this is not the position at the present time. The possible use of the definition, for legal purposes, depends on the choice of interests to be protected and the means of control to be used, which leads directly to one of the main issues and difficulties from the standpoint of existing law. Traditionally the interests which international law has sought to protect have been State interests, by and through the mechanism of States. This has meant that a State has normally only been able to claim against another if it or its nationals have suffered damage within its boundaries, or to the person and property of its

4. Comprehensive Outline of the Scope of the Long-Term and Expanded Program of Oceanic Exploration and Research, U.N. Doc. A/7750, Part I, 3, Nov. 10, 1969. The definition was originally prepared by a SCOR/ACMRR Working Group, and has since been slightly amended. See also The Report of GESAMP's I/II, para. 12. It may be noted that the definition includes the introduction of sounds (*e.g.*, explosions), as well as of substances.

nationals elsewhere. This, and the liberty left to individual States to decide whether to pursue claims, has meant that the general interest (including the maintenance of common facilities, such as the sea and air) has normally gone unprotected and unregarded. The rules of international public policy have, in this sense, been little developed and there has been no public right of action on behalf of the community as such, in striking contrast to the situation within States.⁵ Nor, of course, on this basis has anticipatory international regulation been designed to prevent accidents from occurring.⁶ Examination of the topic of marine pollution leads to the realization that the possibility of "tort action" on the part of individual States after the event, provides a very inadequate means for protecting the condition of the marine environment. If, for reasons of accepted social necessity, the oceans are to be used for maximum (or even merely for greater) gains for the general benefit, a more systematic and uniform means of control will accordingly have to be developed to replace the previous freedom of *laissez aller* allowed to States, and suffered by the seas. The changes are unlikely to take the form, from the outset, of a totally comprehensive and unified set of procedures, but a greater degree of co-ordination between national and international forms of control, within an overall pattern, however loosely defined, may be regarded as already a prerequisite to further pursuit of the agreed goal of providing increased benefits for all States in their use of the seas.

In the next section of this article the major causes and forms of marine pollution are classified according to the scientific and technical aspects and the human activities involved. The main categories distinguished are then examined against the background of existing legal and administrative controls, the problems which arise, and the various proposals which have been, or may be made in order to prevent or control pollution. Following a summary of the recent activities of the main international organizations concerned with this topic, the article concludes with a review, part diagnosis, part forecast, of needs and possible solutions in this sphere.

5. It would be interesting to examine the reasons why the notice of an *actio popularis* has not developed further in international law. As regards the protection of the seas, the answer would seem to lie, first, in the general absence of damage hitherto, secondly in difficulties of proof, and thirdly, in the reluctance of customary international law, given its basis in State sovereignty, to recognize the right or claim of one State to represent community interests. It may be noted that the possibility of responsibility for harm to such interests has recently been touched on by the International Law Commission in its discussion of State responsibility. Report of the International Law Commission on the Work of its Twenty-Second Session, U.N. Doc. A/CN.4/237, at para. 73.

6. The lack, under existing law, of regulatory powers applicable prior to an accident was one of the reasons advanced by the Canadian Government in justification of its decision to establish direct unilateral controls over shipping entering Arctic waters.

I

CLASSIFICATION OF MAIN FORMS OF MARINE POLLUTION

Before considering further the hybrid notion of pollution—sometimes presented as an objective, scientific determined phenomenon, and at others as a matter principally of economic or legal concern—it is necessary to distinguish between the functioning of the environment as a system operating independently of man, and the effects upon the environment of human activities. The condition of the seas is maintained by a host of factors, chief amongst them for present purposes being the interaction with the atmosphere⁷ and the disposal in the seas of the water and other debris carried down by rivers and streams, as well as run off from the land. The seas are capable (or such is the assumption) of absorbing foreign matter introduced in this way without significant or lasting effects, in the same way that they suffer, without major damage, instances of natural pollution. Oil seepages from the sea-bed occur in certain parts of the world⁸ even without drilling. Marine flora and fauna may be affected by diseases or blights from causes independent of man, and toxic metals may be present in sea water as well as being transported by rivers from deposits deep in the earth. The general problem now presented is to determine the effect upon this intricate and balanced environment, of the human introduction of foreign materials on a scale which threatens the operation of the marine environment as a whole, or at least the operation of parts of that environment in a way which is detrimental to man's interests.

Since it is generally agreed that the problem of marine pollution is caused by human activities, the means of regulating the problem must also be presented, in the last resort, in terms of specific activities. While this is so from an administrative and regulatory standpoint, it is not, however, possible to conduct scientific and technical inquiries simply on the basis of the origin of marine pollution in given human occupations. Particular instances of pollution may be caused by a whole variety (or combination) of activities, or may indeed be brought about by natural forces.⁹ Scientific investigations

7. The oceans provide, together with the biosphere, the reservoirs which take up the carbon dioxide in the atmosphere. Since the concentration of carbon dioxide in the atmosphere is rising with the increased use of fossil fuels, the question is presented of determining the limits of the seas' capacity in this respect [see generally the discussion in *Man's Impact on the Global Environment*, Report of the Study of Critical Environmental Problems, 46 *et seq.* (1970)]. For present purposes the possibility of major climatic or other environmental changes, which might threaten human existence, may be distinguished from more limited effects on the oceans and the marine ecosystem, with which this paper deals.

8. For example, as many people promptly pointed out, in the Santa Barbara area.

9. The relationship between direct controls (legal, administrative, etc.) and scientific inquiry requires elaboration. Until strong scientific evidence is clear and forthcoming, there is an understandable reluctance on the part of national authorities to take action; in the case

have therefore proceeded according to the chemical and physical characteristics of particular pollutants and not exclusively on the basis of the kind of activity responsible for producing given pollutants. Nevertheless, such is the nature of the problem: those concerned with the scientific aspects have turned, in the course of their broader inquiries, to surveying human activities in order to provide themselves with orientation and some indication of the boundaries of the situation;¹⁰ and those concerned with potential direct regulatory systems have sought more scientific information before proceeding.¹¹ The task of providing an adequate classification of the main types of pollution is not easy, and any system proposed may vary in emphasis according to whether the question is approached from a scientific or regulatory standpoint, although the essence of the matter is to bring these two into the correct relationship.

Looked at historically, regulation of the disposal of material into the sea has depended either on the evident nature of the pollution (*e.g.*, the production of oil slicks, or the dumping of rubbish in rich fishing areas) or upon the high degree of possible danger (the disposal of radio-active wastes being the best instance in this category). For

where damage to economic interests is immediately discernible (*e.g.*, large oil slicks heading for the holidaymakers' coasts) governmental intervention is fairly speedy, but such instances form, relatively, the exception. As regards scientific investigations of more complex effects, providing precise and comprehensive monitoring of the oceans is very difficult—indeed, we are only just beginning to understand how difficult it is, involving, as it does, the question of how the world as a whole, *qua* environment, operates; such inquiries, if undertaken, will also require government support. It may therefore be quicker and easier (difficult though it may be) simply to ban or limit particular practices at source (*e.g.*, the use of certain chemicals), even before the full mechanism for investigating the oceans has been constructed and exact understanding reached. But since most processes conducted on a scale likely to entail serious harm to the marine environment are widespread and involve existing interests, whether such controls will be introduced (and how strictly they will be enforced) will depend on the weight of scientific evidence, and thus the problem moves round in a circle. As a (perhaps) encouraging note, it should be pointed out, however, that the introduction of direct controls may not be dependent on investigations of marine conditions *per se* if, as in the case of air pollution, harm is likely to be done to man directly, irrespective of that done to him or his interests via the seas.

10. Thus increased attention has been paid to assessing world production figures of particular chemicals which result, directly or indirectly, in marine pollution, so as to enable estimates to be made of the volumes reaching the seas. This technique was particularly used in *Man's Impact on the Global Environment*, Report of the Study of Critical Environmental Problems (1970), and its influence is to be found also in The Report of the Seminar on Methods of Detection, Measurement and Monitoring of Pollutants in the Marine Environment (FIR:TPMB/70/6 Rev) [hereinafter cited as FAO Seminar], which preceded the FAO Technical Conference in December, 1970.

11. Thus the IMCO Legal Committee, which was requested, following the conclusion of the 1969 Conventions concerning tankers, to examine the legal aspects of pollution from noxious and hazardous cargo other than oil, decided to postpone consideration of the matter, until more technical information was available and, in particular, until it had received GESAMP's report on the substances to be considered. IMCO Legal Committee, Ninth Sess., LEG IX/6 Oct. 6, 1970, at para. A.1.

the rest, apart from national sewage and inland and coastal water legislation, the matter has been largely unregulated. Nor until the recent steep rise in the quantities involved, were legislative intervention and scientific inquiries required on a wide scale. A beginning has now been made in the conduct of scientific investigations, and on the basis of the evidence so far available, expert scientific and technical bodies^{1 2} have distinguished the following main groups of pollutants:^{1 3} halogenated hydrocarbons, petroleum hydrocarbons, organic and inorganic chemicals, nutrient chemicals, suspended solids and turbidity, radioactive materials, and the release of thermal energy. The direct disposal of radioactive materials and petroleum into the seas form relatively self-contained classes, or classes with characteristics which are by now, relatively familiar, and have already received a measure of international attention. What has so far been little considered is the dispersal of petroleum hydrocarbons in other ways, not only through sea-bed seepages or through the decomposition of marine plants, but as a result of the use of fossil fuels on land. The 1970 Study of Critical Environmental Problems contains some striking, if approximate, calculations on the matter. Direct losses of petroleum origin into the oceans, amounting to just over two million metric tons in 1969, were sub-divided as follows: normal ship operations were responsible for the release of just over a million metric tons (49.4 per cent);^{1 4} rivers carrying industrial automobile wastes 450,000 metric tons (21.6 per cent); refineries 300,000 metric tons (14.4 per cent); accidental spills 200,000 metric tons (9.6 per cent); and offshore production of minerals 100,000 metric tons (4.8 per cent). To these direct losses must be added a fallout of airborne petroleum hydrocarbons. "If 10 per cent of the hydrocarbons emitted to the atmosphere eventually find their way to the sea surface, the total hydrocarbon contamination of the ocean would be about five times the direct influx from ships and land sources."^{1 5} Although airborne petroleum hydrocarbons are easier for the seas to

12. The following classification follows that used by the FAO Seminar note 10 *supra*, which, together with the FAO Technical Conference and its background papers, constitutes the most exhaustive study of the matter yet made. Specific mention is made in the text, however, of the release of thermal energy, which is referred to separately by GESAMP Doc. 11/11, Annex V. GESAMP's classification, though scientifically similar, also takes account of the different activities involved.

13. N.B. The classes listed are not mutually exclusive. Strictly speaking halogenated hydrocarbons and petroleum are organic chemicals, but are sufficiently distinct in this context to require separate discussion.

14. Tankers 530,000 metric tons (30,000 in the case of those using the "load on top" method, 500,000 the remainder), other ships 500,000 metric tons. *Man's Impact on the Global Environment*, *supra* note 7, at 267.

15. *Id.* at 141.

absorb and decompose, nevertheless, given a situation in which the amounts disposed of are growing rapidly (in the case of all pollutants),¹⁶ it would appear that consideration will have to be given to deciding at some stage what action should be taken with respect to this particular source of pollution.

As regards the other pollutants listed above, the main sources of thermal energy released into the seas are power stations placed at the water's edge. Although the amount of thermal waste is expected to rise, this is, at present, a local problem and not yet one of major proportions. Since the responsible activity can be pinpointed fairly easily, the introduction of controls at source should be relatively easy. Pollution caused by suspended solids or associated turbidity is chiefly produced, so far as human activities are concerned, by dredging,¹⁷ dumping or other operations involving the movement of large quantities of materials. Although this may do damage to the marine ecosystem, here too the problems raised, so far as the evidence goes, do not extend beyond local effects. There is the further consideration (although scientific opinion shows some variation) that human produced turbidity is far less than that which may be produced by environmental forces and to which the seas have long been accustomed.

The remaining pollutants distinguished above—halogenated hydrocarbons,¹⁸ inorganic¹⁹ and organic²⁰ chemicals and nutrient chemicals²¹—produce a wide range of effects on marine flora and

16. World crude oil production is expected to double at least between 1970 and 1980. Thus, since, from a combination of uses man may now be putting in the seas an amount of petroleum hydrocarbons approximately equal to that produced naturally [O. Schachter and D. Serwer, *Marine Pollution Problems and Remedies*, 65 Am. J. Int'l Law, n. 1, at 84-89 (1971) and works there cited], by 1980 the seas will be required to deal with twice that volume; on this basis even if, by 1970, there will be no direct discharges from ships, the oceans would be receiving a considerably larger volume of petroleum pollution than at present.

17. This may be for various purposes, in order to clear channels for navigation, for gravel, or to obtain minerals such as tin or aragonite (*see note 125 infra*).

18. A class of synthetic chemicals which are widely used in industry and agriculture, the best known example being DDT and its associated compounds. They are not easily degraded and this fact, together with the tendency for concentrations to be built up in the marine food chain, results in longlasting harmful effects upon marine animals and plants, and indirectly on man. For further technical details and references as regards this and the other categories mentioned see FAO Seminar note 10 *supra*.

19. This includes a number of heavy metals, released during industrial (or similar) processes or eventually disposed of as waste, many of them highly toxic, both for marine life and for humans. Mercury and lead are considered the most threatening.

20. The most complex case, including petrochemicals, pulp and paper mill waste, detergents, tannins and aniline dyes. The effects produced are equally complex, depending on the quantity and concentration of the matter disposed of, but include the indirect encouraging of marine toxins.

21. Nutrient chemicals (chiefly nitrogen and phosphorus) are necessary for the growth of

fauna, and are themselves the result of a diverse array of human activities. Out of the complex picture which emerges from scientific investigation,²² the following principles provide the elements for some degree of preliminary systematization. First, these pollutants are largely the results of land-based as opposed to sea-based activities. Secondly, in certain instances appreciable quantities of these pollutants are carried to the seas by interaction with the atmosphere—first picked up as fumes or particles and then deposited by rain or dry fallout. The most significant examples at the present time are pesticides and, to a lesser but still important degree, heavy metals such as lead and mercury, which are highly toxic. Thirdly, these pollutants are, except for the case of pesticides used in agriculture or to control diseases, produced during industrial, and to a lesser extent domestic²³ processes and disposed of as domestic and industrial waste. Control of these pollutants thus forms part of the general problem of the disposal of the ever-growing volume of the waste products of modern society.

Turning from this summary account of technical findings to the legal aspects, one of the principal issues so far as the law (and society as a whole) is concerned may be put very shortly: on whom should the consequences of pollution fall? The question invites the ready answer—on him who caused the pollution—but this reaction provides at best a rough guide to positive action. Not only does it lead away from the prior question of what is to be done to prevent pollution in the first place and who is to pay for that, but the person who caused the pollution may not have known of the full consequences of his acts. What if the pollution is the result of accumulation of separate activities and it is impossible to determine the actual degrees of responsibility of numerous human agencies? What are the other beneficial uses of the sea which may be affected, and which will be more costly to interfere with them or to control particular forms of pollution? What if it proves to be far more expensive to make stretches of coastal waters free from pollution than the economic value of the fish which might be nourished there, as is almost certainly the case in many areas? If those waters are used for recreation,

marine plants; overproduction of phytoplankton, however, may lead to eutrophication, namely the removal of oxygen from the water because of the accumulation of decaying material, which results in the suffocation of marine life (e.g., fish) requiring oxygen. Nutrients are released by man chiefly as domestic and industrial wastes. Steps have already been taken to reduce phosphates in detergents.

22. The FAO Seminar and FAO Technical Conference, and many of the 140 papers produced for the Conference, dealt with detailed aspects of the release of chemicals in these four classes into the marine environment.

23. E.g., the use of household detergents containing phosphates and nitrogen.

how much is to be paid for the yachtsman's pleasure? It will be clear from what has been said above that the various users of the sea may all suffer consequences to their interests if pollution occurs and have a legitimate concern in the nature of any control measures introduced.

The balancing of those interests within a State—let alone among States—is an intricate task which has so far proceeded in a loose and unsystematic way. Certain measures of legal regulation exist with respect to marine pollution having its origin in human activities, and it is these which are referred to below, in order to show how these interests are reconciled at present and from that, to project what further adjustments may need to be made.

II

THE EXISTING LEGAL FRAMEWORK

The existing legal framework includes both national and international provisions. While it is usual to regard these as distinct and mutually exclusive methods of control, such an approach is plainly inappropriate with regard to marine pollution; the very nature of the sea renders controls which stop at one side of a national boundary inadequate. In so far as existing controls have been based on a division between national and international areas, the national legislation concerned is generally more developed and particularized. It suffers from the fact that it only applies to waters under national control or in the waters beyond, to ships and citizens of the State in question. In contrast, the international arrangements are generally cast in broad terms and lack adequate means of enforcement; only in one case have detailed treaty provisions been made and even here only in respect of one specific pollution hazard—the discharge of oil from ships. The legal position differs with respect to the human activity and the kind of pollutant concerned.

A. Marine pollution caused via the atmosphere by land based activities

Apart from the general case of the disposal of domestic and industrial wastes, and the other more particular activities considered below, there is evidence that a considerable proportion of marine pollution is caused by activities which take place on land and which result in material being carried as gas or particles by the atmosphere into the seas.²⁴ Although the number of individual pollutants which

24. Two documents prepared by WMO for GESAMP (GESAMP II/2/4 and II/2/1) describe respectively the role of the atmosphere in hydrological cycles which contributes to marine pollution as a result of run off from land contaminated by industrial dust or agri-

may be released in this way is large and the variety of human activities almost equally great in terms of relative danger and quantity prevailing scientific opinion²⁵ indicates that three areas²⁶ are of particular concern: the use of various synthetic chemicals (particularly chlorinated hydrocarbons)²⁷ for agricultural purposes; the release of heavy metals²⁸ (especially lead and mercury) in industrial and other processes; and the passage into the atmosphere of petroleum hydrocarbons for the use of petroleum to provide energy.

As regards existing controls applicable with respect to these dangers, many States have laws relating to air pollution, or to the protection of workers who may be directly exposed to harm during manufacture. Although such legislation is designed primarily for the benefit of the country concerned, it may also operate to prevent the infliction of harm to others.²⁹ Efforts are now underway in many countries to strengthen the body of legal and administrative controls which may be invoked. The measures to be taken vary according to the way in which the pollutant is produced. In the case of lead, attention has been concentrated on banning the addition of this

cultural pesticides, and atmospheric pollution in general and the establishment of a network of stations whereby atmospheric pollution (which contributes to marine pollution) may be measured.

25. As evidenced by the FAO Technical Conference, the preceding FAO Seminar, the 1970 Study of Critical Environmental Problems, and GESAMP's Second Report, Doc. II/11, Annex V.

26. Arguably increased radioactivity of the seas caused by fallout should be added as a fourth case (see GESAMP II/11, Annex V, table 2). The general opinion, however, has been that, over the long term, as more nuclear power stations are built, the disposal of radioactive wastes will be the major problem as regards this form of pollution.

27. This is particularly dealt with by Schachter and Serwer, *supra* note 16, at 95. Chlorinated hydrocarbons are used for pesticides (particularly DDT) and, in the form of polychlorinated biphenyls, for purposes (such as insulation and fire retardation) which, unlike the pesticides, do not involve their deliberate release into the atmosphere. No one appears to have found out yet how the PCBs reach the sea.

28. For a full list, and assessment of relative danger, see FAO Seminar at 27. After lead (used in anti-knock additives to petrol) and mercury (used in manufacture of P.V.C.), which are classified as the most serious dangers, on a world-wide and local basis respectively, cadmium (used in electroplating) and arsenic are the most serious; arsenic is not, however, air borne. The only other toxic heavy metal now known to be carried by the atmosphere to the seas is vanadium and, possibly, titanium.

Mercury compounds, besides being used in factory processes, are also used for agricultural purposes and carried into the inland water system as run off, or to the seas via the atmosphere. A number of countries (Canada, Finland, Japan, Sweden and the United States) have prohibited or reduced the use of mercury compounds in agriculture and strengthened controls in order to cut down mercury losses from industrial processes.

29. But not always very effectively: thus it was reported in the press that trees in Norway were growing less because of the effect on the soil and water there of sulphuric acid carried by winds coming from England. The "black snow" over parts of Scandinavia was traced to pollutants carried by air currents from the Ruhr, N.Y. Times, Jan. 11, 1970. (As against this, it could presumably be said if it were not for the existing controls in the countries where the pollution originates, the effect would be even greater).

metal to petrol, in order to stop the pollution at source. In this instance the problem posed as regards the nature of the control is determined by the impossibility of recapturing the lead once it has been released into the air. The same applies with respect to pesticides, which once dispersed over crops cannot be caught and recycled. The use of DDT (and its associated compounds) as a pesticide is now being phased out in a number of States³⁰ and GESAMP has recommended that restrictive or preventive measures be taken.³¹ Since DDT is used both to raise agricultural production and to prevent malaria, a direct ban is unlikely to be acceptable to States, mostly developing countries, which consider these objectives to have a higher value than the prevention of marine pollution, or of harm to certain species of birds. The World Health Organization, in its most recent statement on the subject,³² has declared that the withdrawal of DDT from malaria operations would be fraught with great danger and is unjustifiable in the light of present knowledge. Nevertheless the Organization recommends that the use of DDT in outdoor locations should be reduced to the minimum, and that research on substitute insecticides and methods should be pursued. Assuming that DDT were confined primarily to disease control, and that its future use for agricultural purposes was not indiscriminate (which would require, *inter alia*, that the volume now produced by the developed countries was not simply "dumped" on the developing countries, as some have feared might happen), the amount finding its way into water, would be held to a level which, if not ideal, would at least prevent the danger of pesticide contamination of large parts of the marine ecosystem from reaching major proportions. The steps necessary to reach agreement on these measures have only just begun, and it is difficult at this juncture to forecast just how informal and consensual the arrangements may be, and how information will be obtained. There would not appear to be any inherent reason for permanent or complex organizational machinery to be required if general consensus can be reached on the main lines of communal policy.

30. Hungary, Sweden and Denmark have banned its use (Schachter and Serwer, *supra* note 16, at 97), and other countries are contemplating similar action. A quarter of the DDT produced is believed to be finding its way into the oceans, virtually all via the atmosphere, *Man's Impact on the Global Environment*, *supra* note 7, at 131, although amounts are also disposed of as domestic and industrial wastes, or are transported by run off.

31. GESAMP II/11, Annex V, at 18.

32. Issued Feb. 12, 1971. DDT was at one time used against a large number of insect-borne diseases. Alternatives have been found in most cases, but not as regards the control of malaria transmitted by mosquitos or of sleeping sickness transmitted by tsetse flies. Annual DDT production now amounts to between 200,000 and 250,000 metric tons, some 15 to 20 per cent of which is used for the control of disease.

Internationally, apart from the attention directed towards DDT pesticides, some tentative beginnings have been made on a regional basis towards the limitation of particular chemicals affecting atmospheric and environmental conditions. Such efforts have been very largely confined to Europe³³ and North America. Apart from treaty or administrative arrangements made on a regional basis, the level of control exercised over the activities of States, and their means of recourse in the event of a dispute arising, are regulated by the application of the general principles of international law.³⁴ In this respect the position is the same as that in the case of harm caused by the disposal of domestic and industrial wastes, which is considered below.

B. The disposal of domestic and industrial wastes (including ocean dumping)

In terms of bulk, domestic and industrial wastes³⁵ form, together with the discharge of polluted river waters, the largest source of marine pollution at the present time. River discharge is, according to recent reports,³⁶ becoming the main cause of marine pollution, making improvement of estuaries and coastal waters dependent upon prior cleansing of the rivers themselves. Most countries have a system regulating the disposal of domestic and industrial wastes (which may indeed overlap with those on air and inland water pollution), often in the form of detailed ordinances prepared with particular regard to the safeguarding of public health. The multiplicity of local and central authorities who may be involved and the absence hitherto of possible international consequences appear to be responsible for the lack of any detailed comparative study of such regulations.³⁷ The

33. Besides the activities of the Council of Europe and of the Organization of Economic Cooperation and Development, the United Nations Economic Commission for Europe has played a leading part.

The matter of environmental protection has also been discussed within the framework of the North Atlantic Treaty Organization.

34. And the well known *Trail Smelter* case see note 42 *infra*. This is an important award, but can hardly be left to provide the sole guidance in this area.

35. The approximate order of magnitude with respect to pollution hazards amongst industrial waste products is as follows: pesticides, heavy metals and other inorganic toxic compounds, radioactive substances, petrochemicals, oil, organic waste, detergents, heat, solid objects and dredging spoils. This list shows clearly the range of land activities and industries affected by efforts to reduce marine pollution. See GESAMP Report on its First Session, GESAMP I/11.

36. *Natural Resources Development and Policies, Including Environmental Considerations*, Report of the Secretary-General, Addendum: river discharge and marine pollution, Doc. A/C.7/2/Add.8, Jan. 14, 1971. See also Annex II, Doc. E/C.7/2/Add.7. (Particular issues raised with respect to the use of international rivers are not discussed in this article.)

37. A report by the Secretary-General, *Marine Science and Technology: Survey and Proposals*, E/4487, Apr. 24, 1968, contains a certain amount of general information on this

wastes may be released into the sea in various ways, either by river, pipeline or dumping in the sea. They will either be processed in order to remove constituents which are commercially valuable or particularly dangerous, or placed in containers, according to the nature of the substance concerned and the stringency of national regulations. As regards the actual area of disposal, there appear to be considerable variations; however, it is probable that the majority of States dispose of considerable quantities of waste in areas beyond their territorial sea.³⁸ The self-interest of the State concerned in disposing of its garbage safely and the capacity of the sea to absorb it,³⁹ has prevented any serious international complication from arising. No international dispute appears to have arisen between two States (although charges have been exchanged)⁴⁰ with regard to damage caused by marine pollution as a result of the disposal of coastal wastes. If such a dispute were to occur, the matter (apart from whatever action the offending State might agree to take for reasons of comity or out of good neighborliness) would be decided according to the general principles of international law. These principles are indeed very general: the freedom of the seas, of reasonable regard to the rights of others, of non-abuse of rights, and the invocation of the maxim *sic* topic (see Parts I, E; II, 2 and 3; III D; and Annex XIV), based in part on a questionnaire sent to States in 1967. Twelve States only reported activity in monitoring and forecasting marine pollution (Australia, Canada, Chile, Federal Republic of Germany, Finland, France, Japan, Norway, South Africa, Sweden, United Kingdom and United States). Further information is to be found in the replies to a more detailed questionnaire sent by IMCO in 1969; see the reply of the United Kingdom contained in IMCO, Annex II, Doc. OP VII/4(b), Aug. 7, 1969. Reference may also be made to *Water Pollution Control: National Legislation and Policy*, FAO, (1968) which contains references to specific acts of national legislation, and G. Moore, *The Control of Marine Pollution and the Protection of Living Resources of the Sea*, prepared for the FAO Technical Conference (FIR:MP/70/R-15), part 3 of which is a survey of national legislation. Moore illustrates the diverse patterns of national management which have been adopted, including legislation relating to harbours and fishery regulations, and the attempts which are now being made to turn these patches of law and administration into a more coherent system of environment management.

38. *E.g.*, in accordance with a voluntary system operated by the Ministry of Agriculture, Fisheries and Food, the United Kingdom dumps toxic wastes in water deeper than 2,000 fathoms outside territorial waters. Denmark stated that "Danish shipowners have instructed their ships not to discharge imperishable sewage and rubbish into Danish waters." IMCO, Annex II, Doc. OP VII/4(b).

39. To date this has been the governing factor, as is borne out by the following statement made by two United States experts: "Historically, waste disposal policies in the U.S. generally have been based on the axiom of maximum permissible levels of water pollution. Indeed, it may be questioned whether there were policies at all . . . [W]ater quality management policies admittedly followed vague estimates of what happened when pollutants were deposited in estuaries and coastal waters. The practice was to dispose first and to investigate later, an invitation to disaster that requires no documentation, for the proof of sinister changes in the estuarine life of many coastal areas in the U.S. is dismally at hand for anyone to examine." W. Espey and F. Bender, *Systems Analysis of Galveston Bay: A Major Step Toward Controlled Environment*, 5 *Ocean Industry* 60-61 (Feb. 1970).

40. For a case involving Italy and France, see *N.Y. Times*, July 19, 1970, at 3. col. 1.

utere tuo ut alienam non laedas. Article 2 of the 1958 Convention on the High Seas does not include the right to dispose of waste materials among the freedoms of the high seas there specified, but having regard to the non-exhaustive character of the definition given and the universal character of the practice, it is highly improbable that an international tribunal would sustain the argument that the disposal of wastes in the high seas is ipso facto prohibited. This is not to say that pollution is itself a permitted use of the seas, but that waste disposal is.⁴¹ The issue in practice would be likely to turn, not on the basic question of the legality or illegality of waste disposal per se, but on the extent of knowledge, the foreseeability of the harm and the standard of proof required, all matters of which international tribunals (by comparison with national courts) have relatively little experience or case law to guide them.⁴² The matter might be somewhat differently presented according to the nature of the complainant State's interest and of its resulting claim (*e.g.*, whether the injury occurred within its territorial sea or was in respect of expenses incurred in anticipation of such injury, or whether damage was done to actual or potential mining interests on its continental shelf, or to fish stocks in the high seas.)⁴³ The number of variables prevent the giving of any simple answer to the question of what ruling an international tribunal might give. As a generalization, the greater the degree of knowledge the defendant State had, or ought to have had,

41. Or, as it was put by the Secretary-General, "... in fact a valuable and legitimate use of the near-shore marine environment is as a diluting and assimilating medium for waste materials, provided that these are introduced within the capacity of the environment," E/4487, at para. 89. The problem thus becomes, in part, determination of the capacity of the environment.

42. The Corfu Channel case, 4 I.C.J. (1949), the Trial Smelter Award, 3 UNRIAA 1063 (1941), and the Lac Lanoux Arbitral Award, 12 UNRIAA 281 (1957), might be cited, but this merely indicates the scarcity of precedents. It is of interest that in the Trial Smelter Award the tribunal ordered that operations might only be continued subject to a regime of specified controls.

43. What is the extent of the "special interest" possessed by a coastal State in the maintenance of the productivity of the living resources in any area of the high seas adjacent to its territorial sea (1958 Convention on Fishing and Conservation of the Living Resources of the High Seas, Article 6)? Would the complainant State need to have adopted conservation measures under the Fishing Convention or to show that the fish stocks were of special importance and regularly exploited by its nationals? What would be the *locus standi* of other States using the same fishing grounds more rarely, or which might wish to do so in the future? What effect would be attached to action on the part of any Fishery Commission concerned? What if the complainant State (or States) could show only a statistical correlation between a decline in catches and an increase in the amount of wastes dumped? It should also be borne in mind that just as pollution has increased in recent years, so has fishing; thus in the recent dispute over Atlantic salmon, Denmark attributed the decline in catches to pollution, as well as to disease, and the United Kingdom attributed it to more intensive fishing. N.Y. Times, Mar. 19, 1970, at 2, col. 3. Many of these (or analogous) issues may of course also be posed with respect to injury to fishing interests caused by other forms of pollution.

of the consequences of its action, the more likely it is that it will be held to be liable and be required to make reparation to the injured State.⁴⁴

The possibilities of complaints between nearby States with regard to the disposal of coastal wastes are undoubtedly growing. The volume of such wastes is increasing enormously⁴⁵—by far the largest volume of any of the sources under discussion—and almost of necessity, the tendency is to dispose of the waste further out to sea as inland and estuarine waters become polluted.⁴⁶ In order to avoid the contamination of more distant waters (which might have the

44. Much of the discussion relating to liability for injurious acts has usually been devoted to the question of whether responsibility should be based on strict or absolute liability or on proof of negligence (*i.e.*, a duty, on the part of the defendant, merely of reasonable care). Examination of the case of marine pollution, caused by waste disposal at least, suggests that the activity concerned (at least in most instances) is not so dangerous or major accidents so inevitable as to justify the automatic imposition of strict or absolute liability. James Fawcett has argued in the context of outer space activities that there should be absolute liability for the consequences of pollution, International Law and the Uses of Outer Space 67, and in the case of accidents with respect to oil tankers a similar approach has been taken. In these instances, however, the contingencies to be guarded against are primarily those which may be catastrophic on a wide scale.

As regards waste disposal, the danger is not of a sudden large catastrophe, but of a steadily deteriorating situation over a period of years, so that the possibility of preventing accidents exists, provided efforts are made. How energetic would efforts have to be to show reasonable care? It is suggested that a distinction might be drawn between disposal of the more dangerous pollutants, for which liability might be strict, and disposal of routine waste, with the important qualification that the degree of harm might depend either on the inherent quality of the waste, as in the case of toxic compounds, or on the volume disposed of, almost irrespective of the substance. The essence of the matter will be the capacity of the sea, in the particular area concerned, to absorb (or to continue to absorb) the waste in question, without deleterious effects for other marine users, which in turn will come back to the question of monitoring and surveillance.

It is one of the themes of the present article that discussion along the traditional legal lines is to some degree barren, or at least secondary: what has to be determined is the capacity of the marine environment to receive coastal and industrial wastes, in various (but increasing) quantities and places, without deterioration, and, when this capacity has been established, to regulate the situation accordingly. Liability, as virtually the sole means of social control should, in other words, be replaced by regulation based on knowledge derived from an established system of international scientific inquiries, and liability reserved essentially to deal with major catastrophes and accidents.

45. A sevenfold increase in the industrial wastes disposed of in the seas over the next decade is forecast by Wenk, *The Physical Resources of the Ocean*, 321 Scientific American No. 3, at 174 (Sept. 1969). Over a million square miles of shellfish-producing waters bordering the United States are now unusable owing to pollution. The threat of pollution to mariculture has been stressed by FAO; see GESAMP I/11, at para. 7.

46. The increase in estuarine pollution in the United States seems to be an irreversible phenomenon; see G. Claus, *Disposal of Sewage in the Oceans and the Pollution of the Estuaries*, Conference on International and Interstate Regulation of Water Pollution (1970). The N.Y. Times, Oct. 27, 1968, at 45, col. 1 reported plans for a sewage pipeline going 80 miles out to sea from the Trenton-Philadelphia-Wilmington area; while this project has not been proceeded with, it has been suggested that sewage sludge, now dumped 12 miles from the shore, should in future be dumped at sites 100 miles out. N.Y. Times, Feb. 15, 1970, at 1, col. 3; N.Y. Times, Feb. 21, 1970, at 33, col. 4.

effect of increasing the damage already done, or threatened, to coastal and estuarine areas) there have been increasing calls to extend national powers over ocean dumping,⁴⁷ possibly in conjunction with some form of international reporting system. While stronger unilateral controls over the dumping in adjacent waters by nationals⁴⁸ of the State concerned are to be expected, the need is growing for joint or co-ordinated action between government authorities in this regard. The problem of the disposal of domestic and industrial wastes is one which affects coastal areas, not the deep oceans, and internationally the position is likely to become critical first in the case of shallow enclosed, or semi-enclosed, seas, such as the Baltic and the Mediterranean, or even the North Sea, all of which are near crowded industrialized areas. Scientific observers and official bodies have collected evidence regarding the pollution of these seas,⁴⁹ and it would appear only a matter of time before regional or sub-regional arrangements are entered into.⁵⁰ The form and scope of such arrangements might raise some nice questions insofar as they diverge from the accepted division between areas subject to national control and the high seas, particularly as regards the legal position of third States. However the basic change would lie in acceptance by the States concerned of the principle of prior agreed regulation, rather than reliance on *post hoc* complaints by individual States. Assuming such

47. See, e.g., President Nixon's message to Congress of Feb. 9, 1971. A report on ocean dumping was made by the Council on Environmental Quality in October 1970. Schachter and Serwer, *supra* note 16, discuss this aspect, including the "standard setting" role which an international organization could play in conjunction with a system of international registration, *id.* at 108.

48. Or even by non-nationals; thus it is reported that the latest Netherlands legislation would control the disposal of wastes beyond Dutch territorial waters by non-Dutch ships where the waste has been transported through the Netherlands prior to disposal.

49. The International Council for the Exploration of the Sea established working groups to study pollution in the North Sea and the Baltic; reports were issued in 1969 and 1970. The International Commission for the Scientific Exploration of the Mediterranean (ICSEM) has organized a symposium on pollution in the Mediterranean and has requested one of its scientific committees to study, on a continuing basis, the effects of pollution in the Mediterranean and the means required to control it. The General Fisheries Council for the Mediterranean adopted two resolutions on pollution in December 1969, providing for the collection of information and establishing an expert group, to cooperate with ICSEM. (Information kindly supplied by Mr. Jean Carroz, FAO.) At the FAO Technical Conference papers were presented dealing with pollution in the Baltic, Mediterranean and the North Sea.

50. Thus a joint research program, aimed at curbing water pollution in the Gulf of Mexico, was recently agreed upon by the member States of the Caribbean Sea and Adjacent Regions Cooperative. N.Y. Times, Mar. 1, 1970, at 12, col. 8. The Council of Europe, the Economic Commissions for Europe, and the Organization for Economic Cooperation and Development, have all been active in this sphere.

As regards the Council of Europe, see in particular Recommendation 626 (1971), adopted by the Consultative Assembly on Jan. 21, 1971, and the accompanying report of the Legal Affairs Committee (Doc. 2896).

arrangements were limited to the surrounding coastal States, these might find that they had sufficient mutual interest to accept a degree of self-regulation, to standardize their methods of control and measurement, to inform one another of the quantities and character of wastes dumped, and of the safety measures taken, and to decide, on a basis of available information, what further controls might be introduced. If it were discovered that, in a particular sea, or in limited areas of it, concentrations of a certain pollutant (*e.g.*, heavy metals or paper and pulp waste) were approaching a dangerous level, it might then be agreed by all the States concerned that further quantities of the substance in question should be disposed of elsewhere or in other ways. The work done by international panels, such as GESAMP, might be of assistance in this regard, in determining categories of dangerous pollutants and ways of measuring their effects. It would be a practical pre-requisite of any common measures adopted to curb pollution that, so far as possible, none of the States parties should be placed at a competitive disadvantage. The economic impact of pollution measures may indeed be considerable;⁵¹ the fact that the States bordering semi-enclosed, intra-continental seas tend to be similar in economic and social standards may be of assistance in this connection. It is not possible at this stage to say whether co-operative arrangements such as those indicated would inevitably need to include the exercise of enforcement and regulatory powers on the part of a specially established regional body, or whether they might proceed on the basis of regular meetings of national officials and mutual restraint. States are unlikely to move directly to the former without having tried the latter; the more loosely organized "consultative" approach is more probable, at least in the interim.⁵²

A point of general interest is that, in either event, the States concerned would have moved towards acceptance of one of the central principles (the *Kohärenzprinzip*) of international river law, whereby the waters of a given drainage basin are regarded as an integrated whole and not as a series of separate entities wherein each

51. As an indication of magnitude, West German industries are now said to set aside six per cent of their new plant investments for pollution control. N.Y. Times, Feb. 28, 1970, at 6, col. 3.

52. This has not worked very effectively in the case of the Great Lakes between Canada and the United States, but it is doubtful if either country would have been prepared to accept an agency with direct enforcement powers. See Jordan, *Recent Developments in International Environmental Pollution Control*, 15 McGill L. J. 279 (1969). Landis, General Counsel of the Ontario Water Resources Commission, has argued in favor of a new treaty with the United States, giving primary responsibility, so far as Canada is concerned, to the provinces: *Legal Controls of Pollution in the Great Lakes Basin*, 48 Can. B. Rev. 66 (1970).

State may proceed as it wishes.⁵³ While this principle may often appear more of an aspiration than a reality, the increased demands for integrated development of river basins, in which a number of countries may be involved, together with the difficulty of separating the problem of pollution of inland and river waters from that of pollution of coastal waters, suggests that the law relating to international rivers and the law of the sea may be about to show, in this respect, a converging pattern of development.

C. Radioactive pollution

Apart from such radioactivity as may be introduced into the seas naturally, either from the earth's crust or from rain carrying the products of the action of cosmic rays on the upper atmosphere, radioactive materials may also be present as a result of various human activities: following the testing or installation of nuclear weapons; from civil applications, such as the use of nuclear energy to provide power for engineering or monitoring devices or for ship propulsion; from the possible release of radioactive materials which are being transported by sea; and from the dumping of radioactive wastes. This diversity and the difficulty of controlling radioactive materials once present in the marine environment, causes the problem of adopting suitable methods of prevention and control to be more difficult than in the case of coastal and industrial wastes, and future control schemes may need to distinguish between, on the one hand, measurement of existing levels of radioactivity, irrespective of source, and on the other, the introduction of particular forms of control with respect to specific nuclear activities.

As regards nuclear weapon tests, the International Atomic Energy Agency (IAEA) has stated that these form by far the largest cause of radioactivity in the seas.⁵⁴ The 1963 Nuclear Test Ban Treaty⁵⁵ placed a general prohibition on the testing of nuclear weapons. However, as is well known, not all nuclear States are parties to this

53. See the series of reports and resolutions on international river law adopted by the International Law Association, culminating in the adoption in 1966 of the Helsinki Rules on the Uses of the Waters of International Rivers. The "Law Relating to International Watercourses" has recently been recommended by the General Assembly to the International Law Commission for study. For a general survey of the topic, see *Natural Resources Development and Policies, Including Environmental Considerations*, Report of the Secretary-General, Addendum: Issues of international water resources development, U.N. Doc. E/C.7/2 Add.6 (1971).

For a report on I.L.A. consideration of marine pollution, see the paper by Cuperus presented to the FAO Technical Conference, FIR: MP/70/E-54.

54. *International Co-op in Questions Relating to Oceans*, Report, U.N. Doc. E/4836, at para. 44 (1970).

55. U.N.T.S. 43 [hereinafter cited as *1963 Treaty*].

agreement and the non-party nuclear States have continued to conduct nuclear tests in the atmosphere. In addition the treaty makes no provision (nor is it easy to say what provision could have been made) for the radioactivity already released into the atmosphere. Lastly, the ban contained in the treaty contains an exception with respect to testing conducted beneath the sea-bed, if this can be accomplished without the effects on the superjacent floor or water.⁵⁶ These facts together indicate that the control of radioactivity from this source, although it has advanced, is not complete. The problems posed (other than those of a scientific nature) concern the issue of disarmament, and indeed the state of international relations in general, and are hardly to be tackled within the scope of the present article. The matter is, however, noted here for its importance from the standpoint of monitoring and other forms of technical surveillance. The same considerations apply with respect to the possible installation of nuclear weapons in the sea or on the sea-bed.⁵⁷ The successful conclusion of the Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and in the Subsoil Thereof, which was signed on February 11, 1971, should, in the words of the USSR representative to the United Nations, *inter alia* "help to diminish the threat of pollution of the marine environment."⁵⁸

The use of nuclear means either to propel ships and submarines or to provide a source of power for various forms of machinery or instrumentation is not very extensive. Apart from nuclear submarines (all of which are military), there are less than half a dozen nuclear powered ships in the world. A convention was drawn up in 1962 on the liability of nuclear ship operators, largely, it would appear, to provide a basis for insurance arrangements and to help secure acceptance of the idea of nuclear shipping.⁵⁹ The high cost of operating nuclear ships has been the main reason they have not been employed more widely, and this situation is likely to continue for some time to come. The use of radioactive sources of power for marine instruments (*e.g.*, ocean buoys) or for larger scale machinery, is still in its infancy, but an extensive development may occur in the near

56. 1963 Treaty, Art. 1. Could this be done, other than by tunnelling from the land?

57. See Working paper, *The Military Uses of the Sea-Bed and the Ocean Floor, Beyond the Limits of Present National Jurisdiction*, U.N. Doc. A/AC.135/28 (1968).

58. Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor, *Beyond the Limits of National Jurisdiction*, 12th meeting, U.N. Doc. A/AC.138/SR.12 (1969).

59. See generally Boulanger, *International Conventions and Agreements on Nuclear Ships*, Nuclear Law for a Developing World, 5 IAEA Legal Series 175; and Hardy, *The Liability of Operators of Nuclear Ships* (1963).

future.⁶⁰ Even if the more ambitious schemes for placing nuclear power plants on the sea-bed to provide electricity for underwater cities are some way from realization, nuclear power sources may be the most suitable for oil drilling and pumping on the sea-bed, and are being actively considered.⁶¹ Apart from national controls, which were not primarily drafted with such applications in mind, the body of law to govern the use of nuclear energy for these purposes has yet to be written. The actual maritime transport of radioactive materials, on the other hand, with the resulting need to obtain insurance coverage, has resulted in consideration of the legal questions involved by IAEA, the European Nuclear Energy Agency (ENEA) and IMCO, in collaboration with the Comité Maritime International. The solution presently envisaged is that a new convention on maritime liability should be prepared, reconciling existing maritime liability provisions with the regimes established by the Paris and Vienna Conventions on civil liability for nuclear damage, whereby liability is borne solely by the nuclear operator.⁶²

The last source of possible radioactivity pollution, the dumping of spent radioactive materials, is the one which has received the most attention, perhaps because it seemed the one which would be easiest to tackle. The fact that these materials were known from the outset to be dangerous to public health, to be in many instances extremely long lasting⁶³ and capable of entering the marine ecosystem, has meant that their disposal in the oceans has been conducted with extreme care. As the IOC Working Group on Marine Pollution noted, no case is known of adverse effects having occurred as a result of such disposal.⁶⁴

The method of disposal has been either through a pipeline or by the sinking of containers in selected deep areas far out at sea; the main danger (apart from the possibility of an accident) lies in the risk of accumulations of radioactivity if dumping were to be continued indiscriminately and in increasing amounts. States engaged in such activities on any appreciable scale have exercised control within the

60. For an excellent survey, see Burgio, *Radioisotopes in the Marine Environment*, The Decade Ahead, 1970-1980, 153 (1969).

61. See, e.g., Edwards and Zupanick, *Floating Powerplant to Support Submerged Off-shore Operations*, 2 First Annual Offshore Technology Conference 481 (1969).

62. IMCO Doc. LEG. VII/5, (Mar. 25, 1970) and LEG. VII/11, at para. 21, (Jan. 1970). See also ENEA, 4 *Nuclear L. Bull.* 23-24, 28-29 (1969).

63. E.g., even half-lives of radioisotopes may be thousands of years—although most are not. Disposal in the sea of radioisotopes with half-lives of thirty or more years has been common.

64. *Recommendations of the First Meeting of the IOC Working Group on Marine Pollution*, Aug. 14, 1967, n. 10 to Table of Major Categories of Pollution.

framework of national legislation relating to nuclear materials. Attempts have also been made to arrive at an international system of controls or, at the least, of common observation of international standards. Article 25 of the 1958 Convention on the High Seas provides:

1. Every State shall take measures to prevent pollution of the seas from the dumping of radioactive waste, taking into account any standards and regulations which may be formulated by the competent international organizations.
2. All States shall co-operate with the competent international organizations in taking measures for the prevention of pollution of the seas or air space above, resulting from any activities with radioactive materials or other harmful agents.

Besides this degree of regulation with respect to the activities of States, the 1958 Conference on the Law of the Sea adopted a resolution recommending that IAEA should assist states by promulgating standards and drawing up internationally acceptable regulations relating to the discharge of radioactive materials into the sea. Pursuant to this resolution, IAEA established a panel of experts to study the technical and scientific problems involved.⁶⁵ The panel submitted a report in 1960 in which it put forward a series of recommendations, the principal of which was as follows: that waste disposal sites should be designated by a responsible national or international authority which should provide for the necessary monitoring of the area; that all authorities setting up disposal sites should provide, to a suitable international authority, information necessary to maintain an adequate register of radioactive waste disposal into the sea; and that IAEA should maintain this register and should receive (a) notice of the licensing requirements of all sea-disposal areas; (b) annual reports on the state of such sites; and (c) the monitoring program and all relevant scientific findings.⁶⁶ It has not, however, as yet proved possible to establish the proposed international register. Although IAEA has conducted various inquiries and sponsored a number of meetings⁶⁷ on the subject of radioactive waste disposal, the proposal for a centralized method of collating information (and so evaluating

65. An account of IAEA's activities in this sphere is to be found in various sources; that given above is taken largely from Annex XI, U.N. Doc. E/4887. See also McDougal and Burke, *The Public Order of the Oceans* 852, and works there cited, for a general discussion of the legal issues.

66. *Radioactive Waste Disposal into the Sea*, IAEA Safety Series No. 5.

67. Including those of a legal panel which met four times over the period 1961-1963 and which produced two different drafts of a report, reflecting two diverging views on the fundamental question of the permissibility of disposing radioactive wastes into the sea under international law. A symposium held in 1966, however, indicated that outstanding problems have narrowed considerably, Annex XI, at paras. 157-159, U.N. Doc. E/4487.

the degree of danger from a general standpoint, thereby forestalling possible cumulative effects) has remained unrealized. The reason for this may be attributed to several causes, including not only such political considerations as may be involved, but also the technical difficulty of determining with accuracy the effects of radioactivity on the individual resources of the ocean and of distinguishing radioactivity in the marine environment due to different sources.⁶⁸ However, in the light of technical advances, a further panel meeting was held in November, 1970, which resulted in further progress towards a set of recommendations which would be generally acceptable.⁶⁹ State practice with respect to the disposal of radioactive wastes has continued on a basis of national regulation and limited international co-operation on regional lines.⁷⁰ If an accident were to occur the principles of international law which might be cited in argument would be much the same as those referred to above in the case of a dispute concerning pollution due to the disposal of domestic and industrial wastes, together with reference to the provisions of the 1958 High Seas Convention. In this instance, however, it may be regarded as very much more likely that, having regard to the pattern followed in the international conventions relating to liability for nuclear accidents in other spheres, the standard of strict or absolute liability would be applied in determining responsibility.⁷¹

D. The Disposal of Military Materials

The disposal of military wastes in the oceans may be regarded as an aspect of the use of the seas for military purposes, and as merely a

68. Perfect control of radiation hazards at sea may indeed prove very difficult, and a decade or so may elapse before it is achieved. See Wang and Cruikshank, 1 *Technologic Gaps in Exploration and Exploitation of Sub-Sea Mineral Resources*, 1969 Offshore Technology Conference, OTC Paper No. 1031, at 295. See also Polvani, *Radioactive Solid Waste Disposal into the Oceans: Implications and Perspectives*, Symposium on the International Regime of the Sea-Bed (1969).

69. *Principles for Limiting the Introduction of Radioactive Wastes into the Seas*, Report of IAEA Panel Meeting, Nov. 1970.

It is now envisaged that national authorities should keep records of radioactive waste released in the marine environment. The pertinent data (types of waste and of radioactivity, quantities disposed of, and location of major releases) would be sent annually to IAEA, which would maintain a central register.

70. Thus in 1967 a group of European States (Belgium, France, Federal Republic of Germany, Netherlands, and the United Kingdom) together disposed of 11,000 metric tons of radioactive material in an undertaking organized by ENEA. *Radioactive Waste Disposal Operation into the Atlantic 1967*, ENEA.

71. A number of States moreover might claim that the activity itself is illegal. As regards the application of the principles embodied in the conventions on nuclear liability, however, it could be argued that these were adopted to regulate responsibility for accidents due to nuclear power sources, and the hazards presented by the marine dumping of used radioactive materials of low strength are not of the same order of magnitude and should be treated differently.

particular form of ocean dumping.⁷² It does, however, have its particular characteristics. Because of the military aspect, information as to the exact character and quantity disposed of is usually classified, or only made partially available after the event. From the nature of the case, the materials in question are likely to include many substances which are highly toxic.⁷³ As regards the legitimacy per se of the disposal of unwanted weapons into the seas, if ocean dumping itself is not illegal it would not become so because of the military purposes for which the goods were manufactured. Nevertheless, there is a matter of psychological sentiment in the attitude often taken towards military dumping which requires mention. In the case of domestic and industrial waste, there is a realization that the substances in question were produced in the course of processes which most people would regard as normal and beneficial for everyday purposes. There is a reluctance to make the same assumption with respect to the production and disposal of war materiel. In this instance there is accordingly a tendency to require the producer State to beat his surplus sword and poison gas into a ploughshare in his own backyard, and not in the public oceans. The enormous toxicity of the weapons which may be produced has undoubtedly raised fears in this respect, and increased the pressure that the disposer State shall not expose others to harm.

As regards current law, the matter stands regulated by general principles in the same way as other acts of ocean dumping. The question has recently received some degree of international attention as a result of the disposal by the United States of a quantity of nerve gas in the Atlantic during August 1970, and it may be that the law in this area may be developed towards some measure of agreed controls. It is of interest to note the various steps taken by different parties. There were first, a series of actions brought by individual citizens before local courts, designed to halt the United States authorities. The resultant publicity prompted international complaints (or requests for information) by various States, either bilaterally through diplomatic channels or before United Nations bodies. The United Nations Sea-Bed Committee, which was meeting at the time in Geneva, issued a unanimous statement expressing its concern "at the practice of dumping toxic, radioactive and other noxious materials"

72. This paper deals with the dumping of military wastes and not with the firing of shells, etc., either in tests or during hostile actions. Apart from the case of radioactive fallout the only appreciable marine pollution caused by military activities is the dumping of material, which constitutes a significant factor in the overall situation. Annex V, at para. 3.8, GESAMP II/11.

73. *E.g.*, biological and chemical warfare agents, poison gas, heavy metals, as well as explosives.

on the sea-bed, and appealed to all governments to refrain from using the sea-bed as a dumping ground for materials which might cause serious harm to the marine environment. The Committee noted the assurances given by the United States delegation that effective precautions had been taken "and that such action will not be taken again."⁷⁴

The conclusion suggested by the above is that the disposal into the oceans of highly dangerous military materials is no longer a matter at the discretion of the individual State, but is one where nascent "community" or "general" interest is beginning to make itself felt in explicit terms. While States disposing of substances which have such a high degree of toxicity may be expected to be even more careful in future than they have been so far, the question of what further measures may be instituted is difficult to answer at this juncture. If an international sea-bed authority were to be set up with jurisdiction over the area, it might be entitled to control and supervise such actions. It is hard to say whether this would be acceptable to all the major States involved, although, since they must all have to deal with the problem, perhaps they might manage to agree to such a proposal. It is encouraging in this regard that the United States proposal⁷⁵ concerning an international sea-bed regime was put in terms which would encompass such powers. In the absence of an international sea-bed authority with wide enough authority, the alternative is a system of registration, possibly as part of a general system of registering acts of ocean dumping. The questions to be answered would then be, how specific would the information have to be, and what form of surveillance, if any, would exist? What form of protection (other than forewarning) would be given to a State which wished to prevent a particular act of dumping which it felt might endanger its interests?

E. Ship-borne Pollutants

States have of course long regulated the conditions under which ships flying their flag may carry harmful or noxious cargoes. Since such regulations have not been uniformly adopted or enforced there have been limits to their effectiveness as a means of preventing the deliberate discharge of such cargoes or of enabling States to deal with the problem of accidental spillages. In the case of the most frequent ship-borne pollutant—oil—recourse has therefore been to inter-

74. Report of the Committee on the Peaceful Uses of the Sea-Bed and the Ocean Floor, Beyond the Limits of National Jurisdiction, U.N. Doc. A/8021, at para. 25. The Legal Adviser of the United States Department of State pointed out that, if the United States draft convention, Annex V, *supra* note 72, had been in force the United States action would have been subject to a precise system of international authorization and surveillance.

75. *Id.*

national measures.⁷⁶ Besides the requirement in Article 24 of the 1958 Convention on the High Seas that States

... shall draw up regulations to prevent pollution of the seas by the discharge of oil from ships ... taking account of existing treaty provisions on the subject. . . .

a series of multilateral conventions have been adopted to regulate oil pollution caused either in the course of a ship's operations (e.g., a release of oil or oily water from a tanker in ballast), or as a result of a major accident (a massive oil spill).⁷⁷

The International Convention for the Prevention of Pollution of the Sea by Oil, which was concluded in 1954 and amended, under the auspices of IMCO, in 1962 and 1969,⁷⁸ is the only existing international convention dealing solely with the prevention of a major potential source of marine pollution prior to its commission. Under the 1954 and 1962 versions of the Convention, the discharge of oil or of oily mixture was prohibited within specified zones;⁷⁹ the 1969 amendments do away with the system of prohibited zones and in principle prohibit oil discharge (except under specified conditions) more stringent than those previously applicable. By way of enforcement each tanker or ship using oil fuel covered by the Convention is

76. By way of explanation, it should be pointed out that ships empty of cargo lie high in the water and may move violently in strong wind or in rough sea. Sea water is therefore pumped into the tanks, as ballast for the ship; tankers receive their ballast water into the same tanks which carry their cargo, and other vessels (unless they have separate ballasting tanks, which are expensive) receive the ballast water into their fuel tanks. Unless the tanks are cleaned before this is done, the water mixes with the oil residue to form an oily mixture. It is this mixture which forms the pollutant when it is discharged in the course of the ship's operations (when tankers take on new cargo, or other ships are refueled).

The possibility of routine oil spills so caused should be distinguished from accidental spills on a large scale, as in the Torrey Canyon case. Such accidents involving the discharge of the cargo of a bulk carrier may involve oil or other substances (such as chemicals or pesticides). Attention with respect to accidents has so far been concentrated on oil pollution, but proposals have been made for parallel regulation of other ship-borne pollutants also.

77. It should also be noted that Canada, which considered that the Conventions concerned provide insufficient protection for her interests, has decided to take unilateral measures whereby ships entering designated zones extending 100 nautical miles from her Arctic coasts are required to satisfy Canadian regulations with respect to the prevention of marine pollution.

78. 327 U.N.T.S. 3 and 600 U.N.T.S. 336. The 1969 amendments are annexed to IMCO Assembly Res. A.175(VI), Oct. 21, 1969. The 1962 amendments entered into force in 1967; the 1969 amendments [which are annexed to IMCO Assembly Res. A.175 (VI), Oct. 21, 1969] are not yet in force.

79. Under the 1972 amendments, the prohibited area extends generally 50 miles from the coast of all countries and may be extended by a State party to 100 miles; special consideration was given to particular regions, such as shallow or semi-enclosed seas like the Mediterranean. Under the 1969 amendments there is a ban on the discharge of oil in excess of a rate of 60 litres of oil for each mile travelled.

required to maintain an oil record book, specifying the ship's operations involving the receiving or discharge of oil or oily mixture. Any State party is authorized to inspect any ship covered by the Convention while in its ports, as well as the ship's oil record book. The effectiveness of the Convention, as a means of preventing oil pollution, has been somewhat limited in practice. The size of the prohibited zone may make detection difficult, and even when ships are caught in the act of violating the provisions of the Convention, the penalties which may be imposed are those of the flag State, which may be minimal or even non-existent.⁸⁰

The 1954 Convention provides in any case little or no help in dealing with the problem of an accidental massive oil spill, a possibility which the increasing use of bulk tankers has rendered more likely. There are a number of technical measures which can be adopted to reduce the possibility of these accidents, such as improved methods of construction and equipment, "load on top" procedures⁸¹ and the use of oil-water separators, the elaboration of traffic routing rules, better training of officers and crew, and the development of better means for removing oil and other pollutants from the sea. Besides preventive steps of this character, which are currently under study by IMCO,⁸² as well as by other international bodies and national authorities, consideration has also been given to the possibility of direct action by a coastal State to prevent or limit

80. According to the Report of the International Panel, *supra* note 44, at VIII-87, many "flags of convenience" vessels appear to enjoy practical immunity. However, it is reported that a radar-like sensory device (called a microwave radiometer) has now been developed which enables Coast Guard planes to detect oil dumping carried on under cover of darkness. N.Y. Times, Mar. 8, 1970, at 76, col. 3.

81. As a means of preventing oil pollution, the use of "load on top" procedures has probably been far more effective than the 1954 Convention, even as amended, although the two need to be looked at together. Of the estimated 530,000 metric tons of oil released in the oceans in 1969 as a result of normal tanker operations, only 30,000 metric tons were attributed to tankers using the "load on top" procedure, and the remainder to those not doing so. Those using the technique, however, constitute eighty per cent of the world's tanker fleet—thus, a mere twenty per cent of tankers may be responsible for ninety four per cent of the direct loss by tanker operations. *Man's Impact on the Global Environment, supra* note 7, at 267. Proceeding from these calculations it has sometimes been suggested that the States which are parties to the 1954 Convention (which are also, for the most part, the States whose tankers use the "load on top" procedures) should decline to allow the tankers of States which are not parties and/or not using such procedures, to enter their territorial seas or to use their harbours, as a means of bringing pressure on those States, either to sign the Convention or to adopt "load on top" practices. The difficulty in this respect is that the States in the first category are also, generally speaking, those with the greatest interest in safeguarding unimpeded freedom of navigation, and who would probably not therefore wish to encourage a move towards the institution of new unilateral measures of control over the transit of ships.

82. Or already established, e.g., the International Regulations for Preventing Collisions at Sea (1960).

pollution when an accident occurs or threatens. Under general principles of international law, jurisdiction over ships on the high seas has been limited to the flag State. Accordingly, in the absence of treaty arrangements, a coastal state would lack clear authority to intervene in order to take protective action. In order to fill this gap, as regards oil tankers at least, a multilateral Convention was concluded in November 1969 under the auspices of IMCO, defining the conditions under which the coastal State may intervene. This Convention, the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, was complemented by a second, the International Convention on Civil Liability for Oil Pollution Damage, which regulates the system of financial liability in respect of major oil spillages.⁸³ Both these Conventions, it should be stressed, are only secondary or indirect means of preventing oil pollution; they come into operation after accidents have occurred or are immediately imminent. Their effect, as a means of forestalling pollution (as opposed to controlling or limiting pollution once it has taken place) largely depends therefore on such factors as the conditions which those who may be called upon to pay in the event of an accident (chiefly the marine-insurers) may choose to impose on ship-owners and operators in return for providing financial coverage. Such indirect, though important, means of accident prevention, thus complement the steps which States may take directly.⁸⁴ This division of functions, together with the existence of the earlier instrument—the 1954 International Convention for the Prevention of Pollution of the Sea by Oil—indicate some of the difficulties of providing outright an effective and unified system of international regulation in spheres where many States and large economic interests are involved; to draw a not too far-fetched municipal analogy, it is as though the police had power to remove cars which caused accidents but it was the

83. The International Legal Conference on Marine Pollution Damage, which led to the conclusion of the two Conventions, was held in Brussels between Nov. 10-29, 1969. For the text of the two Conventions and the resolutions adopted see the attachment to the Final Act. The Public Law Convention will enter into force when fifteen States have become parties (Art. XI); the Private Law Convention will enter into force when eight States have become parties, including five States each with not less than 1,000,000 gross tons of tanker tonnage (Art. XV).

84. Either individually under the 1969 Public Law Convention, or collectively. Thus the North Sea States have entered into cooperative arrangements to keep one another informed of threats of oil pollution, based on a division of the North Sea into zones for which individual States will be responsible. States parties to the agreement may call on one another for assistance; in such circumstances a report is to be made to the contracting parties and to IMCO. The agreement is not in its terms limited to oil pollution caused by ships. Agreement for Cooperation in Dealing with Pollution of the North Sea by Oil, [1969] Gr. Brit. T.S. No. 78 (Cmd. 4205). The agreement was signed at Bonn on June 9, 1969 and entered into force on Aug. 9, 1969.

insurers who were normally responsible for seeing that cars had effective brakes and steering in the first place.

The International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, the so-called Public Law Convention, provides that States parties

... may take such measures on the high seas as may be necessary to prevent, mitigate or eliminate grave and imminent danger to their coastline or related interests from pollution or threat of pollution of the sea by oil, following upon a maritime casualty or acts related to such a casualty, which may reasonably be expected to result in major harmful consequences.⁸⁵

Before taking any steps, the coastal State is required to consult with the flag State and to notify those whose interests may be affected (normally the owners of the ship and cargo). The State may also consult independent experts drawn from a list maintained by IMCO. In cases of extreme urgency the coastal State may take action without prior notification or consultation. The measures taken, which are to be notified, *inter alia*, to IMCO, are to be proportionate to the danger, and may not go beyond what is reasonably necessary or unnecessarily interfere with the rights and interests of the flag State, third States or any persons concerned.⁸⁶ Compensation is payable in the event that damage is caused by measures taken beyond those reasonably necessary. Disputes between States parties as to whether particular measures were justified or as regards the payment of compensation in respect of any measures taken, are to be submitted to a conciliation commission and, failing that, to arbitration, according to detailed procedures set out in an annex to the Convention.

The second treaty, the so-called Private Law Convention, provides that, except in the case of certain limited exceptions,⁸⁷ the owner of the ship⁸⁸ is to be liable for any pollution damage caused within the

85. Public Law Convention, *supra* note 83, at Art. I, 1. The Convention is applicable to any sea-going vessel other than those used for naval purposes. The "related interests" referred to are illustrated as including fishing activities, tourist attractions and the health of the coastal population, Art. II, 4.

86. *Id.* at Art. V.

87. In brief, acts of war, act of God, intentional act of a third party or wrongful act by the authority or government responsible for the maintenance of lights or other navigational aids. Private Law Convention, *supra* note 83, at Art. III, 2.

88. One of the principal issues at the Brussels Conference was whether liability should be borne by the shipowner or by the owner of the cargo. Broadly speaking, coastal States that saw themselves chiefly as potential victims favoured the latter, as offering the best means of recourse against a source (the oil companies) able to pay, and oil transporting States favoured the former. After considerable discussion, the coastal States accepted the position of the shipping States on this point in order to secure their participation in the Convention. Stress was laid throughout the discussion on the fact that whereas the insurers could be

territorial boundaries of a Contracting State, including liability for the costs of any preventive measures taken.⁸⁹ As is customary in international instruments providing for strict liability, a ceiling is placed on the amount of compensation payable in respect of any one incident; in the present instance the upper figure is set at 2,000 gold francs per ton or 210,000,000 gold francs in aggregate (approximately \$14,000,000). In order to claim the benefits of this limitation, the shipowner is required to deposit the relevant sum, or a guarantee, with the court or competent authority in the event that an action is brought against him under the Convention. The fund thus provided is to be distributed proportionately among the claimants.⁹⁰ The owner of a ship registered in a Contracting State and carrying more than 2,000 tons of oil as bulk cargo is required in any event to maintain insurance or other financial security "such as the guarantee of a bank or a certificate delivered by an international compensation fund,"⁹¹ up to the limits of liability prescribed by the Convention. A certificate attesting that this insurance or financial security is in force is to be carried on board the ship. Contracting States are required to ensure that ships, wherever registered, actually carrying 2,000 tons or more of oil as bulk cargo, possess the required amount of insurance or other financial security when entering or leaving their ports or terminals.⁹² If pollution damage does occur, actions for compensation may be brought, within stated periods,⁹³ in the courts of a Contracting State in whose territory (including territorial sea) pollution damage has occurred or which has taken preventive measures.⁹⁴

The Brussels Conference at which the Conventions were concluded also adopted two resolutions. The first of these recommended that pending the entry into force of an international instrument or the readily identified, cargo on a given tanker might be owned by more than one party, and, indeed, ownership could pass from one party to another even during the course of the voyage.

89. Wherever taken, and including also any further loss or damage caused by preventive measures. Private Law Convention, at Art. I, 6 and II.

90. Detailed provisions as regards the position of the insurer and rights of subrogation are contained in Private Law Convention, at Art. V. Claims for compensation may also be brought directly against the insurer or other person providing financial security, Private Law Convention, at Art. VII, 8.

91. *Id.* at Art. VII, 1.

92. *Id.* at Art. VII, 11. As a corollary, contracting states may not permit a ship under its flag to trade unless a certificate has been issued. *Id.* at Art. VII, 10.

93. Within three years of the occurrence of the damage and in any case not more than six years after the accident. *Id.* at Art. VIII.

94. *Id.* at Art. IX, which distinguishes between pollution damage and preventive measures as grounds for action, although in Art. I, 6, pollution damage is expressly defined as including the costs of preventive measures and further loss or damage so caused. The matter is presumably spelt out in Art. IX *ex abundante cautela*.

extension of the Public Law Convention to cover pollution by agents other than oil, IMCO should intensify its work with respect to such agents and that States "which become involved in a case of pollution danger by agents other than oil co-operate as appropriate in applying wholly or partially the provisions of the Convention".⁹⁵ The IMCO Legal Committee decided in January 1970 that further technical information was required before consideration could be given to specific proposals.⁹⁶ GESAMP has since examined the pollution potentialities of a list of substances carried as cargo, selected from the General Index to the International Maritime Dangerous Goods Code.⁹⁷

The second resolution dealt with a proposal made during the Conference that a supplementary scheme, such as an international fund, should be established to ensure that adequate compensation would be available for all victims following an accident, even where there was no liability on the shipowner under the Private Law Convention, or where the compensation due from the shipowner under the Convention was insufficient to repair the damage inflicted.⁹⁸ The resolution, noting that the Convention "does not afford full protection for victims in all cases," recognized that a "supplementary scheme in the nature of an international fund is necessary to ensure that adequate compensation will be available for victims" IMCO was requested to elaborate a draft of a compensation scheme, based on the prin-

95. This followed the failure of an attempt to reach agreement on an Optional Protocol which would have empowered parties to the Public Law Convention to apply its provisions to all agents of pollution other than oil. See generally IMCO Doc. LEG.VII/4.

96. IMCO Doc. LEG.VII/11, at paras. 7-10.

97. GESAMP 1/11, at paras. 14-18, IMCO LEG. VII/4, and Annex V, GESAMP II/11.

98. The proposal must be seen in its context. The two basic principles of the Private Law Convention are the strict liability of the shipowner in nearly all foreseeable cases and the ceiling of \$14,000,000 set on maximum costs of insurance coverage which was not what shipowning interests wished, and the limitation on the amount of maximum compensation was not what countries who saw themselves chiefly as potential victims wished; the result therefore was a compromise between these two sets of economic interests. See also *Economist* (Dec. 1969). The object of the international compensation fund would come nearer to a social security approach, whereby compensation would be paid up to a much higher ceiling figure and with as few exceptions as possible; at the same time the fund would seek to relieve the burden placed on the shipowner under the 1969 Convention of paying compensation in virtually all cases. The fund would have the possibility of recourse against the shipowner, under the usual principles of maritime law, most notable the requirement of proof of fault (or proof, on the part of the shipowner, that negligence had not been committed) and much lower limits of compensation. There would also be the possibility of the fund recovering, at least in part, sums it had itself paid out, from the tanker owners or other parties closely connected with the maritime carriage of oil in bulk. The tanker owners have in fact already established a fund, tanker owners' voluntary organization on oil pollution (TOVALOP), with a ceiling of \$9,600,000 per accident; this fund being intended to compensate governments directly, an Oil Companies International Marine Forum has also been created, with the intention of providing the higher "cover" with which the IMCO Working Group on the compensation fund is concerned.

ciples of providing full and adequate compensation for victims under a system of strict liability, and secondly, of relieving the shipowner of the additional financial burden imposed by the Convention. IMCO, which has set up a working group to examine the matter,⁹⁹ was asked to convene an international conference not later than 1971, to consider the adoption of such a compensation scheme, which, if brought into operation, would thus complement or extend the security afforded by the 1969 Private Law Convention.

For one State at least, the provisions of the 1969 Conventions provided, in her view, inadequate protection for her needs. Canada has objected to the two draft Conventions principally on the following grounds: that they failed to give a sufficient measure of prior control to enable the coastal State to ensure that accidents would not occur; that, in the case of the Private Law Convention, liability was not placed on the cargo owner (and thus directly on the oil industry) as well as the shipowner; and because financial reparation under that Convention extends only to damage inflicted within territorial limits and does not include pollution damage caused on the high seas to fishing vessels and to fishing interests in zones contiguous to the territorial sea.¹⁰⁰ For these reasons, and because oil and other forms of pollution present special dangers to the ecological balance that now exists in the Arctic—and also, it may be said, to emphasize Canadian sovereignty over the Northwest Passage—the Canadian Government has prepared two acts, one extending the limit of Canada's territorial sea from three to twelve miles and enabling fishery conservation zones to be established in areas beyond,¹⁰¹ and the other to prevent pollution of Arctic waters.¹⁰² Under the Arctic Waters Pollution Prevention Act, commercially owned ships intending to enter Arctic waters designated by the Canadian Government as shipping safety control zones will be required to meet Canadian hull, construction and navigation safety standards and to comply with

99. The Working Group held its fifth and final session in March 1971, and it is envisaged that a plenipotentiary conference will be called later in 1971.

100. See the statements and proposals made by the Canadian delegation at the Brussels Conference, in particular those contained in IMCO Doc. LEG/CONF/BR.2 and BR.5, and LEG/CONF/4/Add.3, and the Canadian note, dated Apr. 16, 1970, to the United States.

101. An Act to Amend the Territorial Sea and Fishing Zones Act, 18, 19 Eliz.2, (Can. 1970).

102. Arctic Waters Pollution Prevention Act, 18, 19 Eliz. 2, (Can. 1970). Both Acts are now on the statute book, but have not, as of mid-February 1971, been proclaimed chiefly because of the need to prepare the accompanying detailed regulations.

For commentaries of the Canadian legislation see Bilder, *The Canadian Arctic Waters Pollution Prevention Act: New Stresses on the Law of the Sea*, 69 Mich. L. Rev. 1 (1970), and Neuman, *Oil on Troubled Waters: The International Control of Oil Pollution*, 2 J. of Maritime Law and Commerce 349 (1971).

ice-breaker escort regulations. The shipping safety control zones may extend up to 100 nautical miles from the Canadian coastline north of 60° latitude. The owners of ships and cargoes are required to provide evidence of financial responsibility, in the form of insurance or an indemnity bond, in an amount determined by the Canadian authorities. The deposit of waste is prohibited and penalties may be imposed, ranging from \$5,000 to \$100,000 a day, for any violations. Civil liability for any harm caused, though subject to a maximum ceiling figure, is absolute. Provision is made for the application of similar protective measures, including prior review of proposed activities, with respect to the exploration and exploitation of the natural resources of the land or submarine area adjacent to arctic waters.

Canada's special position in the area and the distinctive character of the region, place the Arctic, and the impending legislation, in a somewhat particular category, and it is difficult to determine at this juncture whether the steps which Canada proposes will remain a solitary example, the unilateral creation of a unique "regime" acquiesced in by other States, or the forerunner of similar acts on the part of other States.¹⁰³ So far as the general question of protecting and regulating marine interests outside existing territorial limits is concerned, a distinction may be drawn between the special interests made by individual States (most notably as regards fishing), and the common interest, shared by all, in preserving the entire marine environment, and beyond that, in the continued orderly conduct of marine affairs. Insofar as there may be a danger of a gradual deterioration in the ecology of the sea caused by rising levels of pollution in different areas and by different activities, it would seem clear that this cannot be dealt with by one State alone but only by agreement on measures of international surveillance and regulation. As regards

103. In notes of Apr. 9, 15, 1970, the United States protested against the Canadian proposals, in particular the exercise of control over United States vessels on the high seas. In a State Department statement of Apr. 19, 1970, stress was laid on the danger that the Canadian example would be taken as precedent by other States seeking to introduce other unilateral changes in existing law. In its reply dated Apr. 16, 1970, the Canadian Government, which had changed the terms of Canada's acceptance of the compulsory jurisdiction of the International Court of Justice before introducing the bills so as to exclude disputes that might arise as to their legality, declined to accede to a United States proposal that the case be submitted to the International Court. The Canadian Premier, Mr. Trudeau, speaking in the Canadian House of Commons, declared that "we will not go to court until such time as the law catches up with technology." In the meantime the United States tanker *Manhattan*, which passed through the Northwest Passage in 1969, has complied with a series of safety modifications required by the Canadian Government and deposited a large bond before undertaking further tests in arctic waters. *N.Y. Times*, Apr. 19, 1970, at 9, col. 1, and *The Times* (London), May 5, 1970, at 7, col. 1.

the protection of special interests, Canada's position vis-a-vis the Arctic does not easily find parallels elsewhere,¹⁰⁴ and fishing States, tempted though they may be to follow the Canadian example, may in fact hesitate to do so unless it appears the only course open to them. The difficulties in maintaining a continuous patrol over large areas of open sea, the varieties of sources of pollution, the need to allow exploration and exploitation of mineral resources to continue, and the technical problems of gauging ocean pollution, may all incline fishing States towards participation in an international solution, if one acceptable to them, as well as to States with other interests, can be agreed upon. Resolution of the issues raised will entail difficult negotiations and a general willingness to accept innovations, with the alternative to the introduction of stronger measures of international control being a move on the part of a number of governments towards unilateral measures, designed to safeguard their immediate concerns. Whatever the exact modalities which may be arrived at, a greater regulation and protection of marine interests (both particular and general), and a considerable change in the existing law of the sea and its institutions looks likely to result.

F. Pollution as a Result of Mineral Exploitation

The exploration and exploitation of the mineral resources¹⁰⁵ of the sea-bed and sub-soil may take place either in areas subject to national control or in the area beyond, since it is now agreed that there *is* an international area beyond that of national jurisdiction,¹⁰⁶ even if its precise delimitation and legal regime have yet to be determined. The legal setting for otherwise identical activities may thus vary considerably, even though, from the point of view of a potential operator, the operational standards imposed may prove to have many common features.

Taking the two sectors in turn, in the case of mineral exploitation in areas subject to national jurisdiction, the only multilateral obliga-

104. Though perhaps some similar cases can be found, *e.g.*, Denmark in relation to Greenland, the areas beyond the northernmost coasts of Norway (including Spitsbergen) and the Soviet Union, and the Antarctic, without considering examples where States might make special claims based on other geographical features (*e.g.*, island archipelagos).

105. These may consist of petroleum (oil or natural gas) or hard minerals, such as submarine phosphate or manganese nodules and crusts, situated either as surficial deposits or as deposits within bedrock. The methods of exploitation are drilling, in the case of petroleum, or various dredging or similar systems in the case of hard minerals.

106. The Declaration of Principles Governing the Sea-Bed and the Ocean Floor and the Subsoil Thereof, Beyond the Limits of National Jurisdiction, adopted by the General Assembly on Dec. 17, 1971 (108 in favor, none against, and 14 abstentions), affirms the existence of such an area. U.N. Res. 2749 (XXV).

tions laid down by treaty are those contained in the 1958 Convention on the Continental Shelf. These provide that:

The exploration of the continental shelf and the exploitation of its natural resources must not result in any unjustifiable interference with navigation, fishing or the conservation of the living resources of the sea. . .¹⁰⁷

And that, in the safety zones established around installations, the coastal State is obliged to take

all appropriate measures for the protection of the living resources of the sea from harmful agents.¹⁰⁸

The extent of the appropriate measures is not further defined. The intrinsic risk of sea-bed operations and the coastal State's need to ensure that its coasts and local fisheries are not polluted have caused States engaged in exploiting the mineral resources of their continental shelf to regulate the activities with some care.¹⁰⁹ In a United Nations study dealing with the common denominators of States' practice with respect to the development of mineral resources on the continental shelf, it was noted that "in every case reviewed, the countries concerned refer to the relevant stipulations of the Geneva Convention on the Continental Shelf."¹¹⁰ The requirement that "all appropriate measures" be taken to protect the living resources of the sea appears in practice to have been largely interpreted as requiring operators to observe the provisions of "good oil industry practice" and to provide the requisite equipment to stop the flow of petroleum if a blow out occurs, or if there is a break in the well casing or pipeline. While operators are generally liable for damage caused to third parties, provisions relating specifically to the prevention of harmful effects are relatively scanty and only in some of the most recent legislation (most notably in the United States Federal

107. 1958 Convention on the Continental Shelf, Art. 5, para. 1.

108. *Id.* at Art. 5, para. 7. On Apr. 1, 1970, forty-one States were parties to the Convention. Would these provisions, observed by all States exploiting their continental shelf, whether or not parties to the Convention, now constitute part of the general principles of law or a customary obligation?

109. Nevertheless, complaints have been made that States could be more careful than they are. Thus, the permanent representative of Norway, speaking in the First Committee during the twenty-fourth session of the General Assembly questioned whether, as regards the international area, the international community would be satisfied "with certain lax approaches used today in oil drilling by various countries to the effect that the more or less haphazard work manuals of a drilling platform are accepted as the only safety code and anti-pollution code applicable to the oceans of the world." U.N. Doc. A/C.1/PV.1676, Nov. 4, 1969, at 33.

110. Government Measures Pertaining to the Development of the Mineral Resources of the Continental Shelf, U.N. Doc. A/AC.138/21, Jan. 27, 1970, at para. 57.

Regulations introduced on Aug. 18, 1969, following the Santa Barbara incident) are specific requirements included designed to afford protection against pollution. The policy followed by the United States is of special interest in view of that country's extensive experience with marine exploration and its dangers. The fact that the full costs of repairing the damage has been placed squarely with the oil exploiting companies¹¹¹ and that responsibility has been cast by statute in terms of absolute liability,¹¹² are features which other countries may need to consider (the main inhibiting factor being, of course, the heavy cost of insurance, with a consequential slowing down of sea-bed exploitation, unless the State agrees to underwrite any damage caused).

As regards the exploration and exploitation of the mineral resources of the area beyond the limits of national jurisdiction,¹¹³ agreement has not yet been reached as to the nature of the regime which should govern such activities. In the course of discussions in the United Nations Sea-Bed Committee, the question of pollution has been raised and it is possible to discern, in outline at least, the various possible solutions to the issues posed. The Declarations of Principles, adopted on December 17, 1970, states in paragraph 11, that

With respect to activities in the area and acting in conformity with the international regime to be established, States shall take appropriate measures for and shall co-operate in the adoption and implementation of international rules, standards and procedures for, *inter alia*:

(a) Prevention of pollution and contamination, and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment;

(b) Protection and conservation of the natural resources of the area and prevention of damage to the flora and fauna of the marine environment.¹¹⁴

111. Water Quality Improvement Act of 1970, § 11(p)(1), Pub. L. 91-224, 84 Stat. 91 (Apr. 3, 1970).

112. *Id.*

113. *See generally* The Report of the Secretary-General: Marine Pollution and Other Hazardous and Harmful Effects Which Might Arise from the Exploration and Exploitation of the Sea-Bed and the Ocean Floor and the Subsoil Thereof, Beyond the Limits of National Jurisdiction, U.N. Doc. A/7924, June 11, 1970.

114. *See* para. 14 of the Declaration:

Every State shall have the responsibility to ensure that activities in the area, including those relating to its resources, whether undertaken by governmental agencies, or non-governmental entities or persons under its jurisdiction, or acting on its behalf, shall be carried out in conformity with the international

The Declaration is necessarily couched in general language and constitutes an agreed indication of intent rather than a legally precise text. The issues to which further attention will have to be given may, with some compression, be reduced basically to two: (i) whether the operational standards and regulations to be imposed are to be set and enforced nationally or internationally; and (ii) what is to be the substantive content of the rules and procedures to be adopted in order to prevent pollution and to govern liability for damage if pollution should occur. The first issue is closely tied to the fundamental question of the character of future arrangements to be established for the sea-bed. Thus an international body with wide powers might well be given regulatory authority, including authority to adopt and apply measures with respect to the control of pollution.¹¹⁵ If, on the other hand, activities are to be authorized by States (which will bear international responsibility), then the adoption and application of appropriate measures might be a matter for individual governments.¹¹⁶ Perhaps a mixed system may also be envisaged: a "two-tiered" arrangement such as has been suggested,¹¹⁷ whereby concessions are given to States which in turn authorize other entities to carry out the actual operations might be compatible with the application of provisions of national law,¹¹⁸ within the guidelines laid down internationally. According to the basic approach adopted, international standards might be stated in general terms in the agreement establishing the international regime and supplemented by more detailed regulations developed by the administering authority.

regime to be established. The same responsibility applies to international organizations and their members for activities undertaken by such organizations or on their behalf. Damage caused by such activities shall entail liability.

115. See the proposal by a group of Afro-Asian States, contained in the Interim Report of the Economic and Technical Sub-Committee of the Sea-Bed Committee, Annex III, U.N. Doc. A/AC.138/SC.2/L.6, Mar. 24, 1970. The nature of the future international regime would also affect the means of implementation of any rules adopted, an issue which is merely noted here. An international body with wide functions might, for example, be empowered to inspect operations and to impose fines or to take further measures if regulations (including those relating to pollution controls) were not complied with. The United States Draft Convention, *supra* note 114, would provide a full international regulatory mechanism for dealing, *inter alia*, with pollution; see Arts. 1(1), 9-12, 19(2), 23, 27 and 40(j) and (k).

116. See the proposals for study put forward by the USSR, *id.* Annex II.

117. Originally, it would appear, by the Netherlands. See the proposal contained in U.N. Doc. A/AC.135/1, at 23, *cited in* Study on the Question of Establishing in Due Time Appropriate International Machinery for the Promotion of the Exploration and Exploitation of the Resources of the Sea-Bed and the Ocean Floor, Beyond the Limits of National Jurisdiction, and the Use of these Resources in the Interests of Mankind, *supra* note 26 (the Study is annexed to the Report of the Sea-Bed Committee to the Twenty-Fourth Session of the General Assembly, U.N. Doc. A/7622).

118. At least in regard to matters not covered by international regulations (for example, questions relating to criminal law and jurisdiction).

Alternatively, fairly explicit rules could be embodied in the fundamental agreement itself.¹¹⁹ The complexity of the subject matter may also have a bearing on the division of national and international functions; as the United States representative pointed out,¹²⁰ whereas the United States Outer Continental Shelf Lands Act is relatively short, the implementary regulations are many pages in length and are supplemented by regional directives, as well as being frequently revised. Adoption of international measures on a comparable scale would thus be a considerable undertaking and require a high degree of knowledge and expertise in a number of disciplines.

The actual process of adopting regulations and of establishing operating conditions on an international basis may itself perform a useful function, however, not only as a valuable act of multinational co-operation with respect to the major part of the world's surface, but also insofar as it may give States with special interests (most notably those whose chief concern is with fishing) a chance to safeguard their interests other than by recourse to liability procedures after pollution has occurred or, possibly, by prior resort to unilateral action. Iceland, with its natural preoccupation over this issue, has sought to argue that coastal States should be entitled to exercise some measure of control over activities in adjacent waters, including power to approve or disapprove of plans for exploration and exploitation,¹²¹ and the Canadian legislation on Arctic waters specifically embodies such a power, together with other regulatory measures. It will be one of the many questions to be determined whether States will wish to concede such a unilateral right to particular coastal States (beyond at least quite narrow territorial limits), or whether protection of fishing interests (including representation of States such as Iceland) cannot more effectively be incorporated in the international regulation process (if one is adopted).

As regards the actual content of the rules and principles to be adopted, the Legal Sub-Committee of the United Nations Sea Bed Committee has so far chiefly confined itself to discussion, in general

119. See the proposal contained in Annex I, para. 17, U.N. Doc. A/AC.138/SC.2/L.6. It is also possible to envisage the adoption of minimum international regulations (subject either to the consent of State members of the international authority or to the adoption of special conventions) to complement national legislation; see the statement by the representative of France, U.N. Doc. A/AC.132/SC.2/SR.20, Aug. 19, 1969, at 68.

120. U.N. Doc. A/AG.138/SC.2/SR.s9, Mar. 13, 1970, at 11.

121. See, e.g., the statement of the representative of Iceland, U.N. Doc. A/AC.138/SC.2/SR.31, Mar. 17, 1970, at 14, and in the First Committee, U.N. Doc. A/C.1/PV.1678, Nov. 6, 1969, at 46. Reference has been made in this connection to Art. 6 of the Convention on Fishing and Conservation of the Living Resources of the High Seas. Contrary views have also been expressed, however. For a summary see The Report of the Legal Sub-Committee, U.N. Doc. A/7622, Part Two, at para. 72.

terms, of the question of liability.^{1 2 2} On this issue it is possible to argue that liability should be made dependent on fault (such as acting without appropriate operational safeguards or without having obtained authorization), or alternatively, that it should be imposed irrespective of whether there is proof of negligence or wrong doing.^{1 2 3} In favor of the easier requirement would be the arguments that, since the operator would be working at a greater distance from the coast, the danger of pollution of beaches, and perhaps of harm to marine life also would be lessened (although the risk to the safety of those actually working on the installation would increase as the depth and distance from the shore increased).^{1 2 4} Secondly, if liability is made too stringent, operators may be reluctant to attempt to exploit the area. On the other side weighty arguments may be advanced, pointing to the standard of municipal regulations and the danger to other interests (notably fishing) if areas of the sea and sea-bed were to be polluted. Resolution of the issue requires consideration, too, of the scope and nature of the resource concerned and of the technical means of its exploitation. In the case of surficial deposits, such as manganese nodules, although there may be some risk of pollution from the chemicals used during beneficiation, and turbulence caused by the release of debris, these are both dangers which can (provided appropriate regulations exist) be brought under control fairly easily.^{1 2 5} The position with respect to the drilling of

122. The program of work of the Legal Sub-Committee includes the elaboration of legal principles relating to the question of pollution and other hazards, and allegation and liability of States involved in the exploration, use and exploitation of mineral resources in the area beyond national jurisdiction. U.N. Doc. A/7622, Part Two, at para. 5. The matter was particularly discussed during the Third Session of the Sea-Bed Committee, held in August 1969. *Note also* The Declaration of Principles *supra* note 114, para. 11.

123. For a summary of the views expressed see U.N. Doc. A/7622, Part Two, at para. 70. *See also* the statement of the Yugoslav representative, who distinguished between damage to the property of the operator or of the individuals, and that which might be done to the common interest or to the economy of the nearest coastal State. He suggested that the concept of liability for the activities in question should be strengthened to provide not only for compensation but also criminal prosecution of those responsible. U.N. Doc. A/AC.138/SC.1/BR.22, Aug. 22, 1969. Although the proposal for criminal prosecution has a forerunner in the 1884 Convention for the Protection of Submarine Cables (which renders the intentional or negligent breaking or damaging of submarine cables punishable by the appropriate signatory power), it is not evident why the nature of the injury, as having been done to the common interest, should of itself justify criminal proceedings, except possibly in the case of intentional or negligent acts—but these are not those most likely to occur.

124. On this aspect (and generally) see the statement of the United States representative in the Economic and Technical Sub-Committee, U.N. Doc. A/AC.138/SC.2/SR.5 Mar. 17, 1969.

125. Intensive dredging in particular areas, equivalent to strip mining, could do long lasting damage to marine flora and fauna. *See* the criticism expressed over a proposal to mine 5.2 million acres off the Bahamas for aragonite (a pure form of calcium carbonate). N.Y. Times, Apr. 6, 1970, at 41, col. 1. The fact of the matter is that no one knows at present what the effect of such undertakings may be. The Bahamaian venture may become

petroleum deposits is more complicated. The cost of marine drilling increases with the depth of water, and in order to provide economies of scale which will make the venture profitable, the offshore deposits which are exploited tend, on average, to be larger than those exploited on land, and may need to be larger still to justify exploitation at greater depths than is now undertaken.¹²⁶ Since at the present time it would be hard to deny that marine drilling techniques are in advance of means for restraining or removing oil pollution if a blow out or other incident occurs, the conclusion is reached, in the words of the United States delegation, that "the chance for accidents of massive proportions in this environment is a very real one."¹²⁷ In the case of marine exploitation of oil, States may accordingly need to give careful consideration to the adequacy of operational procedures (including the process by which the adequacy of such procedures is to be determined—which goes back to the fundamental question of the nature of the institutional arrangements to be made for the sea-bed) and to the adoption of suitable provisions with respect to liability. In keeping with the risk that accidents may occur which result in large-scale damage, the suggestion has been made that insurance or financial security should be required to cover such eventualities and that the activities of would-be operators should be made dependent on their participation in an insurance fund.¹²⁸ The suggestion thus neatly parallels the arrangements proposed with respect to accidents on a similar scale involving oil tankers. Others have proposed that States should be responsible for the national activities they authorize.¹²⁹ The two approaches could be combined, as in the 1969 Private Law Convention with respect to tankers: it could be made a condition of the international arrangements to be agreed upon for the sea-bed that individual operators

the largest operation for the exploitation of marine hard minerals so far undertaken. See Wang and Cruickshank, *1 Technologic Gaps in Exploration and Exploitation of Sub-Sea Mineral Resources*, 1969 Offshore Technology Conference, OTC Paper 1031, at 285, 291, where it is pointed out that knowledge of the effect of dredging and associated processes "on the benthonic biological regimes and their susceptibility to environmental changes is almost completely unknown."

126. Dep't Int., U.S. Geol. Survey, McKelvey and Wang, *World Subsea Mineral Resources, A Discussion to Accompany Miscellaneous Geologic Investigations Map 1-632*, 2d printing, at 9 (1969).

127. Working paper presented by the United States, Annex IV, at para. 9, U.N. Doc. A/AC.138/SC.2/L.6.

128. See the list of topics for study suggested by certain States, *id.* Annex I, at para. 19. And what would be the ceiling of liability?

129. Proposals for study put forward by the USSR, *id.* Annex II, at para. 1. Para. 11 of the Declaration of Principles begins with the assertion of the responsibility of States for the acts of those under their jurisdiction, but then qualifies this by reference to the international regime to be established. The matter thus still stands open.

should have adequate insurance coverage or a financial security in lieu, either from a private, governmental, or international source (or from all or several of these, in the event of a multinational venture).

As regards the particular interests to be protected, the danger to the nearest coast would be reduced as the distance from the shore increased. In principle, however, coastal States would be entitled to recover for such damages as they might suffer within their boundaries by reason of accidents occurring in the international zone. Navigation would be relatively little affected.¹³⁰ The main economic interests which would need protection are those of other mineral exploiters, who might be forced to suspend their operations,¹³¹ and of course, those of persons or States engaged in fishing. If the latter could demonstrate a decline in the size of their catch due to oil pollution, or a drop in sales, it would be difficult to deny a claim for recompense. Besides these considerations relating to specific interests, there is also the question of overall environmental protection. Even if the chances of a catastrophic accident are set aside, there may be a need to guard against a gradual deterioration in the marine environment brought about by activities continued over a period of years.¹³² As in the case of the other pollutants, the establishment of international means to observe and report on the state of the seas would help to prevent such an eventuality, independently of the position (essentially the security of reparation and participation in the regulatory process) granted to particular economic interests.

III

INTERNATIONAL PROPOSALS AND DISCUSSIONS

This section is intended as a brief summary of the proposals which have recently been made or discussed by international bodies with respect to the problem of marine pollution.

130. From accidents, that is. The need for ships to receive information with respect to the site of drilling installations, and the institution of shipping lanes, is a separate issue now being handled by IMCO; see IMCO Res. AVI/Res.180, Oct. 28, 1969.

131. Assuming that strict liability was generally applied with respect to oil pollution caused by mineral exploitation, arguably mineral operators should receive compensation only in the event of intentional or negligent conduct on the part of a neighboring operator. (This idea is derived from certain suggestions put forward by Goldie, *Liability for Damage and the Progressive Development of International Law*, 14 Int'l Comp. L.Q. 1189 (1965), with respect to accidents between space vehicles). However, what about damage to marine operators engaged in activities within national jurisdiction, caused by operations in the international area, or vice versa? The complications appear endless.

132. This would appear to be at least as likely to occur as a result of intensive dredging, conducted continuously, as through the occasional escape of oil following drilling; the fact that both activities may be conducted at the same time, on an ever larger scale, increases the need that appropriate safeguards be adopted in due course against the possibility of a gradual deterioration in the marine environment.

In 1969 the Intergovernmental Oceanographic Commission (IOC) completed the preparation of its proposed long-term and expanded program of oceanographic research,¹³³ which includes a series of projects relating to marine pollution. Having noted that "the levels achieved by some pollutants in some parts of the ocean are already a matter of deep public and scientific concern, and dangerously high levels may be imminent with respect to others," the Commission emphasized that "[I]ssues or impairment of use through contamination may only be prevented by rational policies based on research and monitoring." For this to be effective all pollutants, whatever their source, would need to be monitored, and eventually, so far as possible, controlled. At the same time detailed investigations should be made of the complex effects of each type of pollutant. The Commission therefore proposed a number of scientific projects, including the establishment of a world wide system of monitoring of the constituents of marine pollution,¹³⁴ designed to lead (together with the other inquiries conducted) to the preparation of periodic, comprehensive reports on the health of the oceans. These reports "would review the state of the ocean and its marine resources as regards pollution, and forecast long-term trends to assist governments individually and collectively to take the steps required to counteract its effect." No specific proposals are made with regard to the means by which the suggested world-wide system of monitoring might be conducted. Elsewhere in the IOC program, however, a description is given of the Integrated Global Ocean Station System, which is being developed in conjunction with World Weather Watch [operated by the World Meteorological Organization (WMO)], to provide oceanographical and meteorological information and to facilitate understanding of the interaction between the oceans and the atmosphere. The Integrated Global Ocean Station System is arranged on a basis of voluntary participation whereby States provide facilities and staff to operate fixed and mobile observing stations, the necessary co-ordination being supplied by IOC in collaboration with WMO. At a more advanced level of co-ordinated inquiry, IOC has also proposed the

133. This arose out of the request by the General Assembly, in Res. 2467 D (XXIII), Dec. 21, 1968, that IOC cooperate with the Secretary-General of the United Nations in the preparation of the comprehensive outline of the scope of a long term program of oceanographic research. The program was drawn up following a series of inquiries and meetings, in particular of a joint working party nominated by the Scientific Committee for Oceanic Research, the Advisory Committee on Marine Resources Research and WMO. The program is contained in U.N. Doc. A/7750, Nov. 10, 1969, from which quotations are taken.

134. This would comprise "the collection of samples from various environments and biota, their submission and analysis at analytic centers, the transmission of the results of analyses to oceanographic data centers and the evaluation, interpretation and publication of the results on a regular basis." *Id.* project 3.7.

adoption of a convention which would establish uniform rules for the deployment of ocean data acquisition systems (ODAS), which would make available further information about the characteristics of the environment of the oceans.¹³⁵

IOC does not itself have funds and institutional means instantly at its disposal to carry out the projects described. The long-term and expanded program represents an agreed list of desirable items drawn up by experts in order to show what is required scientifically, in the hope that Governments and others will then provide the financial and material support to enable the requisite knowledge to be obtained. One of these means, so far as marine pollution is concerned, is to be found in the Joint IMCO/FAO/UNESCO/WMO/WHO/IAEA Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), which was established in 1969. At its first session in March 1969,¹³⁶ the Group agreed to identify certain main categories of pollutants and to establish research priorities with respect to them. The Group pointed out, *inter alia*, that, if the effects of pollutants are to be measured effectively, a norm must be established by which changes in the environment itself can be measured, and for this a high degree of monitoring will be required. In the case of the dumping of various materials, particularly radioactive substances, petrochemical and other chemical wastes and pesticides, the Group noted the view expressed by an earlier IOC working group, that a measure of international control should be introduced by means of the registration of the activities in question, and suggested that further efforts should be made to establish the exact categories of pollutants to be brought under international control by such means. With respect to the information system relating to marine pollution, the Group distinguished two problems, besides that of the registration of deliberate or accidental discharges or spillages: the collection of pertinent environmental data (the essential need here being to ensure that all relevant data are deposited in, or known to, the World Data Centres for Oceanography and, as appropriate, specialized data centres such as those maintained by the International Council for the Exploration of the Sea and by FAO); and information about scientific documentation (the priority need under this heading being for a good reference retrieval system—marine pollution is already

135. See, e.g., Summary Report of the Third Meeting of the IOC Group of Experts on the Legal Status of Ocean Data Acquisition Systems, U.N. Doc. SC/I/C.EG-1/7, Dec. 20, 1969. The proposal remains under discussion. This work, aimed essentially at defining the legal status of ODAS and protecting them from depredation, has been done in collaboration with IMCO and will be examined by a conference of governmental experts to be convened by UNESCO and IMCO in February, 1972.

136. Report of Second Session, *in particular*, Annexes V and VI, GESAMP II/11.

covered, at least in part, in at least nine English language abstracting and bibliographic periodicals, and by some in other languages).

Since GESAMP's first session in March 1969, the problems relating to ocean monitoring have been further examined, both by GESAMP itself and by an expert group advising IOC on its long-term and expanded program of oceanic research.¹³⁷ The more extensive consideration of the matter which has been undertaken has served to evidence the very considerable scientific and technical difficulties in the way of simply instituting a system (or series of systems) of ocean surveillance. Although the task can be carried out, it cannot be done easily; a large amount of preliminary work will have to be done first. This was brought out by the 1970 Study of Critical Environmental Problems¹³⁸ and at the Technical Conference on Marine Pollution and its Effects on Living Resources and Fishing, held by the Food and Agriculture Organization (FAO) in December 1970. This Conference, and the Seminar which preceded it, resulted in the most comprehensive examination so far made of the scientific aspects of pollution as it affects the flora and fauna living in the seas, and of the problems involved in attempting to measure both the existing state of the seas ("base line studies") and changes in that state.

Whereas the activities of IOC and FAO concern the scientific investigatory aspects or the effects upon living resources respectively, the work of IMCO has been concerned primarily with the prevention and control of ship-borne pollution. In addition to the 1962 and 1969 amendments to the 1954 Convention, and the two 1969 Conventions, drawn up within the framework of IMCO, an international conference will be convened by IMCO in 1973 "for the purpose of preparing a suitable international agreement for placing restraints on the contamination of the sea, land and air by ships, vessels and other equipment operating in the marine environment."¹³⁹ The subjects

137. Report of First Session of the IOC Group of Experts on Long-Term Scientific Policy and Planning (GELSTAP), Section Concerning Marine Pollution, U.N. Doc. SC/IGC-Inf. 171, Dec. 4, 1970.

138. Issued under the title, *Man's Impact on the Global Environment*, *supra* note 7. The Study was produced by some forty scientists and others who met in July, 1970, for an intensive, one month interdisciplinary examination of the complex problems (including ocean pollution) coming under that heading. The results of their work are likely to provide much of the intellectual motor for endeavors in this field for some time to come. The *carry over* (in part of individuals, but in considerable part also of ideas) at the FAO Seminar and FAO Technical Conference, for example, is marked, and influence on the 1972 Conference on the Human Environment (to aid which the Study was made) may also be expected.

139. IMCO Assembly Res. A 176(VI), Oct. 21, 1969. The expression "other equipment" has been defined by the IMCO Maritime Safety Committee to include pipelines from drilling rigs and platforms for conveying gas or oil to the shore, but excluding pipelines from shore installations. IMCO Doc. OP VIII/6.

under consideration for the Conference are: deliberate dumping by ships and barges; operational discharge from ships; accidental release from ships and submarine pipelines; and exploitation of sea-bed mineral resources.¹⁴⁰

The United Nations itself has been concerned with the problem of marine pollution from various standpoints, including that of providing co-ordination of the activities of all United Nations agencies concerned with marine affairs. The Administrative Committee on Co-ordination established a sub-committee on marine science which, in 1966, sent a questionnaire to member States on the subject of marine pollution. The replies received were incorporated in a comprehensive survey of activities in marine science and technology, prepared by the Secretary-General,¹⁴¹ in accordance with the terms of General Assembly resolution 2172 (XXI) of December 6, 1966. Having considered this report at its twenty-third session held in 1968, the General Assembly endorsed the concept of a co-ordinated long-term program of oceanographic research, which IOC has since prepared, and invited member States and organizations, especially IMCO and IAEA, "to promote the adoption of effective international agreements on the prevention and control of marine pollution as may be necessary."¹⁴² At the same session the General Assembly adopted resolution 2467 (XXIII) relating to the international area of the sea-bed, part B of which dealt with possible marine pollution.¹⁴³ In operative paragraph 1 of resolution 2467 B (XXIII), the General Assembly welcomed "the adoption by States of appropriate safeguards" against the dangers of pollution and other hazards which might arise from the exploration and exploitation of sea-bed resources beyond the limits of national jurisdiction, "notably in the form of concrete measures of international co-operation." In operative paragraph 4 of the same resolution, the Secretary-General was requested to undertake a study "with a view to clarifying all aspects of protection of the living and other resources of the sea-bed and ocean floor, the superjacent waters and the adjacent coasts

140. Report of IMCO Sub-Committee on Marine Pollution, 8th Sess., OP VIII/II, Sept. 15, 1970.

141. Marine Science and Technology: Survey and Proposals, U.N. Doc. E/4487 Apr. 24, 1968. Parts I E, II A 2 and 3, and III D, together with Annex XIV, deal with various aspects of pollution and describe existing practices in relation to pollution and its prevention. The report also gives information, in Annex XI, paras. 153-73, of the relevant activities up to that date of IAEA.

142. G.A. Res. 2414 (XXIII), Dec. 17, 1968.

143. Part A of Res. 2467 (XXIII) established the United Nations Sea-Bed Committee, whose consideration of the question of marine pollution arising out of mineral exploitation was previously referred to.

against the consequences of pollution and other hazardous and harmful effects" arising from the exploration and exploitation of resources beyond the limits of national jurisdiction.¹⁴⁴

In addition to these specific proposals, at its twenty-third session the General Assembly also adopted resolution 2398 (XXIII) of December 3, 1968, providing for the convening, in 1972, of a United Nations Conference on the Human Environment. In 1969 the General Assembly, having referred to this Conference and those proposed by IMCO and FAO, and IOC's expanded program of oceanographic research, requested the Secretary-General

... in co-operation with the specialized agencies and intergovernmental organizations concerned, to complement reports and studies under preparation, with special reference to the forthcoming United Nations Conference on the Human Environment, by:

(a) A review of harmful chemical substances, radio-active materials and other noxious agents and waste which may dangerously affect man's health and his economic and cultural activities in the marine environment and coastal areas;

(b) A review of national activities and activities of specialized agencies of the United Nations and intergovernmental organizations dealing with prevention and control of marine pollution including suggestions for more comprehensive action and improved co-ordination in this field;

(c) Seeking the views of Member States on the desirability and feasibility of an international treaty or treaties on the subject.¹⁴⁵

In the course of preparations for the Conference on the Human Environment, further reference has been made to the possibility of international monitoring of environmental conditions. In his initial report¹⁴⁶ the Secretary-General pointed out that while several existing or planned international research programs (in particular World Weather Watch¹⁴⁷ and the International Hydrological Decade) provide an institutional basis for monitoring, there is as yet little international agreement on the methodology to be used. In meetings of the Preparatory Committee for the United Nations Conference on the Human Environment, held during March 1970, attention was drawn to the way in which national and regional monitoring systems

144. Marine Pollution and Other Hazardous and Harmful Effects Which Might Arise from the Exploration and Exploitation of the Sea-Bed and the Ocean Floor and the Subsoil Thereof, Beyond the Limits of National Jurisdiction, Rep. of the Sec. Gen., U.N. Doc. A/7924, June 11, 1970.

145. G.A. Res. 2566 (XXIV), Dec. 13, 1969.

146. Problems of the Human Environment, U.N. Doc. E/4667, May 26, 1969, at para. 59.

147. Described *id.* Annex F.

might participate in international monitoring arrangements and also, to an aspect which has as yet been relatively little considered in relation to marine pollution, namely the effect, in economic terms, of the introduction of pollution controls on different countries, in particular the possibility that such controls might place developing countries at a further disadvantage in their efforts at industrialization. In the course of subsequent meetings of the Preparatory Committee further consideration has been given to the methodological problems involved in instituting monitoring or other regulatory systems within an agreed overall framework. Having regard to the number of organizations concerned with international aspects of marine pollution, and the decision of the General Assembly to call a conference on the law of the sea in 1973, which will deal both with the establishment of an international regime (including machinery) for the international area of the sea-bed and with "a broad range of related issues" including the prevention of pollution,¹⁴⁸ it is apparent that attention will also have to be given to ensuring that the objectives and functions of the various bodies are effectively co-ordinated. Of the three international Conferences which have been announced, that on the Human Environment in 1972, on the Law of the Sea in 1973, and the third to be called by IMCO, also in 1973, the division of responsibilities in this area may be broadly expressed as follows: whereas the 1972 Stockholm Conference may be expected to lead to the adoption of a Declaration on the Human Environment and to provide the political consensus and guidelines for future action in specific areas,¹⁴⁹ it will in all probability devolve on other bodies to work out the full array of legal texts (including adjustments of existing law) which technological advances and the need to adopt a more conscious approach towards environmental management will require. The 1973 Conference on the Law of the Sea, and the IMCO Conference may be expected to help in this respect, the former dealing with the fundamental issues to be resolved with regard to the law of the sea (in particular the question of the limits of areas of national and extra-national jurisdiction and the

148. G.A. Res. 2750 C (XXV), Dec. 17, 1970.

149. It may be noted that at its second session (Feb. 8-19, 1971) the Preparatory Committee decided, *inter alia*, to establish two intergovernmental working groups, one on marine pollution and the other on environmental monitoring. The working group on marine pollution will report on: (i) the extent to which general guidelines and criteria can be established; and (ii) specific actions which might issue as regards, (a) particular substances, (b) an appraisal of international arrangements, in particular those on a regional or sub-regional basis, and (c) an appraisal of the action which the Conference might take to improve the enforcement of existing instruments and to encourage the implementation of further instruments in this field. Rep. Prep. Comm., 2d Sess., A/CONF.48/PC. 9, at para. 42.

form of regime to be applied to the latter area), and the IMCO Conference assisting in providing the more technical body of legal regulation which will be needed.

IV

A PATTERN OF NEEDS AND OF POSSIBLE SOLUTIONS

There is general agreement that some degree of international action is now required with respect to marine pollution.¹⁵⁰ The matter has to be assessed on an international basis, and decisions reached on what is to be done. Thus the difficulty is to devise a series of measures of prevention and control which will be both adequate to the task and acceptable to the community of States. While the difficulty appears, when put in those terms, a truism scarcely worth recording, it serves to focus attention on the fact that much will depend on the way in which States now perceive and evaluate the problem. If it is decided to treat marine pollution as part of a wider concern for the maintenance of the environment as a whole, then comprehensive steps are more likely to be envisaged, and in general, a more radical approach adopted as regards existing procedures. If, on the other hand, marine pollution is regarded as a marginal issue which has not yet crossed the threshold of serious danger, attention is likely to be focussed on protection of immediate economic interests, and marine pollution will be treated (as it has been so far) as a series of particular hazards and receive a series of specialized solutions. This division, between an overall and sectional approach to marine pollution can be overdrawn; a golden compromise can, and perhaps will, be arrived at. Nevertheless it presents itself very near the outset as a fundamental issue to which States will have to address themselves; the importance in this context of scientific evidence and of the need for strong scientific reasons to justify any major innovations does not require comment. In order to place the issue in its full setting, attention should be drawn to the fact that a similar choice is presented, or is about to be presented, in a number of sectors of the law of the sea: the future status and regime of the international area of the sea-bed, the development of mineral resources, the rapid increase in fishing, and the impending changes in means of marine transport, will all require major reassessment to be made of existing maritime law within the relatively near future. The question which presents itself is, at what stage should this be done and what institutional changes should be made? If, by reason of the factors just

150. In the words of the Secretary-General, "[I]nvestigation and control of marine pollution . . . is a matter on which international action on both regional and global scale is now becoming urgent," U.N. Doc. E/4487, Apr. 24, 1968, at para. 278.

indicated, or because of their sheer accumulation, it was decided to make some change on a fairly large scale in the law of the sea and its institutions, then almost certainly the case would be strongly presented for an overall approach to be adopted with respect to pollution and for the devising of a single system of pollution surveillance and control.

Meanwhile, it is necessary to continue to regard marine pollution as a separate issue, with its place in the total scheme of future marine affairs still to be determined. The problems involved can be grouped under three broadly distinct, though related, headings: (1) the need for scientific study, on a regular basis, of the state of the oceans, as part of the environment, and of the exact effects of pollution; (2) the establishment of various technical and regulatory means for the prevention and control of different forms of pollution having their origin in separate human activities; and, (3) the problem of liability if the pollution due to specific activities causes damage to others.

As regards the first function, it would appear unassailable that means must be devised to increase knowledge of the seas and of the consequences of the release, accidental or deliberate, of foreign substances into the seas. The oceans form so large and important a part of the world that surveillance of the environment (with all that that implies with respect to weather control and forecasting, the understanding of physical laws, and the preservation of human existence) can only be conducted on a basis which includes the marine zones. Furthermore, only by conducting inquiries which encompass the entire environment, including the oceans, will it be possible to distinguish between the effect on the one hand, of human activities which may lead to marine pollution and, on the other, that of the operation of natural phenomena which may produce a deterioration in marine conditions. Lastly, only a comprehensive scheme will enable accurate determination to be made of the consequences of particular pollutants. The work of IOC in seeking the establishment of the Integrated Global Ocean Station System, together with World Weather Watch, and other suggestions which have been made¹⁵¹ relating to various institutional means of monitoring the environment, are all founded on the need, scientifically speaking, to establish the natural parameters of the environment, in order to measure

151. *E.g.*, for a global network which would monitor changes in the earth's environment, such as those caused, *inter alia*, by pollution. This proposal was considered by the Congress of the International Biological Programme, held in September 1970. The creation of an international environmental agency has been proposed by Baxter, at the Columbia University Conference on International and Interstate Regulation of Water Pollution, Mar. 13, 1970, and by Kennan, *To Prevent A World Wasteland: a Proposal*, 48 Foreign Affairs 401 (Apr. 1970).

the scale of such changes as man may wish to impose, and to guard against the possibility of a gradual (as well as a sudden) deterioration in existing conditions. All of these projects have as their characteristic that, to operate effectively, they must eventually be global in scope and scientifically inclusive in the range of their inquiries. The division between national and international mechanisms required to operate such systems has yet to be determined. To some extent the means at our disposal, such as space satellites,¹⁵² reduce the need for scientists on the ground or in the water, but national co-operation, through the assistance of scientists in different countries, the compilation of information on national practices (for example, waste disposal statistics) and the reporting of accidental or deliberate discharges, etc., may be regarded as an essential component of any monitoring and information system likely to be adopted.

The operation of an ocean surveillance system (however organized in its details) will be of importance to, though functionally distinct from, the adoption of technical and regulatory means for the prevention and control of pollution caused by specific human activities. The information provided by the surveillance system will indicate the degree of urgency (or otherwise) with which action may need to be undertaken, as well as of the exact impact of particular pollutants on the marine environment (a matter affecting the question of liability also). Nevertheless enough is already known for there to be a number of areas in which technical measures can be taken, and where a start has already been made. In the case of waste disposal (whether of normal coastal wastes or of radioactive materials) the matters to be considered range from the siting of industrial plants and the incorporation of waste disposal and anti-pollution devices at source, to the means of disposal to be used and local conditions in the disposal area. The possibility of ship-borne pollutants and of pollution as a result of mining activities raise technical questions of a different character, concerning methods of ship construction, the training of personnel, the method of loading cargoes or of operating drilling or dredging machinery, the establishment of navigational rules and procedures, and the reporting to the appropriate authorities of accidental or deliberate discharges of oil. Each of these concerns is at the present time receiving attention from various specialized bodies, whether national, international or industrial, and it may be presumed that such efforts will continue (as well as inquiries into ways of

152. See Sherman, *Space Craft Oceanography—Its Scientific and Economic Implications for the Next Decade*, 1 *Space Exploration and Applications* 645 (U.N. 1969) and *Development of Natural Resources: Natural Resources Satellites*, Rep. Sec. Gen., E/4779, Feb. 4, 1970.

combatting pollution once it has occurred), whatever institutional changes may be made.

Technical measures of this nature may be distinguished from more direct regulatory arrangements. In the case of pesticides, and various other substances which result in atmospheric pollution or in marine pollution via the atmosphere, there may be limitations on the nature of the controls which can be introduced. Where, as in the case of pesticides spread on the ground or lead added to petrol, the pollutant cannot be recaptured, the choice is either to find an effective substitute or to discontinue the use of the substance, or as an intermediate step, to reduce the quantities involved by determining which, among a number of purposes, the international community regards as the most valuable. Regulatory systems, other than on a prohibitory or reduction basis, may be introduced in other areas, however, besides actual technical means of preventing pollution. Ocean dumping, for example, could be controlled or supervised in a number of ways including, as has been suggested, a system of registration. Conditions in particular areas, notably shallow enclosed or semi-enclosed seas, may well lead to the adoption of regional arrangements on the part of neighboring States, more stringent than those which may be advocated on a world-wide basis.

Arrangements of this nature would apply with respect to deliberate acts of waste disposal (including disposal of radioactive wastes) coming from the land. The discharge of oil in the course of routine ship operations has already received a measure of regulation by international agreement, and the remaining question here would be whether any further enforcement measures may prove necessary. As regards mining operations, it may be presumed that national safeguards will continue to apply with respect to operations in areas under national jurisdiction; the adoption of pollution controls on a national or international (or mixed) basis as regards mining activities in the international area will depend to a large extent on the form of machinery which is established to regulate such activities—an issue which will be determined on a wider basis than that of pollution alone, and it is only when this question has been settled that the pattern and substantive content of the regulations concerned will finally emerge.

While a system of international, as well as national, registration may be applied with respect to the disposal of radioactive wastes (a separate issue, it may be pointed out, from the monitoring of the seas as regards radioactivity), in this instance the possibility exists (however remote) of the occurrence of a catastrophe, namely the sudden infliction of harm on a wide scale, as opposed to the gradual

deterioration of marine conditions, the main danger presented by routine acts, whether of dumping of coastal wastes or of ordinary mineral exploitation. In this respect the situation as regards the dumping of radioactive wastes has some features in common with that in respect of bulk carriers or mining operations, which also involve the possibility of large-scale accidents. In these instances the question of liability has therefore to be considered, if only as an eventuality, as well as that of the day-to-day regulation of the activity itself. The solution adopted with respect to accidents involving oil tankers has been described in the text. A solution along similar lines with respect to other dangerous bulk cargoes appears probable, and a financial guarantee or insurance fund requirement may well form part of future arrangements for the international area of the sea-bed. In general, however, the question of liability, important though it is (and will surely always remain), will be only one, and not necessarily the most significant, among the means whereby marine pollution is controlled. The problem of the adoption of suitable forms of control of marine pollution proves on examination to be extremely complicated, with a host of scientific, technical, economic and legal ramifications. While the international community is unlikely to adopt overnight the principles of a managed universe, the issue of liability may tend to shrink in importance by comparison with an emerging body of regulatory law, and be determined, in practice, by information derived from scientific inquiries and a monitoring system operating on an international basis.

In summary, therefore, it is suggested that the problem of marine pollution should be regarded from a triple standpoint:

(i) As part of the need for the protection and observation of the environment as a whole—a need which requires the eventual adoption of measures on a world-wide basis, within the framework of agreed scientific programs of inquiry.

(ii) The adoption of (a) technical, and (b) regulatory, means of control with respect to various human activities which may give rise to major instances of marine pollution—a range of means extending from operational procedures, on which many different agencies are working, according to the nature of the subject-matter, to the adoption of various institutional arrangements, whether on a universal or a regional basis, and including in all probability a large degree of national activity and co-operation within the mechanism of a number of international agreements.

(iii) Recourse to agreed principles of liability and reparation to cover specific items of damage established, at least in part, by the scientific means referred to above, and subject to the conditions (such as channelling of responsibility to a single party and ceilings on the amount of maximum financial liability) laid down by treaty.