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Freedom for Science in the Oceans

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"Americans," wrote de Tocqueville in 1835, "judge that the diffusion of knowledge must necessarily be advantageous and the consequences of ignorance fatal" (*1*). No less true today, this characterization perhaps helps explain the astonishment with which most American oceanographers have reacted to the efforts of developing countries to curtail their freedom to conduct scientific research in the oceans. The response of our marine scientists has been to base their defense of this freedom largely on the intangible but deeply felt conviction that "the quest for knowledge about the oceans is a universal right not to be abridged by national restrictions" (*2*, p. 1). The comparatively few efforts that have been made to reply to the often well-articulated contrary views of the developing countries tend to stress the economic and social benefits that accrue from unrestricted basic research. This argument has proved less than convincing to countries whose mistrust of science is based on the belief that its benefits (which they do not question) are limited to the wealthy few possessing the technology to exploit its findings. For, not surprisingly, the growing tension that exists between the developed and developing countries has become a factor in the debate within the United Nations over freedom for science (*3*).

Since 1945, the area of the ocean known as the "high seas" has been steadily eroded by coastal states' expanding their claims of jurisdiction. More recently, the legal doctrine of freedom of the seas, which historically has applied beyond the limits of national jurisdiction, has come under increasing attack by states calling for the establishment of some form of international authority to regulate on behalf of the international community activities under and on the high seas. These pressures for change, exerted primarily by the developing countries, have led the U.N. General Assembly to call for a new Law of the Sea Conference to begin in 1973. A 90-nation "Committee on the Peaceful Uses of the Seabed and Ocean Floor Beyond the Limits of National Jurisdiction" (known simply as the Seabed Committee) is currently engaged in negotiations preparatory to the conference.

Almost inevitably, the result of the 1973 conference will be that substantially more, if not all, of the ocean space will fall under some form of national or international jurisdiction. The extent of the jurisdiction exercised in the various areas of control that develop will be a matter for negotiation, and freedom for science will certainly be one of the more controversial bargaining points. If science is to continue with a minimum of regulation, the opponents of controls will have to approach these negotiations with more than impassioned pleas for total freedom. Their case will have to be built on a realistic assessment of what can be achieved in view of the prevailing political climate, and they will have to bring something to bargain with in terms of specific proposals aimed at meeting the objections of those who seek to restrict or prevent science in their areas of jurisdiction. Above all, they must be flexible enough to adapt their position to changes in the legal doctrines that justify actions within the ocean.

Freedom versus the Common Heritage

The 17th-century doctrine of freedom of the seas provided the basis for all law of the sea for nearly 300 years. The preeminence of this doctrine was challenged in 1970, when the U.N. General Assembly declared the seabed and its resources beyond the limits of national jurisdiction, to be the "common heritage of all mankind" (*4*). To implement the concept of common heritage will require different legal arrangements than would prevail if the seabeds remained under traditional law. The comparisons in the box on page 17 illustrate these differences.

The Attack on Freedom

The dissatisfaction of developing countries with traditional law of the sea was evident at the 1958 Law of the Sea Conference (*5*). The acceptance of the common heritage concept 12 years later provided a basis for a legal system more compatible with their interests and has led to attacks of increasing frequency on the doctrine of freedom of the seas.

Freedom of the seas evolved into accepted law during a period when the major European nations were beginning to develop sizable merchant fleets. The origin of this concept in 1609, as a counterclaim to the Pope's division of the ocean between Spain and Portugal, has not been lost on the developing countries, who correctly contend that international law is only valid as long as it reflects the interests of the majority of the international community. Freedom of the seas, they argue, met this test as long as the oceans were regarded primarily as avenues for commerce. The principle has become increasingly obsolete as traditional uses of the sea have been expanded and other uses have emerged. Moreover, some have contended that no principle can be held as binding on states that did not even exist during the period in

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which it became accepted international law.

The developing countries thus maintain that there exists today a need for new legal arrangements governing the uses of the sea—arrangements guaranteeing them access to the ocean resources, which are the common heritage, but which de facto are denied to all but the developed countries under the existing concept of freedom of the seas. This point was effectively presented to the U.N. International Law Commission by the Ecuadorian delegate, who argued that "the alleged equality of all states with respect to their rate of access to the high seas and their right to exploit its resources is somewhat illusory, because only the great maritime and shipping powers exercise this right on a really large scale. Thus, the exercise of this right depends on economic power, and equality before the law loses all reality in the face of the economic inequality of states" (*6*, p. 21).

The doctrine of common heritage meets this objection by providing that a state's right to share in seabed resources is not dependent on its economic power. The Seabed Committee has accordingly been charged with designing an International Seabed Authority (ISA) for the purpose of ensuring the equitable distribution of profits from seabed resources among the international community. A major problem in this effort has been the inability to agree on the limits of the geographical area in which the common heritage concept is to apply.

Developing countries have, by and large, argued with equal fervor for both the common heritage and the right to wide areas of national jurisdiction over ocean space. Their critics have been quick to point out that such national claims remove from the area of the common heritage most of the known seabed resources. This criticism has not yet moved the developing countries to reconsider their position, nor is it likely to, since it has yet to be shown that in the short term a coastal state will profit more from the international management of seabed resources than it would from outright ownership of its adjacent continental shelf. Thus, from the perspective of most poor countries, the most advantageous bargaining position is to claim ownership of their shelves and use the vehicle of common heritage to secure a share in whatever resources lie beyond.

This position portends ill for science. If it prevails, it promises: (i) the creation of a strong ISA with broad powers to regulate activities on and under the high seas and (ii) expanded national jurisdiction over ocean space now considered high seas.

The Functions of the ISA

In general, the developing countries have maintained that the ISA should have broad powers to regulate activities (including scientific research) within the area of its jurisdiction (*7*). The developed countries argue that the ISA's functions should be limited to granting leases to mining rights on the sea floor and levying taxes on any resources recovered, with the proceeds being used to support projects of benefit to the international community. The traditional concept of freedom of the seas would remain applicable to all activities not specifically conceded to the ISA.

This apparently procedural dispute reflects the more fundamental disagreement over the legal basis for activities within the ocean. Underlying the position of the developing countries is the assumption that common heritage has replaced freedom as the basis for all law of the sea. The ISA, by virtue of its common heritage mandate, thus acquires at least potential jurisdiction over all activities formerly considered free.

The preference of developed countries for an ISA of strictly limited jurisdiction assumes that the two legal doctrines can coexist. The United States in particular reflects this attitude. The United States was among the first countries to endorse the concept of seabed resources as the common heritage of mankind and to call for the establishment of an international authority to oversee exploitation (*8*). At the same time, the United States has continued in its support of the principle of freedom of the seas, particularly as this freedom relates to navigation, overflight, and (with a much lower priority) science. By so doing, it perpetuates an ambiguity introduced originally in 1945, when President Truman claimed for the United States ownership of all seabed resources on its adjacent continental shelf out to a water depth of 200 meters. Then, as now, the United States held to a territorial sea of 3 (nautical) miles in the interest of maximum freedom for navigation. Thus the effect of the Truman Proclamation was to claim jurisdiction only out to 3 miles on the ocean surface, while at the same time claiming far more extensive jurisdiction on the ocean floor. How to exercise jurisdiction on the ocean floor without exerting some control over the water column above has never been made entirely clear.

This question ceases to be theoretical in the case of the proposed ISA. Any lease the ISA grants on the sea floor will inevitably result in some form of mining activities on the sea surface. Large-scale seabed mining, legal by virtue of the common heritage principle, may impede or prevent other, more traditional uses of the ocean still justified on the basis of freedom. When this does occur, no clear way exists to evaluate the relative merits of the two competing activities, since each claims rights arising from a different legal concept.

Priorities among mutually exclusive uses can only be established if some common standard for comparison applies. When, as is the case with traditional law of the sea, all peaceful uses are presumed free, no such standard is provided. The rather crude criterion of "unreasonable interference" developed because conflicts have occasionally occurred. But the concept of freedom, as its name implies, remains predicated on the assumption that such conflicts will be the exception and that they can be easily resolved in view of the vastness of the ocean and the limited number of activities it supports. However, as activities increase and the apparent size of the ocean decreases, there arises a need for more precise standards than those provided by "unreasonable interference" to establish the optimum balance among activities. The common heritage concept permits uses to be ranked by the degree to which they serve the common heritage, or, alternatively, by the degree to which they do not impede it. The latter is perhaps the better test, since there are many uses which benefit the user and neither help nor harm anyone else.

There obviously can be no universally applicable ranking of activities. Priorities will vary with circumstances, but priorities can always be established if there is a clear objective. Maximizing the common heritage is a vague objective in the abstract, but for any given situation it translates into the realistic and practical goal of balancing activities for the maximum benefit of

the greatest number. This balance is not apt to occur naturally in a "free" environment, since often activities that compete for the same ocean space are not in direct economic competition with one another.

However, even if one agrees to the theoretical advantages of regulating activities for the maximum benefit, it is questionable whether, in practice, the ISA can effectively exercise this function. The difficulty here is not only organizational, it also involves achieving agreement on the limits of the ISA's authority. Even acceptance of the common heritage concept as the legal basis for all activities in the ocean should not empower the ISA with blanket jurisdiction. Its function is properly limited to regulating only those activities that are mutually exclusive, ecologically damaging, or economically and biologically wasteful. All other activities not included in these categories must, by definition, either serve the common heritage or not impede it, and thus the ISA has no legal claim to jurisdiction over them.

Be this as it may, positions at the forthcoming conference will be based on considerations of national and group interest rather than sound law. The developed countries have ignored the logical inconsistencies in their position simply because they cannot go on record as opposing common heritage in principle; at the same time, however, they are not willing to accept the possible curtailment of existing freedoms that its support implies. Their fears in this regard are not groundless, since the developing countries quite obviously support this concept largely as a means of exerting their collective influence in an area from which they are currently excluded by a combination of existing law and lack of technology. In view of the current international climate, it is unlikely that a strong ISA dominated by the developing countries would prove a particularly impartial judge of what activities constituted the common interest.

Regardless of how narrowly the role of the ISA is initially defined, the future will see continuing pressure exerted by the developing countries to broaden the ISA's functions within the area of its jurisdiction. Since science is one of the issues on which positions are divided most clearly along developed-developing lines, efforts to empower the ISA with control over research will continue, even if the attempt fails in 1973.

Limits of National Jurisdiction

The seaward extension of national jurisdiction in the form of a territorial sea was an early exception to freedom of the seas. The right of a state to exercise sovereignty over the strip of ocean adjacent to its coast arose from the need to provide a measure of security against seaborne attack, and the initial seaward limit of jurisdiction of 3 miles was established for the very pragmatic reason that, in the 17th century, this was the maximum conceivable range of shore-based cannon. The original limit thus established a precedent for future adjustments as better cannon were invented or other new conditions arose. However, few states chose to avail themselves of this precedent until after the Truman Proclamation in 1945.

Although the proclamation was intended to claim jurisdiction only over the continental shelf beyond the territorial sea, the U.S. action has been invoked by other states to justify claims for more comprehensive jurisdiction. Iceland recently established an exclusive fisheries zone out to 50 miles from its coast. Chile claims a similar zone 200 miles wide, and Canada maintains the right to prosecute polluters in its Arctic waters. Brazil, Ecuador, and Peru have simply claimed a 200-mile territorial sea, although Ecuador and Peru refer euphemistically to this area as a "maritime zone." So the Truman Proclamation has come back to haunt the United States. The United States, along with the other great maritime powers, considers the major ocean "resource" to be freedom of navigation, and today it finds itself in the embarrassing position of having paved the way for claims that, if honored, will give its naval and research ships access to large parts of the ocean only upon the sufferance of coastal states, over 70 of which are classified as developing nations.

The limits of national jurisdiction have thus become one of the thorniest issues in the Seabed Committee negotiations. The alternatives currently being debated range from 12- to 200-mile limits, with the most likely compromise being a 12-mile territorial sea, with free transit guaranteed by treaty through all straits that would otherwise come under national jurisdiction. Between 12 and 200 miles, in the area becoming known as the "resource zone," states will probably be given

Freedom	Common Heritage
The seabed belongs to everyone (or to no one) and all have equal right of access to it.	The seabed is the common heritage of all mankind and the right of access to it is not necessarily equal for all purposes.
Everyone has an equal right to exploit the seabed for his personal gain and no one may deny this right to another.	Exploitation of the seabed is done on behalf of the international community.
Any usage of the seabed is permissible (unless specifically prohibited by treaty), providing only that it does not interfere "unreasonably" with other uses.	Uses of the seabed are allowed on the basis of their conformity to standards established under the concept of the common heritage.
If two users compete for the same part of the seabed or otherwise propose uses that are mutually exclusive, priority is established by who gets there first.	Priorities among competing uses are established by balancing the interests involved for the greatest net benefit of the world community.
Existing law of the sea requires no specific administering or enforcing agency. Claims of "unreasonable interference" are settled by persuasion or coercion.	Law devised to implement the common heritage concept may require an administering agency to determine priorities, collect revenues, issue licenses, and so forth.

limited jurisdiction for specific purposes (conservation, resource and fisheries management, and so forth).

It is in these resource zones, where the relative jurisdictions of the state and the ISA remain to be defined, that positions on science have become polarized. Developing countries demand that research be one of the activities over which they retain jurisdiction. Developed countries are pushing (with varying degrees of emphasis) for minimum restrictions on science beyond a narrow territorial sea. The stakes involved are evident if one considers that the area between 12 and 200 miles seaward encompasses some 30 percent of the world ocean and is, by and large, the area of most interest scientifically and economically (*9*).

Common Heritage and Access for Science

Access for scientists to all of the oceans beyond narrowly defined limits of national jurisdiction is one of the "freedoms" the developed countries hope to preserve at the forthcoming conference. Not unexpectedly, the attacks of developing countries on freedom for science have taken much the same form as those on the parent concept. Developing countries contend that science cannot be called a freedom when its exercise is limited only to the handful of nations who have a research capability, nor does it meet the test of being in the best interest of mankind when its results can provide military and economic advantage only to the few possessing the technological ability to exploit its findings.

These arguments are based on a quite different perception of basic research than exists among the developed countries. H. L. F. Von Helmholtz's famous statement that "whoever, in the pursuit of science, seeks after immediate practical utility may rest assured that he seeks in vain" has become such a truism for Western scientists that it appears in *Bartlett's Familar Quotations* (*10*). In contrast is the developing country's view, as expressed by Brazilian diplomat Saraiva Guerreiro, that "in the last analysis, every particle of scientific knowledge can be translated into terms of economic gain or national security, and in the technological society, scientific knowledge means power" (*11*).

The frequent mention oceanographers make of the economic implications of their work contributes to this impression. Warren Wooster, a member of the National Academy of Sciences' Task Force on Freedom for Science, writes in an article demonstrating the "tenuous" connection between scientific research and economic payoff, that scientific geological investigations "will be less detailed and will otherwise differ from that of commercial petroleum or mineral prospectors" (*12*). Not long afterwards, K. O. Emery reported on his investigation of the Eastern Atlantic Continental Margin. He cited the mapping of two features that "may be potential sources of oil" (*13*). A great deal of additional work lies between the preliminary survey described and the actual drilling for oil in these areas. But developing countries have very few petroleum geologists, so they cannot be blamed if they see in the apparent contradiction between Wooster's statement and Emery's findings substantiation of their suspicion that "knowledge means power."

The actual relationship between basic research and power has been much debated. Suffice it to say here that, although this connection appears to be growing increasingly direct, it still remains impossible to predict what basic research will bear fruit in terms of social, military, or economic utility. The only certainly is that the more basic research is encouraged the better the chances for the kind of practical return from the oceans necessary to make the "common heritage" a meaningful concept.

Seen in this perspective, science can no longer be said to be the parochial concern of one group of men or one group of nations. If it can be organized to contribute to the common good, the entire international community will benefit from arrangements that most facilitate the conduct of research.

The question thus becomes one of whether the absence of regulations is the condition that produces the best basic research. Would it not be better to focus the collective attention of the limited number of research oceanographers on particular problems, perhaps by coordinating all research through the proposed ISA? Or, on a more local level, would not individual developing countries do better to stipulate the types of research they felt was needed off their coasts and only permit access to those willing to undertake it?

These might be feasible approaches if it were possible to predict what basic research will pay off in terms of tangible benefits. Research can be directed toward specific objectives, such as optimizing the return of food or minerals or minimizing the danger of hurricanes and pollution, but the potential of the ocean is so vast that further basic research will almost certainly lead to the discovery of other uses, and implications of existing uses, still undreamed of. Without knowing what these uses are, there is no way to mobilize scientific talent directly toward their achievement. The only alternative, as one laboratory director put it (*14*), is to "get good men and turn them loose," knowing from experience that even the most apparently esoteric investigation may lead to valuable results in solving the global problems of hunger, poverty, and pollution.

Another factor to consider in evaluating the implications of controlling basic research is the personality of the investigator himself. Very few scientists in basic research are much motivated by the possibility of their work leading to any practical results. More commonly, they are men driven mainly by a sense of curiosity developed sometimes to the point of eccentricity. While it is easy to make too much of the fact that scientists are somehow a breed apart, it is a fair generalization to say that, as a group, they are notoriously impatient with the petty intrusions of everyday life. Therefore, the environment in which they operate best is a fragile one, easily disrupted by the necessity to conform to bureaucratic regulations requiring lengthy advance notice of their investigations, detailed research plans, specific handling of data, and all the other requirements that follow with increased controls.

Both the proven but unpredictable return from basic research and the peculiar nature of the few men competent to conduct it suggest that restrictive regulations on science do in fact run counter to the common heritage concept. For if the ocean and its resources are the common heritage of mankind, it follows that states accepting this principle are obligated to subordinate, to some degree, their own interest in the area to the common interest of the international community. Scientific freedom can be justified on the grounds that, since research does yield knowledge of potential social utility, no state accepting the common

heritage principle can properly erect barriers that restrict mankind from learning what he must know about the ocean in order to optimize its use for the benefit of all. The same logic condemns states that pay lip service to the common heritage concept, while at the same time claiming expansive areas of national jurisdiction. The concept is meaningless if the greater part of ocean resources is in the hands of individual states.

To maintain (as many will) that arguments such as these have little weight in the United Nations is to underestimate the amount of idealism underlying the concept of a common heritage. Although the developing countries have exploited this concept for the political leverage it affords, they and much of the rest of the world community are not blind to the hope that common heritage will provide the basis for a new world order based on cooperation rather than competition. Positions against regulation of science that are based on the idea of a common heritage will be difficult for any country to oppose, both politically and in principle.

Open Research versus Limited Exploration

If science is governed by the common heritage concept, the test of scientific "legitimacy" (that is, whether or not a particular type of investigation is subject to regulation) becomes a question of whether the investigation is structured so that its results contribute to the common good or whether they contribute only to the advantage of the sponsor. The difficulty, of course, lies in making this distinction. "A proposed U.S. position on freedom for science in the oceans" (*2*), drafted by the National Academy of Sciences, attempts to do this by differentiating between open research, which is "intended for the benefit of all mankind and characterized by the prompt availability and full publication of results" and limited exploration, "intended for the economic benefit of a limited group" (*2*, p. 2). The proposal suggests that these definitions are "easily understood and subject to operational tests" and calls for no restrictions on open research in areas beyond the territorial sea.

The academy does not consider the issue of burden of proof. Does it suffice for the scientist to apply these "operational tests" to his own work, or must he convince someone else that his is really open research? Publication, after all, occurs after the fact. How can developing countries, with little scientific capability of their own, be assured that they are receiving all data collected, and of what use is it to them if they do receive it? Even if universally known, data are only useful to those with the technology to exploit them.

It would seem that even if the developing countries accept the academy's definition and agree that research should not be regulated in the resource zones and the deep sea, it is likely that they will insist on some form of neutral international machinery to verify the nature of research proposed in areas of concern. Granting this, it would certainly be good politics, as well as an indisputable gesture of good faith, if the developed countries themselves proposed specific machinery for verification and agreed to abide by its decisions as an arbitrator. In 1968, an informal proposal that the Intergovernmental Oceanographic Commission (IOC) act in this capacity, met with vehement opposition, particularly from some U.S. oceanographers who claimed that the IOC had neither the staff nor the scientific expertise to make judgments of this kind. The fear was also expressed that such a "clearinghouse" would cause interminable delays and frustrations to the reseacher (*15*).

Arbitration procedures established by treaty for use on an ad hoc basis may prove less ponderous than an established agency. The procedures common to international arbitration, whereby the disputing parties select referees from a list of neutral experts, could certainly be employed in cases where the nature of a proposed investigation was in question. Regardless of the method, however, some delay and frustration are inevitable. The risk of the certifying procedures becoming a bureaucratic nightmare must be weighed against their advantages.

To date, the opponents of regulation have been on the defensive, fighting to retain as much of the status quo as possible in light of a changing international environment. A case for science, based on the common heritage concept, takes the initiative away from the advocates of control. The only part of their argument left intact, and the one they will certainly fall back on, is the contention that science is not in the common interest as long as it is used by the developed to exploit the developing. For the reasons given earlier, it is unlikely that the National Academy of Sciences' effort to differentiate between types of research will dissuade developing countries from this suspicion unless a mechanism that they can trust is created to assist in differentiating between open research and limited exploration. By proposing such a mechanism themselves, the advocates of scientific freedom eliminate the major remaining objection of their opponents with an alternative that, again, is difficult to oppose politically or in principle.

As matters now stand, the 1973 conference will very probably give states the right to regulate science within their resource zones. An effectively presented argument against regulations as being incompatible with the common heritage concept, combined with an offer to submit proposed investigations to the scrutiny of an impartial body, may not convince the developing countries to withdraw their demand that investigators request permission to work within their resource zones. A mechanism for third-party settlement could, however, provide an alternative to individual states' having the final authority over what science is done in the area between 12 and 200 miles off their coasts.

In areas where a 200-mile jurisdiction is now claimed, access for the purpose of doing research has been obtained by bilateral negotiations between the parties involved. This would certainly become the pattern if the 200-mile limit applied universally. Recourse to arbitration would be necessary only when bilateral negotiations broke down (a major objection to the IOC proposal was that the commission would act as an intermediary in *all* requests). The third party could be a neutral body to which a developing country without an oceanographic capability of its own could turn if it were uncertain of the implications of the research proposed. The third party could serve equally well as a court of appeals for those whose requests for access were summarily rejected, particularly if states agreed by treaty to abide by its decisions. The procedures established would also work in cases of disagreement between an investigator and the ISA over the nature of research, in the event that the ISA is given control over research in its area of jurisdiction.

The establishment by treaty of procedures for binding third-party settlement in cases where the ISA or the state withholds permission for research within their respective areas of control is the position most favorable to basic research, and one that none of the competing interest groups at the 1973 conference can effectively oppose. Having claimed that a legitimate distinction exists between basic research and limited exploration, the developed countries cannot object to entrusting this determination, when contested, to a neutral body of experts. Nor can developing countries justify in the name of the common heritage claims to the right to bar from their resource zones research certified by an unbiased third party to be in the common interest.

Freedom for science is no longer a universal right. But access to the oceans for research "intended for the benefit of all mankind" is equally justified under the common heritage doctrine. It would be ironic if the new law of the sea that is being created to make this doctrine a reality were to contain provisions which would impede the understanding of the marine environment on which all nations, rich and poor alike, are going to depend increasingly in the years ahead.

References and Notes

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3. I make an obvious oversimplification in treating both the developed and the developing countries as unified blocs. The variety and complexity of the issues confronting the 1973 Law of the Sea Conference, sponsored by the United Nations, assures that voting will not always be strictly along these lines. Science, however, is one of the issues in which the difference between developed and developing countries is most apparent.
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14. P. M. Fye, personal communication.
15. This proposal was made informally, and, although it generated considerable comment, it was apparently never mentioned in official records. I learned of it from A. E. Maxwell, provost of the Woods Hole Oceanographic Institution and a frequent delegate to the IOC.

16. This article would not have been possible without the help of Robertson P. Dinsmore, Richard L. Haedrich, Herman Franssen, Maureen Franssen, Paul M. Fye, Kaleroy L. Hatzikon, and, above all, P. Sreenivasa Rao, who spent many hours introducing me to the mysteries of international law. This article is Woods Hole Oceanographic Institution Contribution No. 3089.

Depressive Disorders: Toward a Unified Hypothesis

Clinical, experimental, genetic, biochemical, and neurophysiological data are integrated.

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Depressive disorders are perhaps the most distressful, and certainly among the most common, maladies that afflict mankind. Although man has known and experienced melancholic states since antiquity, it is only during the past decade or so that we have begun to develop scientific insights into the basic mechanisms involved.

Unfortunately, the literature on depressive disorders, like that on other psychiatric disorders, is composed of isolated research reports, with few attempts at systematically integrating them (*1*). Different schools of thought utilize dissimilar dialects, thereby hindering communication, while ethical considerations often preclude direct testing of hypotheses in human subjects. Studies are being carried out in an attempt to create experimental animal models of depression—models that would simulate the central features of human depressions. This article reviews these studies, as well as other formulations, both clinical and metapsychological, that derive from different frames of reference. We present evidence that depression in animals is sufficiently analogous to human depression to offer insights into the human condition. A comprehensive hypothesis of depression, incorporating and synthesizing findings from different schools, is proposed.

Depression as a Final Common Pathway

Several models of depression, reflecting diverse theoretical orientations, have been formulated.

1) The "aggression-turned-inward" model, originally proposed by Abraham and later elaborated by Freud, sees depression as hostility turned inward upon the loss of an ambivalently loved person (*2*). Although this is the most widely quoted psychological theory of depression, there is no systematic evidence to substantiate it (*3*). Indeed, this theory does not lend itself easily to empirical verification because it is expressed in metapsychological terms.

2) The "object loss" model, which

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