THE SACRED IN HUMAN EVOLUTION

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I

Neither history nor anthropology knows of societies from which religion has been totally absent, and even those modern states that have attempted to abolish religion have replaced it with beliefs and practices which themselves seem religious. A century ago E. B. Tylor (1871), whom some consider "the father" of modern anthropology, attempted to account for the universality of religion by reference to the psychic unity of mankind. It is the experience of dreaming, common to all men, that has suggested to all men the existence of the soul, he argued, and it is from a primordial belief in the soul that religion in its manifold forms has evolved. But, as Durkheim (1961) asked at the beginning of this century, "How could a vain fantasy have been able to fashion the human consciousness so strongly and so durably?" He argued that it cannot be accepted that "systems of ideas like religions, which have held so considerable a place in history, and from which, in all times, men have come to receive the energy which they must have to live, should be made up of a tissue of illusions."

We must agree with Durkeim, for it is both plausible and prudent to assume, at least initially, that anything which is universal to human culture is likely to contribute to human survival. Phenomena that are merely incidental, or peripheral, or epiphenomenal to the mechanisms of survival are hardly likely to become universal, nor to remain so if they do. When we consider further that religious beliefs and practices have frequently been central to human concerns and when we reflect upon the amount of time, energy, emotion, and treasure that men have expended in building religious monuments, supporting priestly hierarchies, fighting holy wars, and in sacrifices to assure their well-being in the next world, we find it hard to imagine that religion, as bizarre and irrational as it may seem or even be, has not contributed positively to human evolution and adaptation. Surely so expensive an enterprise would have been defeated by selective pressures if it were merely frivolous or illusory. Indeed, it would have succumbed to selection if its importance were not comparable to its cost, and our thesis here is that religion has not merely been important but crucial to human adaptation.

I take the term *adaptation* to refer to the processes by which organisms

or groups of organisms maintain homeostasis in and among themselves in the face of both short-term environmental fluctuations and long-term changes in the composition and structure of their environments. Homeostasis may be given a more or less specific, if not always precise, systemic meaning if it is conceived as a set of goal ranges on a corresponding set of variables abstracted from what, for empirical or theoretical reasons, we take to be vital or indispensable conditions of the systems under consideration. Adaptation is, thus, cybernetic. In response to system-endangering changes in the states of its components or in some aspect of the environment, an adaptive system initiates corrective programs. These corrective programs may return the deviating component to a safer state, make compensating changes elsewhere in the system, or initiate changes in organization.

In this view, adaptation subsumes both the self-regulatory processes through which living systems maintain themselves in fluctuating environments and the self-organizing processes by which living systems transform themselves in response to directional environmental changes. But this distinction between self-regulation and self-organization should not be overdrawn, because in a changing universe the maintenance of organization is likely to require continual modification of organization. What Hockett & Ascher (1964:137) have called "Romer's Rule" is the connecting generalization here. As they phrase it, Romer's Rule states that "The initial survival value of a favorable innovation is conservative, in that it renders possible the maintenance of a traditional way of life in the face of changed circumstances." To put this in other terms, self-organizing change (i.e. organizational change in response to environmental changes) is a function of the self-regulatory processes of a more inclusive system. For example, in the passage that inspired Hockett and Ascher, Romer (1954) long ago argued that through the enlargement of their limbs and other relatively minor organizational modifications of various of their subsystems, the early amphibians became able to migrate from one drying-up body of water to another and thus could maintain their general riverine and lacustrine organization in the face of environmental dessication during the Devonian period.

Romer's discussion of the amphibian also calls our attention to another aspect of living systems: their hierarchical organization. As living systems increase in complexity, there is increasing differentiation of special purpose subsystems within them. Concomitant with this "progressive segregation" of subsystems is also likely to be increasing centralization of control functions, or "progressive centralization" (Hall & Fagen 1956, Miller 1965a, 1965b, Von Bertalanffy 1969).

Thus, although it is possible to entertain a cybernetic concept of adaptation, it would be a mistake of represent adaptations as simply collections of more or less distinct corrective feedback loops. When we refer to the adaptation of any living system, in a general sense, we imply much more than the sum of its homeostatic devices (some of which may be, in part, contradictory), for these special adaptations must be adapted to each other in structured ways. Adaptation, human or otherwise, must take the form of enormously complex sets of interlocking corrective loops arranged hierarchically (Kalmus 1966) and including not only mechanisms regulating material variables, but regulators regulating these regulators, others regulating them, and so on.

Cybernetic processes, like all other processes, require energy, but they are primarily informational. In response to the receipt of information concerning the states of systemic components, messages—directives or the like—specifying corrective programs are transmitted. Similarly, although they require energy and may and frequently do have important effects upon the material environment, religious activities are primarily part of the informational processes of human societies. It is the informational aspects of religion and their place in the cybernetic processes of adaptation that will receive most of our attention here. But it is even less possible to propose a generally acceptable definition of religion than of adaptation. I mean by the term simply to refer to the sets of sacred beliefs held in common by groups of people and to the more or less standard actions (rituals) that are undertaken with respect to these beliefs. It is convenient to take up rituals and beliefs separately, and after a brief discussion of ritual we shall proceed to the sacred nature of religious beliefs and to the nature of the sacred.

II

The term *ritual* has not been restricted to religious phenomena in its application. Psychiatrists use the term, or the closely related if not synonymous term *ceremony*, to refer to the compulsive behavior of some neurotics (Freud 1907), and Webster's International tells us that a ritual is "any practice . . . regularly repeated in a set precise manner so as to satisfy one's sense of fitness. . . ." Nor has the term been restricted in its application to human activities, for ethologists have used it virtually interchangeably with *display* to refer to a class of activities observed among many species in several phyla (Cullen 1966, Etkin 1964, Hinde 1966, Huxley 1914, 1966, Lorenz 1966, Tinbergen 1964, Wynne-Edwards 1962).

Whereas scientists concerned with the behavior and social organization of humans have sometimes tended to regard ritual as pathological or as having at best anxiety-reducing functions, students of animal behavior have taken animal rituals to be communication events, and a similar view of human rituals has been adopted by Goffman (1956), Leach (1954), Wallace (1966), and other social scientists. Accordingly, for our purposes here we shall define ritual—both human and animal, religious and secular—as conventional acts of display through which one or more participants transmit information concerning their physiological, psychological, or sociological states either to themselves or to one or more of their participants.

Both the content and the occurrence of rituals may be of importance in

communication. As far as content is concerned, information concerning social arrangements may be communicated in the course of public rituals, as may quantitative information. For instance, among the Maring of New Guinea information concerning the amount of military support that may be expected from a friendly group in future warlike endeavors is transmitted in rituals. Among these people there are no chiefs or other leaders who can command obedience, and individual men signify their willingness to come to the aid of another group by dancing in the latter's ritual festival. Accordingly, the hosts estimate the amount of military support they may receive by the number of visitors who participate in these entertainments (Rappaport 1968). In the potlatches of the Northwest Coast Indians rather precise information concerning the social status of individuals is communicated by the number of valuables they give away. The relative political influence of Melanesian big men can be compared by counting the number of valuables each throws into the struggle when they are engaged in competitive feasting. Some human rituals, it would seem, may be regarded as public counting devices. [Similar claims have been made by Wynne-Edwards (1962) for some animal rituals.] As such, they may play an important role in regulation by revealing the states, not otherwise apparent, of important systemic variables. On the basis of such information, corrective action may be taken if necessary or possible.

The role of ritual occurrence in communication is more subtle than that of content. The mere occurrence of a noncalendrical ritual may be a signal. Since any ritual included in the repertoire of a people can, at any particular time, be in only one of two possible states—occurring or not occurring—occurrence can transmit a binary, or *yes–no*, signal. But although the occurrence of the ritual may transmit *yes–no* information, it may have been triggered by the achievement or violation of a particular state or range of states of a continuous or *more–less* variable, or even of a complex state or range of states involving the relationship among a number of such variables. As such, the occurrence of a ritual may be a simple quantitative representation of complex quantitative information, or to put it differently, the occurrence of a ritual might summarize complex analogic information and translate it into a simple digital signal. The importance of this operation may be illustrated by reference to male puberty rites. The social, psychological, and physiological development of males is continuous and gradual, unmarked by any definite and dramatic biological event such as menarche. Therefore, considerable ambiguity inheres in the role of the adolescent male in many societies. His physiological development is insufficient to structure his behavior and consequently he is uncertain as to whether to act as a boy or a man. Conversely, others are uncertain of what to expect from him. In a few societies the youth himself ameliorates this ambiguity by deciding to undergo a *rite de passage*. In the Society Islands, for instance, a boy has his penis superincised without necessarily consulting the adult males (Robert Levy, personal communication). This act signals to the community that certain unobservable but complicated biological and psychological development processes have reached the point that the boy is prepared to assume a new status. More frequently, the signal is transmitted in the other direction, and it is the adult men who decide that the time has come to initiate one or more of the community's youths. The initiation signals to the boys that certain complex sociological processes, involving attitude change and consensus formation among the adult men and concerning which the boys can have only vague or ambiguous information, have reached such a state that a new status with its attendant responsibilities is either granted to or forced upon them.

Whether initiated by the adult men or the boy, the virtue of the ritual is that it reduces the ambiguity inherent in continuous, analogic, or *more–less* information. The *yes–no* statement of ritual occurrence, other things being equal, is free of ambiguity. Cullen (1966) has also emphasized the role of ritual in the reduction of ambiguity in animal communication.

The reduction of ambiguity clearly enhances the operation of communication systems, and it is unnecessary to argue this point. It is worth noting, however, that in this light we may regard some rituals or their occurrence as "context markers" (Bateson 1968:19 ff), signals specifying a change in context in situations in which this would otherwise be unclear. An obvious example, to be observed among both men and animals, is stereotyped sequences of behavior indicating peaceful intentions.

There is yet another way in which the binary aspect of ritual occurrence is important in communication: it aids in transduction of information between unlike systems. In the case of male initiation, for instance, rituals articulate a psychophysiological system (an individual) on the one hand and a social system on the other. Each of these systems is characterized, of course, by continuous quantitative processes and continuous change in such variables as emotional and cognitive states, status and role behavior, affiliation, etc. Although they are related to each other and affect each other, the psychophysiological processes and the social processes are both quasi-autonomous. Neither is a direct function or outcome of the other, and information concerning the two sets of processes is not altogether commensurable. Since this is the case, continuously fluctuating quantitative information concerning the process of either of these systems is not directly meaningful in the other. By "not directly meaningful" I mean that it cannot effect systematic nonrandom proportional changes in the other. But the ritual, as binary transducer, summarizes this quantitative information into a simple statement which not only is nonambiguous but is meaningful in the system into which it is transmitted: "the boy is prepared to become, or has become, a man," or "the men are ready to transform the boy into a man." Control transduction between unlike components of physiological systems also seems to rely heavily upon binary mechanisms because of the difficulty of translating quantitative information directly between incommensurable systems (Goldman 1960), and we may further note that ritual transduction is not

restricted to the relations of individuals to social systems. Elsewhere, I (1968, 1971) have discussed the role of ritual in articulating a local ecological system to a regional political system in the Highlands of New Guinea.

Both ritual occurrence and ritual content, then, have played an important part in human as well as in animal communication. Indeed, ritual remains, even in industrialized societies, a mode of communication of some importance. For instance, the march on Washington of November 15, 1969, could be regarded as a ritual. Its *occurrence* was supposed to indicate that antiwar sentiments of sufficient strength to impel people to travel considerable distances at considerable expense now gripped a significant portion of the American population. Its *contents* were meant to convey information concerning the size, composition, fervor, militancy, and orderliness of that portion of the population to the public, to the government, and to itself.

This example suggests another aspect of ritual communication that requires comment: it is extremely expensive. It should be kept in mind that the *occurrence* of a ritual can, in itself, transmit only one bit of information. And although a great deal of quantitative information may be transmitted by the *contents* of a ritual, this form of transmission requires much more energy than do other means available to men. Animals have little or no choice, but men have other modalities available to them, and we may ask why, with the development language and writing (not to mention electronic information processing and transmitting equipment), ritual persists as a mode of communication.

For one thing humans do not communicate all manner of messages through ritual. Messages may be low in information, but highly meaningful —that is to say important—and it is probable that only important messages which are low in information content are likely to be transmitted in expensive rituals. It is further implied here that not all modalities—smoke signals, speech, letters, telegrams, books, radio, and rituals—carry all kinds of messages equally well and that ritual may have special virtues as well as limitations.

Although human ritual may, and usually does, include discourse (language), it is also likely to include music, special postures, gestures, or body movements, special uses of the voice, and assemblages of people at special places and times. Whereas other modes of communication are more or less strictly discursive, ritual is, in part, nondiscursive. The nondiscursive aspects of a ritual are likely to evoke in the participants and the observers strong emotional states—reverence, ecstasy, commitment, or whatever. Since this is so, to transmit a message in ritual is not only to transmit the information contained in that message but also to transmit a nondiscursive, or emotional, message about that information. The medium is not the message. It is a metamessage.

III

We have been speaking so far of public rituals in general. Religious rituals are yet more special. They are sacred, and the sanctity of the ritual

also constitutes a metamessage concerning social information transmitted in the ritual. It is necessary now to discuss what we mean by the sacred.

Religious rituals may be formally distinguished from secular rituals. Whereas the semantic content of the secular ritual is exhausted by the psychological, physiological, or social information transmitted in the ritual, this is not so in religious rituals. Religious rituals always include, in addition to messages of social import, implicit or explicit reference to some idea, doctrine, or supernatural entity. Sentences of the latter type are generally associated with the ostensible purposes of the ritual; "Hear, oh Israel, the Lord our God, the Lord is One" and "Jesus Christ is the Son of God" are examples of such sacred sentences. The explicit purposes of the rituals in which such propositions are enunciated is to worship the dieties they name, or to affirm the doctrine enunciated, or something of the sort.

Propositions such as these sacred sentences are peculiar. Since their terms have no material referents, they are not amenable to verification, but neither are they vulnerable to falsification. They are, in a strict logical positivist sense, nonsense. Yet, they are taken to be unquestionably true. This characteristic, I believe, is the *sine qua non* of sanctity. I take the term *sacred* to refer to the quality of unquestionable truthfulness imputed by the faithful to unverifiable propositions (for a more detailed discussion see Rappaport (1971).

Although sanctity inheres ultimately in propositions which do not have material referents, it is socially important as a metastatement about sentences that do have material referents, setences containing information upon which societies operate, sentences such as—to use the Maring example cited earlier—"We will lend you support in warfare." To sanctify sentences like these is to associate them with the unquestionable truthfulness of the ultimate sacred propositions. To put it a little differently, to sanctify sentences is to certify them.

While sentences may be sanctified through association with ultimate sacred propositions in rituals, they may also be sanctified by connection to such propositions in discursive structures like theology. Indeed, the latter is probably more usual, with the function of religious ritual more often being simply to affirm the sacred propositions themselves. To put this differently, in the liturgical aspect of religious rituals ultimate sacred propositions are periodically reaffirmed and may, outside of the rituals, sanctify sentences directly important in the regulation of society. The sacred thus escapes from strictly religious contexts, and sentences concerning economic arrangements, political authorities, and other social conventions may, in fact very likely will, be sanctified.

Our argument implies that the sacred plays an important role in human organization, but it is perhaps possible to make a stronger assertion: human organization could not have come into existence, or persisted, in the absence of ultimate sacred propositions and the sanctification of discourse.

Human organization is based upon language, that is, symbolic communication. In symbolic communication signals are only conventionally related,

and not intrinsic, to their referents. The advantages of symbolic communication—that it frees signals from the constraints of what is present at present and permits discourse upon the past, future, distant, imaginary, and hoped for—have been justly celebrated by many writers. But a problem that is concomitant to these very advantages has generally been overlooked. If signals are only conventionally related to their referents, they can occur in the absence of their referents, and their referents may occur without a signal being transmitted. Therefore lying becomes possible. Lies are the bastard offspring of symbols. Since the operation of any society is dependent upon the transmission of information among its members, the ability to lie, to knowingly transmit false information, poses a serious problem to societies relying largely upon symbolic communication. How can the recipients of messages be assured that the information which they receive is sufficiently reliable for them to act upon? If they are unwilling or unable to give credence to the information they receive, their responses in any context (assuming that contexts could even be specified) may be expected to tend toward randomness, eliciting yet further random responses. Needless to say, the operation of any society depends upon some degree of orderliness and predictability.

Some messages, those containing logically necessary truths or those that can be assumed to be true from experience, present no problems. But the preponderance of messages upon which social actions rely are neither logically necessary nor can they be validated from experience, and even should means of validation exist, the recipient of important information is seldom in a position to employ them. The sanctification of such sentences, however, assures the recipient that they are sufficiently reliable to act upon. This is not to claim, of course, that sanctification insures truth, although it may help. It is to say that people are more willing to accept sanctified than unsanctified messages as true; to the extent that they do, their responses to sanctified messages will tend to be predictable and the operation of the society orderly. The acceptance of messages as true, whether they are true or not, contributes to orderliness and may, in fact, make it possible. Following Bateson's lead (1951), we suggest that the creation of such orderliness may in fact create truth, for the validity of many of the sentences upon which social orderliness depends is a function of belief in them. In short, the concept of the sacred has not only been made possible by symbolic communication, but it has made symbolic communication (upon which human adaptation rests) possible. This implies that the idea of the sacred is as old as language and that the evolution of language and of the idea of the sacred were closely related, if not indeed bound together in a single mutual causal process. It may be suggested, further, that the emergence of the sacred was perhaps an instance of the operation of Romer's Rule, for it possibly helped to maintain the general features of some previously existing social organization in the face of new threats posed by an ever-increasing capacity for lying.

IV

Sanctity, thus, serves as a foundation for symbolic discourse. But although sanctity may escape from the constrictions of ritual, it in turn is rooted in ritual. At the least, sacred propositions are affirmed in rituals, and the nature of such affirmation has both epistemological and evolutionary significance.

In the course of a religious ritual the communicant is likely to have, at least sometimes, a "religious experience." The particulars of these experiences and their intensity vary from religion to religion, from communicant to communicant, and from time to time. What seems common to these experiences is that they are not discursive. They are emotional. Since they are not in discourse, they cannot be discredited by reason. The truth of such an experience seems to the communicant to be sufficiently demonstrated by its mere occurrence, and since a sacred proposition or its symbol (e.g. the cross) is taken to be intrinsic to the experience, the sacred proposition partakes of this often powerful and compelling sense of truth.

Thus, sacred propositions, which are unfalsifiable because their terms are nonmaterial, are supported by emotions, which are material (they reflect actual psychological-physiological states) but, because nondiscursive, also unfalsifiable.

As we noted earlier, it is not only religious ritual that affects the emotional states of the participants. Just as participation in ritual, religious or secular, stimulates emotion in humans, changes in the affective states of animals also occur during rituals. Cullen (1966) has suggested that this heightening of emotion among animals in rituals may enhance the likelihood of appropriate response to the messages being transmitted. Be this as it may, it is not implausible to suggest that the emotions experienced by men and animals in some rituals may be somewhat similar. Men and the higher mammals seem to resemble each other emotionally more closely than in their rational or secondary processes, and as long ago as 1928 Kohler suggested that those emotions which we associate with the religious seem to occur among the great apes. Erikson's recent discussion (1968) of the ritualization of ontogeny in humans lends plausibility to Kohler's impression. Erikson places the ontogentic basis of the numinous emotions—the feelings of dependence, surrender, and love that Rudolph Otto (1926) claimed to be characteristic of the religious experience—in the earliest ritualized (stereotyped, repetitive, periodic) interactions of a mother with her infant. The relationship between mothers and helpless neonates is perhaps sufficiently similar among apes and humans to generate more or less similar emotions. The implication here is that emotions called "religious" or "numinous" when they came to be associated with the concept of the sacred may not only be present in infants before they acquire language, but may have been present among the ancestors of men before language or a concept of the sacred evolved.

The development of the numinous in earliest infancy seems to have important implications for the subsequent development of the child's communicative capacity. What he learns in these earliest interactions is that she upon whom he depends utterly, and whom he experiences as a numinous presence, is reliable. That is, he learns to trust before he learns, or perhaps can learn, language. It may be argued that it is the development of this trust that enables him to accept symbolic messages, first from the mother and then from others. At any rate, it seems clear that failure in these earliest ritualized contacts has severe effects upon the development of the communicative ability of the child (Erikson 1968:714, Frank 1966).

Ontogeny is, of course, not a recapitulation of phylogeny, but it had a phylogeny itself, and we are concerned here with the evolution of the socialization of the young. Perhaps gradually, as symbolic communication became increasingly complex, the idea of the sacred arose out of the trust which, developed before all else in the numinous experience of mother by the dependent infant, is a necessary precondition for the acceptance of messages that the recipient himself cannot verify. To put this a little differently, the numinous emotions, which we suggest appeared in the hominid line before language, may have served as a nondiscursive foundation for the concept of the sacred, itself discursive, which evolved along with language and made language possible. The affective aspects of ritual, the place of ritual in animal communication, the continuing affirmation of the sacred in ritual, and the possibility that children are socialized for the numinous in very early and highly ritualized interactions, make it reasonable to believe that the concept of the sacred first emerged in the context of rituals.

V

Although sanctity may have emerged as a response to the possibility of lying, it seems after emergence to have taken on other important social functions. The ability to use language demands a high order of intelligence, and as Bergson long ago (1935) suggested, such an order of intelligence may itself pose problems for society.For one thing, human intelligence was probably an evolutionary product of intraspecific competition and, thus, perhaps evolved in such a way as to serve the interests or needs of the individual at the possible expense of society. In a word, human intelligence perhaps evolved toward selfishness. For another thing, increasing intelligence increasingly displaced genetic specification as a basis for human social life. Human social organization is genetically underspecified, if not unspecified. Social conventions are arbitrary and humans are born with a capacity to learn any of a virtually unlimited number of sets of social conventions. This has provided humans with an adaptiveness unparalleled in the rest of the animal world, but the very intelligence that makes it possible for men to learn and behave according to *any* set of conventions makes them understand that the *particular* set of conventions by which they do live, and which often inconveniences them or even subjects them to hardship, is arbitrary. Since this is the case, they may be aware that there are, at least logically, alternatives. But no society, if it is to avoid chaos, can allow all alternatives to be practiced. For each context or situation, all but one or a few must be proscribed and the proscriptions must somehow be made effective. Thus, in addition to the possible innate selfishness of their members, human societies are faced with containing what Bergson called the "dissolving power" of their intelligence.

In the course of human evolution further problems seem to have emerged with social differentiation and craft and subsistance specialization. When discrete social groups become closely identified with particular special-purpose subsystems of a society—such as business firms, professional or trade associations, or bureaucratic agencies—they tend or attempt to elevate the more or less narrowly defined interests of their group to positions of predominance in the larger system of which they are merely parts. This process and the attitude justifying it are nicely summed up in the famous statement "What is good for General Motors is good for America." Needless to say, no matter how benign General Motors may be, this assertion cannot in the long run be true, because to elevate the interests or goals of a lower-order system to a position of predominance in a higher-order system is to increase the specificity, and therefore decrease the adaptiveness, of the higher-order system.

Sanctity has quite clearly had an important, even predominant, role to play in containing the self-interested pursuits of individuals and social groups and in supporting the conventions regulating society. These are problems inherent in hierarchical relations, and we earlier characterized adaptation as a hierarchically organized regulatory structure. We may now return to a discussion of the characteristics of such control hierarchies and the functions of sanctity within them.

There may be some ambiguity in the notion of control hierarchies. I am referring explicitly to controls at various levels of inclusiveness—that is, to hierarchies of systems, subsystems, sub-subsystems, and so on. For example, if a primitive horticultural community together with its territory were taken to be system, we might be able to discriminate within it, by virtue of partial discontinuities in systemic coherence and the existence of discrete regulatory mechanisms, a number of major subsystems (such as an enculturation subsystem, a military subsystem, a subsistence subsystem, and so on) and within these perhaps subsystems of lower order. For instance, the subsistence subsystem might include production, distribution, and consumption subsystem, each composed of variables in more coherent relations with each other than with those in other subsystems and each possessed of a more or less discrete regulatory mechanism.

Each of these regulatory mechanisms consists of an image of the regulated domain—which elsewhere I (1963, 1968) have called a "cognized model"—as well as corrective programs, reference or ideal values for the regulated variables, and mechanisms sensitive to changes in the states of

these variables. The domains of the lowest-order controls include the concrete variables of the general physical, biological, and social environment. The domains of higher-order controls include the outputs of the controls of next-lower order, for which they set output reference values. For instance, a production quota (an output reference value) is not likely to be set within a production system but to emanate from the controls of a more inclusive system (here labeled a subsistence system) which regulates relations among the outputs and demands of its several subsystems.

Let us turn to the place of sanctity in such hierarchies. Sanctity flows from ultimate sacred propositions containing no material terms, but it can suffuse sentences consisting entirely of material terms, and it can and does suffuse the sentences composing cognized models and their corrective programs.

In this regard it may be suggested—though no studies, so far as I know, have been made in just these terms—that cognized models in higher-order controls are likely to contain more abstract and fewer concrete terms than do those of lower-order controls. While this feature of control hierarchies is probably more evident in primitive societies, it is to be noted in modern societies as well. For instance, the terms of economics, which may include such notions as "free enterprise" and "corporate ownership," are less concrete and carry a stronger moral connotation than those of agronomy, and the contents of the cognized models which maintain community coherence within viable limits are likely to include yet more abstract terms, such as honor, prestige, and freedom, and gods, ghosts, and demons. In other words, the higher the level of control, the greater the importance of moral and mythic terms in its cognized model. Such a progression from the concrete to the abstract is expectable on several grounds. It could be argued simply that the relations among such concrete things as soils, plants, and agricultural techniques constrain their conceptualization more than coherence among systems constrains its conceptualization. But more important, and more germane to our present discussion, is a matter that we raised earlier. The range of differences possible in the regulation of the components of a low-order system, such as a production system, is probably narrower than in higher-order systems. The physiological requirements of cultigens, for instance, probably put greater restraints upon agricultural practices and the cognized models associated with them than the necessity to maintain coherence between production and consumption systems places upon procedures of distribution, etc., and the cognized models associated with them. Thus, to use an example from modern societies, Soviet wheat agriculture probably resembles American wheat agriculture more closely than the Soviet economic system resembles the American economic system. Since there is greater latitude or freedom in the maintenance of coherence *between* systems than in regulation *within* systems, it may be suggested that the higher its level, the more arbitrary the particular control mechanism. That is, the particular control mechanism that does operate is only one of a number of

possible mechanisms which could maintain the proper degree of systemic coherence. However, as we have already observed, any society must choose only one or a limited number out of the possible range if chaos is to be avoided. But the arbitrariness of the selection is possibly understood by the actors; i.e., they can conceive of other ways to maintain comparable levels of systemic coherence, and those subject to a control are not likely always to feel that it is operating in their immediate interests. Arbitrariness invites criticism and recalcitrance. However, to phrase regulation in moral or mythic terms—that is, to sanctify it—is to place it beyond criticism and to define recalcitrance as sacrilege. Sanctification transforms the arbitrary into the necessary, and regulatory mechanisms which are arbitrary are likely to be sanctified.

A related point may be made about another sense in which we may speak of sanctity and abstractness in control hierarchies. The systems with which we are dealing are "hybrid systems" in Pask's (1968) terms, for they consists of (*a*) bodies of discourse, which we have labeled cognized models, (*b*) material objects, and (*c*) the activities undertaken with reference to the cognized models but affecting the material objects. It thus seems that the structure of control hierarchies is "heterarchical," to use another of Pask's terms. The implication is that the level of discourse embodied in cognized models is likely to correspond to the level of control.

This possible feature of control hierarchies is of considerable significance with respect to a point already mentioned: the establishment of the output reference values of a regulatory mechanism is not a function of that regulatory mechanism but of one of higher order. It suggests that these reference values cannot be derived from the function or logic of the systems in which they operate. But since the reference value of a lower-order control is an output of higher-order control, it presumably may be deduced from the cognized model and input of the higher-order control. In other words, reference values either are or are something like theorems in the higher-order systems from which they emanate, but they also are or are something like axioms in the lower-order system in which they operate. Thus, the higher-order controls, which we have discriminated in terms of the greater inclusiveness of the domains subject to them, may also be what Bateson (1968), following Whitehead and Russell, has termed "of higher logical type," and Gödel's theorem, or something like it, may operate between controls on different levels. (I have used the phrase "something like" because the logic of the discourse with which we are concerned may not be amenable to rigorous formalization.)

This obviously can result in problems when the lower-order system, into which the reference value enters from above, is coextensive with an individual or social group with purposes of its own. Whereas most men are willing to accept such axioms as "the shortest distance between two points is a straight line" as the basis for some of their behavior, they are likely to be more dubious about accepting calls to fight in distant wars or production

quotas whose rationale they do not understand or believe to be in their own interest.

Sanctification again plays an important role. On the one hand, as we have already noted, recalcitrance may become sacrilegious, and sacrilege implies punishment. But no society thrives on punishment, and sanctification also operates positively here in a way which I believe to be both more interesting and more important and which may be illustrated by reference to the Maring of New Guinea. Among these people relations between hostile local groups are mediated by sanctified truces, and even when they are more powerful than their enemies, Maring groups rarely launch attacks in violation of these truces. Although their material advantages might be well served if they did so, they do not take this to be the case because they believe that if they were guilty of such sacrilege, their deceased ancestors would not assist them in their bellicose undertaking and they would therefore fail.

This peace-keeping operation depends upon the nonmaterial nature of such components of higher-order cognized models as spirits of deceased ancestors. Through the invocation of unquestionable propositions concerning spirits whose very existence cannot be verified, or falsified, the purpose of a higher-level system, the entire Maring population, is made to appear to one of its subsystems, a local territorial group, to be its own purpose. The societies of ancient Mesopotamia, organized economically around the temples of gods whose well-being was conceived by their servants—the entire community—to be a necessary precondition for their own prosperity, could serve as another example, as could those archaic societies in which there was conceived to be a correlation between the health and prosperity of the king and the state of the crops. In more modern societies such morally laden and sanctified terms as honor may function in a similar way. In general terms, then, through sanctification the purposes of higher-order systems may be injected into lower-order systems. As such, sanctification operates as a counterthrust to attempts by individuals or social groups to promote their own purposes to positions of dominance in higher-level systems. In slightly different terms, sanctity helps to keep subsystems in their places.

In summary, to invest social conventions with sanctity is to hide their arbitariness in a cloak of seeming necessity. Conventions, to the extent that they are sanctified, are likely to be taken by those subject to them to be as "natural" as if they were genetically determined. Indeed, they seem not to be mere conventions, but reflections of human nature, and those who flaunt them seem less than human. Further, to sanctify conventions is also to ameliorate, at least partially, the conflict between the individual and the society. The interests and needs of the society are presented to the individual as his own ultimate interests and needs, and his inconveniences and sacrifices on behalf of the society are rewarded symbolically. Recalcitrance, selfishness, and resentment thus are replaced by docility, compliance, cooperation, altruism, commitment, and enthusiasm. Thus, in further accordance with Romer's Rule, while the initial survival value of the concept of the sacred was conservative, it subsequently made possible the great range of new organizational forms based upon symbolic rather than genetic specification and transmission.

VI

In the last section we attempted to describe the place of the sacred in social control hierarchies generally. However, it must be recognized that the role of sancity in the regulation of society changes in the course of sociocultural evolution. In many technologically simple societies there are no authorities with sufficient power to coerce compliance with the norms of proper social behavior. (Following Bierstadt 1950, I take power to be the product, in a mathmetical sense, of men × resources × organization.) In such societies, as we argued in the last section, the sanctification of norms goes far to insure that they are honored. Sanctity, thus, is a functional equivalent of political power among some of the world's peoples. We can distinguish among past and present human societies a continuum from those governed largely by sacred conventions in the absence or near absence of human authorities [e.g. Australian Aborigines (Meggitt 1962, no date, Spencer & Gillan 1899, Warner 1937), New Guinea Highlanders (Brookfield & Brown 1963, Rappaport 1968)], through societies in which authorities have little power but claim great sanctity [Polynesia (Sahlins 1958)], to those of the contemporary west, in which authorities stand much more heavily upon power than they do upon sanctity. This continuum seems to be correlated with technological development, which is expectable, for technological development places increasingly powerful means of coercion in the hands of authorities, and very powerful authorities consequently have less need for sanctity than weaker ones.

Although this continuum may be observed among various contemporary or new contemporary people it has evolutionary implications. The compelling nature of the sacred and of religious emotions and the possible importance of rituals in the regulation of animal societies may reasonably cause us to speculate that religions rituals were important in the regulation of primordial human societies. The ethnographic literature, moreover, provides us with numerous instances of societies still functioning—or functioning until recently—in which religious ritual regulates social, economic, and in some instances even ecological relations. It has been argued by Piddocke (1965), Suttles (1960), and Vayda (1961) that the potlatches of the Indians of the Northwest Coast of the United States served to correct disparities between the fishing success of local groups, and Ford (1971) has proposed that the calendrical ceremonies of various Indians of the American Southwest, which usually involve large-scale redistribution of foodstuffs, ameliorate differences in the harvests of the various households making up local communities. In some New Guinea Highlands societies rituals seem to regulate pig

husbandry and, through pig husbandry, other aspects of social and political life and ecological relations (Brookfield & Brown 1963, Rappaport 1968, Vayda, Leeds & Smith 1961).

Pigs are important to the subsistence of Highlands societies as occasional sources of high-quality protein in a diet otherwise consisting largely of tuberous vegetables; as converters of garbage, feces, and substandard tubers; and in some instances in tillage (the beasts' rooting softens ground to be gardened). Further they are important as wealth objects. Bridal payments, homicide compensations, and other such transactions usually include pigs, either alive or cooked. But although pigs are crucial to the operation of these societies, they can become too much of a good thing (Vayda, Leeds & Smith 1961), requiring additional labor for support, invading gardens, and possibly even pressing upon the ecological capacity of local group territories. The large, spectacular, noncalendrical ritualized festivals, which have been observed in virtually all of the Highlands societies, seem to be held in response to system-endangering increases in the size of local pig populations. In these rituals large numbers of pigs are sacrificed to spirts. The resulting pork is widely distributed, providing the donors with prestige and temporary surcease from the labor and tribulations of pig husbandry, the recipients with high-quality protein, and the environment with protection from possible despoliation by a plethora of pigs. Among the Maring, Narak, and perhaps other Highlands societies these ritual cycles, whose timing is based upon the demographic processes of local pig populations, also regulate the frequency of warfare and include conventions for redistributing people over land and land among people (Rappaport 1968).

Although we earlier discussed the informational aspects of ritual, our brief references indicate that rituals may do more than communicate information. They may themselves constitute corrective programs (i.e. sets of actions, such as distributions of foodstuffs or sacrifices of pigs) which return deviating variables to desired states. In some cases, for instance in the calendrical rituals of Southwestern Indians, ritual regulation is *time-dependent*, that is, it is undertaken at fixed intervals. In others, as in the noncalendrical pig festivals of Melanesia, it is *variable-dependent*. The occurrence of the ritual is a response to changes in the state of a regulated variable.

The virtue of regulation through religious ritual is that the activities of large numbers of people may be governed in accordance with sanctified conventions in the absence of powerful authorities or even of discrete human authorities of any sort. As such, it is plausible to argue that religious ritual played an important role in social and ecological regulation during a time in human history when the arbitrariness of social conventions was increasing but it was not yet possible for authorities, if they existed at all, to enforce compliance.

But ritual regulation has its shortcomings. It is rather inflexible, it may be slow to act, and its corrective actions are likely to be imprecise. Discrete authorities, who can respond immediately, proportionally, and perhaps in

innovative ways to systemic disturbance, are much finer regulating mechanisms than Melanesian ritual cycles, and the emergence of such authorities surely constituted an important evolutionary advance in which sanctification also played a part. Sentences such as "The chief has great mana," "Henry is by Grace of God King," and "Pharoah is the living Horus" imply, to say the least, that the directives of the authorities named are to be obeyed. These sentences further indicate that the regulatory prerogatives of these authories stood at least partially on sanctity rather than on power. Sanctity, it may be suggested, has permitted the progressive centralization of regulatory hierarchies in circumstances in which the ability of authorities to aggregate power is limited. [The chiefdoms of Polynesia (Sahlins 1958) may be cited in this regard.] Since the conditions enabling authorities to aggregate power seem to have emerged rather recently, it would appear that sanctity, before power, provided a foundation for the regulatory prerogatives of discrete authorities. Indeed, sanctity may have permitted the emergence of discrete authorities. It is important to remember that the archaic states were, at least at the outset, theocratic. Furthermore, it can be argued that it was their sanctity that made it possible for early authorities to begin to command the men and control the resources that eventually provided them or their successors with actual power.

With increasing power, authorities have come to rely less upon sanctification, but few authorities or social systems have dispensed with it entirely. The United States is "One nation under God," and its officers take oaths when they assume their duties. Sanctity is much less expensive than police, and no society can stand only upon the threat of force. Our observation, that sanctification presents to the individual as his own goals those of the society and thus replaces possible recalcitrance with compliance, remains true in contemporary societies.

VII

I have argued elsewhere (1971) that in technologically simple societies —whose authorities, in the complete or relative absence of power, stand upon their sanctity—the sacred and the numinous form part of an encompassing cybernetic loop which maintains homeostasis among variables critical to the groups' survival.

It has already been suggested that in such societies the prerogatives of the authority derive from his association with ultimate sacred propositions, but the unquestionable status of the ultimate sacred propositions depends upon the sense of the numinous, the affective religious experiences of the faithful. Inasmuch as the religious experience is an intrinsic part of the more inclusive emotional dynamics of the organism, which are closely related to its physical state, it is at least plausible to assume that religious experiences are affected by material conditions. But in technologically undeveloped societies the latter are at least partially a function of the control hierarchy that the religious experience itself supports. It may be suggested

that the willingness, indeed the ability, of the members of the congregation to affirm through religious experience the propositions that sanctify the control hierarchy may be in some degree a function of the hierarchy in maintaining homeostasis in and among those variables crucial to the congregation's survival. This is to say that should the authority be ineffective or repressive for a more or less protracted period, it may be faced with a millenial or revitalistic movement (Wallace 1966, Worsley 1957). In such movements, which have occurred countless times in human history, men sometimes withdraw the emotional support generated in their religious experiences from the sacred propositions ratifying existing authorities or regulatory institutions and bestow it upon new sacred propositions—enunciated by prophets, mystics, or messiahs—legitimizing new authorities or institutions. More frequently, such movements do not challenge ultimate sacred proprositions, but the connection of existing authorities or institutions to them. In either case, needless to say, these movements may be revolutionary.

Correction or change may, of course, occur in the absence of such revolutionary events. Ultimate sacred propositions, such as "the Lord our God, the Lord is One," are in fact propositions and they contain no material terms. Earlier we noted that it was necessary that these propositions contain no material terms, for this places them beyond the reach of falsification. There is another reason. If they are ***propositions*** containing ***no material terms***, they cannot be irrevocably bound to *particular* social forms. What is sanctified by any such ultimate sacred proposition is not specified by that proposition. Therefore, the association of particular propositions with particular directives or institutions is not intrinsic to the propositions themselves, but is rather the product of interpretive acts. Now, any product of intepretation allows reinterpretation, but reinterpretation does not challenge ultimate sacred propositions. It merely modifies, challenges, or replaces previous interpretations. Furthermore, continuing reinterpretation is likely to be assured by the cryptic nature of sacred discourse. It is not their weakness but their strength that myth and revelation are obscure. It is important, if evolution is to take place, that what is accepted as unquestionably true be clearly and definitively understood by ***no one***. Thus, the concept of the sacred not only may allow but may even encourage organizational change in response to changed circumstances and at the same time provide continuity through such changes. Since we described adaptation as, in part, the process by which homeostasis is maintained through organizational change, sanctity is important or even crucial in the adaptive processes of human groups.

A possible malfunction of sanctity may have become apparant in the course of this discussion. Sentences directly involved in regulation (thus including material terms and perhaps expressed as directives) are sometimes taken not merely to be sanctified by ultimate sacred propositions but virutally to be ultimate sacred propositions themselves. This results in a loss of adaptiveness, for oversanctified regulatory mechanisms are highly resistant to modification through reinterpretation. A possible instance of such

confusion in the level of sanctity to which a regulatory sentence is to be assigned is the prohibition of mechanical and chemical means of birth control to its communicants by the Catholic Church. Modification or abrogation of this prohibition could be achieved through reinterpretation without any challenge to dogma.

In the last paragraph the term *level of sanctity* was employed. If adaptiveness is to be preserved, the degree of sanctity accorded to a sentence should correspond to its position in a control hierarchy. This, in turn, should correspond to its logical type, which is also to say to its specificity. The higher their position in the control hierarchy, the higher the logical type of the sentences associated with regulation, and the greater the degree of sanctity they may be accorded. Ultimate sacred propositions cannot adaptively be irrevocably associated with anything more specific than the extremely underspecified goal of the social aggregate: survival. To bind them irrevocably to particular social forms (as, by implication, to private enterprise in its opposition to "Godless" communism) is to overspecify the terms under which the society may survive., i.e., to reduce its adaptiveness.

It also must be recognized that sanctity is degraded by power. When, because of technological development, it became possible for authorities to stand upon power rather than upon sanctity, they did not dispense entirely with sanctity. Rather the relationship between sanctity and authority changed. Whereas the unquestionable status of ultimate sacred propositions previously rested upon affirmation through the religious experiences of the faithful, it now came to rest, overtly or covertly, upon force. Whereas previously authority was contingent upon its sanctification, sanctity now became the instrument of authority. Coercion is expensive and difficult, and compliance and docility are achieved more easily and inexpensively through first the encouragement of religious experiences inspired by hopes of salvation in another life and, second, inculcation of the belief that the world's evils are a result of the worshipper's own sinfulness rather than a matter of external exploitation or oppression which the worshipper could possibly resist.

But although the sacred and the numinous may be degraded in the churches of technologically developed states, they may retain a positive role in the adaptation of contemporary societies. As we have already observed, revitalistic movements have arisen throughout history among men sensing and often suffering from the malfunction of control hierarchies that, perhaps because of overspecification and the oversantification of particular social arrangements or institutions, seem to have become unable to reform themselves. We are witnessing the emergence of such a movement now in the fervor investing ecological issues and the organizations being formed in response to these issues. It seems apparent that at least some of those participating in this movement are already according, out of emotional experiences that we may call religious, sacred status to general ecological principles at the same time that they are withdrawing sanctification from such

previously sanctified notions as progress, industrialization, and free enterprise. There seems to be a new ecological religion developing around us, and it should be taken seriously by scientific ecologists concerned with ameliorating the environmental problems currently besetting life on earth. Rivitalistic movements have frequently been as maladaptive as that to which they are a response, but nevertheless they may be regarded as a means, as old as religion (which is possibly to say as old as man), by which social systems that have become too rigid to correct themselves by other procedures are ultimately corrected. We may suggest that there remains for the sacred, which played an indispensable part in the emergence of man, a crucial role in his continuing survival.

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BIOLOGICAL CONTROL OF INSECTS

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Biological control of insects is a very broad subject and if in discussing it one were to tack on all of the biological manipulations utilized or suggested for insect control, the treatment might well require several volumes. Therefore, in view of the available space and the writer's experience, this paper will be concerned only with biological control of insects as effected by predators and parasitoids (natural enemies). Insect control by such factors as genetically determined host resistance to pest insects, autosterilization, and pheromonal manipulations of pest biology or behavior, will not be discussed. Nor will the paper touch upon microbial control of insects or biological control of weeds by insects. These are highly complex subjects which deserve the attention of appropriate specialists. In any event, biological control of insects as effected by predators and parasitoids is a sufficiently meaty subject to occupy the allotted pages.

The author belongs to that group which adheres to a broad concept of biological control of insects. This is the concept of Stern et al (77) and DeBach (13), which defines biological control as "the action of parasites, predators, and pathogens in maintaining another organism's population density at a lower average than would occur in their absence." This describes a natural phenomenon—the regulation of a species' numbers by natural enemies. There is no stipulation that biological control involve man's manipulation of natural enemies, but on the other hand the definition accommodates this possibility.

The current paper will treat two major aspects of biological control: the classic and the naturalistic. The paper will not meticulously examine all of the recent literature. Instead, critical publications, both old and new, will be cited as they relate to matters bearing on the present status of biological control of insects. Finally, the discussion will concentrate on developments subsequent to 1960, which marks the end of the period treated by the comprehensive volume *Biological Control of Insect Pests and Weeds* (12).

CLASSICAL BIOLOGICAL CONTROL

In the writer's view, classical biological control is the use of exotic natural enemies against pest insects. It has its basis in the fact that when insects