

BIOLOGICAL ASPECTS OF AGGRESSION AND VIOLENCE

by Hudson Hoagland

Studies of aggression and violence are represented by a rapidly growing literature, which I shall make no attempt to review, since others have done so very well.¹

Americans are indeed a violent people. Our homicide rate is eight times that of England and four times that of Japan, Australia, and Canada. A third of all Americans, fearful of mugging and sexual assault, are afraid to walk alone at night in their own neighborhoods. Rioting, burning, and looting haunt our major urban centers; and, as the tensions mount, Americans buy more guns. In 1967 firearms caused approximately 21,500 deaths (nearly three every hour)—7,700 murders, 11,000 suicides and 2,800 accidental deaths. In addition there were 55,000 cases of aggravated assault by gun and 71,000 cases of armed robbery by gun. There were more than 100,000 nonfatal injuries caused by firearms in 1966, and in 1967 some 4,585,000 firearms were sold in the United States.

Our children are fed violence continually by the mass media. One study shows that the average American child from three to sixteen years old spends more hours watching television than in attending school. According to another study, seventy American films showed twice as much violence as thirty films from other countries. Thus

Hudson Hoagland is president emeritus, the Worcester Foundation for Experimental Biology, Shrewsbury, Mass. This paper was presented at the Sixteenth Summer Conference of the Institute on Religion in an Age of Science, August 10-17, 1969, at Star Island, N.H.

images of violence brainwash the most impressionable members of our society.

For six hundred years the citizens of ancient Rome watched circuses in which men killed each other. Hundreds of thousands of gladiators perished in municipal arenas to the delight of the public. Today we get vicarious thrills out of seeing actors die violent deaths nightly on TV in our living rooms, and this represents progress over the intervening two millennia.

"That man is an aggressive creature will hardly be disputed," writes British psychiatrist, Anthony Storr, in his book, *Human Aggression*. "With the exception of certain rodents, no other vertebrate habitually destroys members of his own species. . . . The sombre fact is that we are the cruellest and most ruthless species that has ever walked the earth." Long ago (1911) William James said: "Man is the most formidable beast of prey and indeed the only one that preys systematically on its own species."

OUR EVOLUTION HAS VITIATED VIOLENCE AS A DEFENSE

Our great concern with the problem of violence has led to the development of a new scientific specialty. The psychobiology of violence is being studied by a number of biomedical specialists—psychologists, biologists, psychiatrists, neurologists, and pharmacologists. Their view is that whatever a person does, consciously or unconsciously, is a result of events occurring in his brain. This paper will primarily concern itself with aspects of these matters but, before discussing the brain and violent behavior, I would like to consider what is to me a false belief that we can maintain our national security by faith in our ability to produce more effective mass violence than could a potential enemy. This belief that we can get security by technology and its product, the armaments race, poses a most serious threat to our continued existence. This threat results from changes we ourselves have wrought in our environment by the invention and deployment of nuclear weapons, to which, as biological organisms, we must adapt or face extinction as a species.

General Eisenhower warned us of the danger to our future of the military-industrial complex. In 1969, 44 percent of our federal budget, eighty-one out of 184 billion dollars, was being spent on weapons that rapidly become obsolete and would be suicidal if used. General Shoup, commandant of the U.S. Marine Corps (ret.) and former member of the Joint Chiefs of Staff, wrote:

ZYGON

America has become a militaristic and aggressive nation. Our massive and swift invasion of the Dominican Republic in 1965, concurrent with the rapid build-up of U.S. military power in Vietnam, constituted an impressive demonstration of America's readiness to execute military contingency plans and to seek military solutions to problems of political disorder and potential Communist threats in the areas of our interest. . . . We maintain more than 1,517,000 Americans in uniform overseas in 119 countries. We have 8 treaties to help defend 48 nations if they ask us to—or if we choose to intervene in their affairs. We have an immense and expensive military establishment, fueled by a gigantic defense industry, and millions of proud, patriotic, and frequently bellicose and militaristic citizens. . . . Our militaristic culture was born of the necessities of World War II, nurtured by the Korean War, and became an accepted aspect of American life during the years of cold-war emergencies and real or imagined threats from the Communist bloc. . . . Somewhat like a religion, the basic appeals of anti-Communism, national defense, and patriotism provide the foundation for a powerful creed upon which the defense establishment can build, grow, and justify its cost. More so than many large bureaucratic organizations, the defense establishment now devotes a large share of its efforts to self-perpetuation, to justifying its organizations, to preaching its doctrines, and to self-maintenance and management.²

Nineteenth-century concepts of national sovereignty and balance of power have always led to war. These power concepts have produced two devastating world wars in my lifetime; a third one, with nuclear weapons, would destroy us. World war to advance national ambitions became obsolete in 1945 when we atom-bombed Hiroshima, and the kind of frenetic nationalisms we see everywhere today, fed by emotions of superpatriotism inflamed by communist, fascist, and militarist ideologies, are exceedingly dangerous in this crowded world of hydrogen bombs and chemical and biological weapons.

Vietnam is typical of the kind of vicious, escalating violence that is integral to competitive sovereignties torn by conflicting ideologies and uncontrolled by law to prevent war. I believe that more Vietnams are bound to recur frequently under the present system of irresponsible nation states in which hates develop between peoples, creating tensions that demand relief. The Israeli-Arab war, the Pakistan-India war, and the Korean War, as well as Berlin blockades by East Germany and the invasion of Czechoslovakia by the USSR, are other examples, any of which could escalate to World War III.

The invasion of Czechoslovakia by the Soviet Union and its satellite states is similar to our invasion of the Dominican Republic and our intervention in the civil war of Vietnam. All of these events are characteristic of a world in which power blocs and unrestrained national sovereignties, following concepts unchanged since the prenu-

clear age, guard their "spheres of influence" against potential threats, real or imagined.

Some twenty years ago, I pointed out that man's great cerebral cortex, which, more than any other organ, distinguishes him from other animals, may, in terms of biological adaptation, turn out to be a phylogenetic tumor, capable of producing chemical, biological, and nuclear weapons which can destroy him as a species. Our cerebral cortex is the most rapidly evolving organ known, having doubled in size in the last half million years. Its richness of neurones and interconnections is what distinguishes us from our nearest anthropoid relatives. While our neocortex has evolved so rapidly, our ancient limbic brain has changed very little in the past forty million years. Unless we can bring our intelligence to bear to control the hates and fears arising in this ancient brain, we may well join the thousands of other extinct species in the near future.

Richard Barnet, in a review of Ralph Lapp's book *The Weapons Culture*, wrote:

Military power is less and less relevant to the real threats to national security in a world undergoing political revolution, and its ineffectiveness to achieve useful political results is being demonstrated around the world, most notably in Vietnam. The plain truth is that, after spending \$1300 billion since 1945 on defense, the Pentagon cannot prevent the nuclear annihilation of the United States. Today more hostile missiles are aimed at us than ever before. Each year the people of the United States pay a staggering national security bill and end up with less security than they had the year before. It is not surprising that the military establishment seeks to justify a bad bargain in mystical or heroic terms, for the defense budget would not stand the test of practical social or political accounting. . . . As long as the premise undergirding the military establishment—that more weapons mean more security, more power, and more prosperity for the American people—is immune from political debate, we will continue to finance the "weapons culture." Public discussion of substantive issues of defense, in which the military establishment is challenged to defend its budget in terms of specific national priorities, would be useful. But the military will always come up with a plausible argument for more until the very assumptions of the arms race are rejected by the electorate and the great bureaucracies that feed on the defense budget are recognized for what they are: a threat to the national security.³

Arnold Toynbee has reviewed the history of the concepts of unrestrained sovereignty and national states which date only from the end of the thirteenth century. He writes:

This triumphal progress of the concept of national sovereignty over a period of five and a half centuries is impressive. It is proof of the concept's potency in captivating human hearts and winning their enthusiastic allegiance. The

ZYGON

cult has become mankind's major religion, a religion whose god is a Moloch to whom parents are willing to make human sacrifices of their sons and of themselves and of all their fellow human beings too, if a "conventional" war should escalate into a nuclear one. . . . The intensity of worship of the idol of the national state is, of course, no evidence that national sovereignty provides a satisfactory basis for the political organization of mankind in the atomic age. The truth is the very opposite. While our hearts are still blindly devoted to national sovereignty, our heads are already telling us that in this age national sovereignty spells mass suicide. The supreme political question of our time is whether the head is going to persuade the heart. Will allegiance to the fatal ideal of national sovereignty be transferred to the ideal of world government in time to save mankind from self-destruction?⁴

Konrad Lorenz and other ethologists have pointed out that animals well armed by nature in competing with each other for social status in the herd, pack, or flock, or in competition for mates and territory, seldom do each other much damage. Their fights are formalized duels in which threats play a major role. On the other hand, unarmed animals such as doves and rabbits, if confined together in a limited space, will fight to the death. They have never had to evolve surrender signals, as have the well-armed carnivores, horned ungulates, and hawks. Man is also biologically an unarmed animal, lacking fighting teeth, claws, or horns, and, according to Lorenz, his behavior in combat has the unrestrained property of the rabbits and doves in contrast with such animals as wolves, lions, and hawks. These latter indulge in ritualized combat, since, were they to use their powerful weapons on each other, the best of them would die and the aggression therefore would not be biologically adaptive. Aggressive gestures and formalized duels are adaptive, since they stabilize social organizations of animals, assuring proper spacing in hunting, grazing, and breeding territories, and produce hierarchical societies in which each animal knows its place with respect to those lower or higher in the hierarchy. This type of organization is characteristic of nearly all vertebrate animals including, of course, man, who has his own definitions of territoriality, is competitive, and is very much aware of social hierarchies into which he finds he must fit. Thus we are prepared to defend not only our homes and country but our ideologies—our politics, religion, and philosophy—as part of our territorial identification. Status in our social hierarchies is of great importance to us and is determined by possessions—by keeping up with, and surpassing, the Joneses—and the positions we achieve in business and the professions. We exert aggression in obtaining position on the ladders of rank, and we exert aggression, and sometimes violence, to hold such positions. Thus there is marked competi-

tion to attain the rank of professor, colonel or general, director or president, bishop or cardinal, or gangster leader. Man finds himself in many roles, and usually aggressive competition is involved in attaining and maintaining the roles of his choice. The parallels between the social behavior of many animal species and that of *Homo sapiens* shows many points of resemblance, as one might expect, since aggressive behavior in general is adaptive, although it may become nonadaptive in resorting to violence. Thus Hitler's aggressions were nonadaptive both for him and for Germany, and a nuclear war would be nonadaptive for the human species as well as for many plant and animal species.

There is a close relation between violent behavior and crowding, and it is for this reason that the threat of nuclear war will increase with population growth. Many studies of animals prove that crowding beyond specific limits, either in nature or captivity, results in fighting, collapse of social hierarchies, cannibalism, particularly of the young, and failure of various aspects of reproduction processes. In this way animal societies, ranging from lower invertebrates up, reduce their populations when they have exceeded a critical number. Thus populations tend to grow and decline in regular cycles. This has been demonstrated with rats, mice, hares, monkeys, lemmings, deer, and many other species, including a host of insect species. Among mammals the dying off is characterized by overactivity of the adrenal cortex called upon to meet competitive stresses. This stress response mechanism ultimately breaks down if the stresses of crowding are sufficiently prolonged and severe. The overstressed adrenal system produces atherosclerosis, hypertension, enhanced susceptibility to all infectious agents, and a variety of other endocrine and metabolic disorders which may result ultimately in death.

Space does not permit me to describe the many fascinating experiments both in the laboratory and in the field that prove these brutal methods of population control of animal societies. In man we know that crowding in concentration camps produced overactivity of the adrenal and deaths therefrom, even when the prisoners were well fed. Organized social relations among prisoners also collapse above certain levels of crowding. We suspect, but it has not been proved, that in slums and ghettos crowding accounts in part for the crime, delinquency, and rioting. Schizophrenia is much more prevalent in crowded urban areas than elsewhere. People with low flash points for violence, of whom there are estimated to be several million, are likely to be triggered off when crowded.

ZYGON

The world-population average growth rate of 2 percent will double the population in thirty-five years. Growth is faster in the poorer countries, and in some of the poorest countries the population is doubling in eighteen or twenty years. Under these stressful conditions, the probability of wars and revolutions is increased. Indeed, Robert McNamara, in his recent book, has shown striking correlations between population densities and revolutions and wars, which are inversely correlated with the wealth of the countries. Thus the hazard of international violence and nuclear war is enhanced by competition and stresses resulting from burgeoning populations.

WHAT IS THE ROLE OF THE BRAIN IN PRODUCING VIOLENCE?

I would now like to consider physiological bases of aggressive behavior and violence. There have been intense controversies over the years as to the significance of instinctive behavior at various levels of evolutionary development. Programmed into the nervous systems of animals by their genes are rich varieties of behavior patterns that may be triggered into action by stimuli in the environment. It is generally assumed that most of the behavior of invertebrate animals is of this kind: spiders are not taught by their parents to build webs, they are programmed to do it by their genes. Steps in the production of an embryo, human or otherwise, are programmed into the developing embryo and its mother without conscious action on the part of either of them. Intake and utilization of food and water and elimination processes are also programmed into us by our genes.

In the developing mammal, Lorenz and others have shown that the tendency to follow a moving object, called imprinting, comes about at an early age and cannot be elicited beyond a certain period in the animal's development. Imprinting assures that the young will follow the mother in its first adventures beyond the nest. Elaborate mating rituals of birds and of fish are certainly not learned but programmed into them and stimulated by environmental factors and internally secreted sex hormones that trigger the patterned rituals. Ethologists have studied the stimulating mechanisms which elicit mating and feeding responses in a variety of animals. For example, the gull has been extensively investigated, and the role of shapes and colors of objects in setting off stereotyped behavior patterns has been established. An interesting example of practical importance is that of a salmon river in Sweden that lost its salmon when a hydroelectric plant was installed that changed the speed of water flow, temperature, and vegetation, which in turn changed the nature of the river bottom. Knowledge of the pattern

of events involved in the breeding of salmon led to a student of behavior recommending the placement of beds of gravel, walnut-sized, along the river, since the salmon lay their eggs in this type of gravel. This again made salmon available in the river, upon which the livelihood of many people in the area depended.

We are familiar with squirrels that bury nuts in the ground in caches for the future. We are not so aware, however, that the same squirrel, if given a nut in a room with a concrete floor, will go through all the motions of burying it, since this process is instinctive and can be proved not to be acquired by learning.

Neurophysiologists have learned much about the mammalian brain in relation to functions of tracts of nerve fibers and centers of gray matter laid down by the genes that mediate the behavior characteristic of hunger and thirst, and about tracts and centers concerned with expressions of rage and fear—tracts triggered into action by appropriate stimuli. Indeed, advances in neurophysiology, brought about by surgical ablation of specific anatomical regions and tracts, by electrical stimulation of specific areas and by injecting minute amounts of chemical agents into localized brain areas, have markedly expanded our knowledge of brain and behavior in recent years. The review by Moyer (see n. 1) gives an account and references to some of these advances.

Localized electrical stimulation of brains of cats is illustrative. Cats which normally do not attack rats will do so during stimulation of specific regions of the hypothalamus. If the lateral hypothalamus is stimulated, the cat quietly and efficiently stalks and kills an experimental rat, biting it in a characteristic way. Nonkiller rats have also been stimulated in exactly this same way and turned into killers of mice. Animals when so stimulated, if no object is available, will explore in a restless manner, searching for a victim. The cat stimulated in the lateral hypothalamus shows unlearned preferences in the type of stimulus objects it will attack. An anesthetized rat will be attacked more quickly and persistently than a stuffed rat, but there is little tendency to attack a rubber block the size and shape of a rat. Stimulation of the medial hypothalamus produces a different kind of aggression. The cat then attacks with a scream, tearing at the stimulus object with unsheathed claws. In this case the object may very well be the experimenter. The limbic brain includes the amygdala and hippocampus, the phylogenetically ancient cerebral cortex; and these regions have rich connections to lower-brain structures such as the septum and hypothalamus which are definitely affected by localized electrical or

ZYGON

chemical stimuli. Focal stimulation or ablation of regions of the limbic brain produces emotionally charged responses of one kind or another, with fear and rage as extreme examples. Thus bilateral amygdalectomy will change a savage wild animal into a gentle, friendly one. This has been demonstrated for the usually untamable lynx and also for savage and dangerous macaque monkeys and other fierce animals. Following such an operation one may put one's hand in the mouth of an animal that normally would have bitten it off, and that postoperatively shows no aggression in response to handling. There are few animals more savage than wild Norway rats. Following bilateral amygdalectomy they can be handled as pets and put on one's shoulder or in one's pocket. These operations on animals produce no other changes in characteristic behavior. Delgado and his colleagues have implanted electrodes in the limbic brain of monkeys and, by telemetry, have been able to turn aggressive behavior on and off by electrical stimulation from a distance. The small stimulating wires are connected to a miniaturized stimulator buried under the skin, or attached externally, which picks up electrical signals from a distance. Under these circumstances the dominant, alpha monkey of the group was reduced to the bottom of the social hierarchy by limbic stimulation each time he showed threatening behavior to other group members. Immediately following such stimulation he retreated from his threatening posture and soon was reduced to the bottom of the hierarchy. Indeed, the stimulus key was left in the cage with the monkeys, and a submissive, but obviously bright, monkey discovered that when he was threatened by the boss, all he had to do was to push the key to remove the threat and in this way could control the situation—an example, I suppose, of "the meek shall inherit the earth."

There is Delgado's famous experiment in which a Spanish fighting bull with implanted brain electrodes charges at a man in the arena armed only with a telemetry stimulating box. Pushing one button stops the bull in full charge and pushing another turns it to trot amicably away.

The human brain contains structures similar to those of other mammals, and man's ancient limbic brain involved in mediating emotional behavior is most similar. A number of experiments with human subjects have been carried out, especially in relation to treatment of epileptics and brain trauma patients. Thus a mild-mannered woman became violently aggressive and hostile when electrically stimulated in a region of the amygdala. When the current was turned off she instantly reverted to her mild-mannered and apologetic self. Investigators

have discovered in brain systems suppressor circuits which are antagonistic to the aggression circuits. Interruption of these suppressor circuits can turn peaceful, gentle animals into killers. We can also, by cutting circuits mediating aggressive behavior, dramatically reduce it. This was demonstrated in the lynx that I have mentioned which, by amygdectomy, was turned into a friendly creature. It has been shown by a number of investigators that spontaneous firing of the aggressor circuits in man, as detected by recorded electrical activity, may make people a constant danger to those around them and to themselves. A few courageous surgeons have successfully operated on such people by producing lesions in the posterior hypothalamus. Lebeau in France recommends singulectomy on intractable cases of anger, violence, and permanent agitation. The patient's hostile feelings are thus brought under control. Indeed, a patient of Dr. Sano, after temporal lobe incision, reported that he could not get angry if he wanted to. Robert Heath in New Orleans has reported implanting permanent electrodes in the septal region of violent psychotics. A raving, violent paranoid patient, when stimulated by these electrodes, became relaxed, his hostility dissipated, he smiled and was at peace with the world. Such a condition may last for hours following a thirty-second period of stimulation. Moyer and Ervin have both pointed out that it is a short step from this to giving the patient his own transistorized power pack with an antihostility button which he himself can press whenever he feels intolerable hostility coming on.

To me the most interesting work being done along these lines is that of Frank Ervin, William Sweet, and their collaborators at the Massachusetts General Hospital. There are three major types of epilepsy—major convulsive seizures known as grand mal, transient lapses of consciousness or petit mal, and temporal lobe epilepsy, which has been called psychomotor epilepsy. This last type of epilepsy is characterized by periodic distortion of perception, hallucinations, and psychotic behavior involving the limbic brain systems. The temporal lobe epileptic can get in much difficulty socially, and alcohol can easily trigger off violence. While 85 percent of other epileptics can be controlled by drugs, 80 percent of temporal lobe epileptics are refractory to them. Surgery has been the only generally effective therapeutic procedure for temporal lobe epilepsy. The brain surgeon is aided in detecting focal epilepsy by the use of the electroencephalogram, although recording through skull and scalp is highly limited and not of much use in localizing deep lesions or those in amygdala or hippocampus. To improve on these procedures, the group at the Massa-

ZYGOX

chusetts General Hospital, in collaboration with Delgado of Yale, have designed and constructed a remarkable, lightweight telemetry apparatus. A stylet inserted deep into the brain, contains at intervals along its length fifteen small contact electrodes that can either pick up the local electrical activity of the brain or deliver electrical stimuli. The stylet is held by a plug-in box, connected with the surface of the skull, into which may be plugged leads to a small stimulator box attached to the subject, or to a broadcasting device which picks up the brain waves and feeds them by telemetry to a distant electroencephalogram recording machine and computer. The stimulator can pick up electrical pulses generated at a distance and activate one of the fifteen brain leads to deliver highly localized currents. The electrodes are located at various places in the limbic brain so that stimulation and recording can test multitudinous tracts involved in emotional behavior. With this equipment patients are free to move about unrestrained. They may be stimulated by an experimenter, unknown to them, who presses a key as much as a hundred feet away and in another room, and the brain waves can also be picked up from one or more of the fifteen leads, recorded, and correlated with the overt behavior of the patient. With this device it is possible to locate the source of abnormal brain waves and direct the surgeon to the proper place for treatment such as tract cutting or tissue removal in the case of tumors or other types of brain damage. This device is also used for treating intractable pain by stimulation of the lateral amygdala, where a stimulus delivered for roughly thirty seconds twice a day will relieve intractable pain for eight to twelve hours.

Some studied cases of violent behavior are illustrative: A twenty-two-year-old daughter of a physician had an irresistible urge to take long walks or runs at any hour of the day or night, and she also had at times gross illusions about the appearance of her face. During these seizures she might dangerously attack persons. On one occasion she plunged a blade of scissors into her nurse, who failed to take prompt interest in her statement that she felt a running urge coming on. She stabbed another woman in the heart when the lady inadvertently brushed against her. Electrodes were implanted in the hope of localizing a hippocampal lesion, and she was stimulated, without being told, by telemetry while she was chatting amicably with her psychiatrist. Before and after the stimulation her electroencephalogram was recorded, and it corresponded to behavioral changes. She promptly lost interest in her conversation and suddenly directed an attack against the wall with pounding fists. This coincided with high-voltage spikelike deflections

in the right amygdala and hippocampus. A similar attack occurred the next day in which, following similar stimulation, she swung her guitar past the head of her surprised psychiatrist, smashing the instrument against the wall. In each it took about two minutes following the brief stimulus to build up the electrical seizure, followed by the furious outburst.

Another patient was a baby-sitter who killed her crying charge by smothering it in a plastic bag. Later she confessed she had also destroyed another crying baby in a similar way, although at the time the cause of death had not been known. She also had occasional outbursts of violent destruction of things in her room. At nearly all other times she was pleasant and balanced. All her neurological tests were normal, as were her electroencephalogram and spinal fluid tests, but a pneumoencephalogram suggested a lesion on the tip of the left temporal horn of the brain. In attempting to locate this more precisely for surgery, a temporarily localized electrode placement was used. With the electrodes in place, an experiment was carried out in which a phonograph record of a crying baby was played to the patient. This immediately produced a seizure pattern in the limbic brain and a violent response, which was of great interest in view of her murders of two crying children. When the crying-baby record was turned off, the electrical seizure pattern stopped and so did her tantrum.

A clinic at the Massachusetts General Hospital has been studying the episodic loss of control in some 200 patients; 135 cases have been worked up in detail. Sixty percent of the group have been arrested for violent crimes, and eight are murderers. Many have used an automobile for assault. It is of interest in relation to the 55,000 people killed by automobiles annually in this country and the million persons suffering injury that about 50 percent of these deaths have involved the use of alcohol and that young people with criminal records have been responsible for a large fraction of these accidents. Violence, incidentally, is the major cause of death in the United States of people between the ages of sixteen and twenty-four years. In the Massachusetts General Hospital group of two hundred patients, a quarter of them showed temporal lobe electroencephalogram discharges of six and fourteen per second, characteristic of psychomotor epilepsy. In childhood most of them showed late enuresis, cruelty to animals, fire setting, or a recurrent history after puberty of violence to persons. Stimulation of certain areas in the limbic brain or the cutting of fiber tracts may relieve these attacks. Indeed, a properly placed electrical stimulus, lasting only a minute, may cancel out aggressiveness for periods up to

twenty hours daily so that self-shocking with suitably implanted electrodes may well result in self-control of these dangerous people, many of whom come to the clinic voluntarily because they fear that violence they have displayed in the past may be repeated.

These neurological approaches to violence are new—so new, in fact, that they have not as yet found application beyond hospital walls, but their potential for diagnosing violence and for correcting it are promising. It is believed that there are about a half-million temporal lobe epileptics, many of whom are dangerous. Postmortem examination showed that Charles Whitman, who deliberately shot and killed a number of people from a clock tower at a Texas university, had a small, slow-growing temporal lobe tumor.

Prisoners arrested for violence, including the so-called psychopathic personalities, many of whom may be suffering from temporal lobe epilepsy, are seldom studied by psychiatrists and given any form of therapy. It is especially significant that those arrested for violence show a 50 percent rate of recidivism. There is little information about the number of people with low flash points for setting off the brain mechanisms mediating violence. Genetic factors play a role here. Thus two Y chromosomes (the male-sex-carrying chromosomes) are found quite often among prisoners serving terms for crimes of violence. It has been known for a long time that certain chemical factors enhance violent tendencies and that male sex hormones play significant roles. This is clear from results of castration, turning bulls into gentle oxen, roosters into capons, fierce stallions into geldings, tomcats into house pets, and men into eunuchs. Moreover, the administration of the male hormone, testosterone, restores aggressiveness in all these cases. In one study of female prisoners, 62 percent of the cases of violence occurred in the premenstrual week, and only 2 percent occurred in the postmenstrual week.

Of all the drugs to which men are attracted, only alcohol seems to be agreed upon as an agent promoting violence when imbibed in sufficient amounts by susceptible persons. It seems likely, however, that there may be developed in the future specific chemical agents to activate special brain centers that may serve to block violent aggression. The present pharmacological tranquilizers do shift mood and suppress emotions to some degree, but they are relatively nonspecific.

Neurophysiologists working in cooperation with biochemists, psychologists, and psychiatrists offer hope of diagnosing violent behavior and ultimately bringing it under better control.

HOW CAN RELIGION HELP?

One of the topics with which this conference deals is the place of religion in the control of aggression, and I would like to conclude with a few remarks on this aspect of the topic that seem relevant to me.

In 1942 I discussed religion from the point of view of a biologist interested in the brain.⁵ I pointed out that the brain is an organ of great survival value, enabling animals to adapt better to their environments. It developed so as to enable animals to make configurations of their environments to which they could react effectively. Such configurations are necessary for motile animals to enable them to find food and mates, escape from predators, etc. In the course of evolution brains have become enlarged (there are ten billion neurones in the human cerebral cortex), with increased numbers of circuits and increased capacity to synthesize sensory data into meaningful configurations to which the organism can respond efficiently and so better survive by natural selection. I argued, and still believe, that man's concern with making sense of his universe is a direct product of the integrative properties of the brain. Science and art are aspects of behavior that bring significant portions of our world into relationships that are meaningful and therefore emotionally satisfying. The exercise of curiosity and imagination is a reflection of this basic property of the brain to form meaningful configurations—we see it in animal behavior from simple vertebrates on. Primitive man endeavored to bring order out of the chaos of the universe around him by animism, magic, symbolism, and myth. Sophisticated men have developed all-embracing ideologies, theologies, and monistic philosophies and sciences to interpret the universe—hopefully to control it, or to enable them to adapt to it. Thus, for me, religion in all its forms is a reflection of this process of adaptation in which man has attempted to bring sense and meaning to life and death and his own destiny in relation to the world, real or imagined, he finds about him—his “ultimate concern” as Tillich has used that term. I also argued that the all-embracing ideologies of communism and fascism were examples of synthesizing social concepts that brought the same type of satisfaction to their adherents as one found in religions and that thus, psychologically, Nazis or Communists had much in common with devout religious persons.

Inevitably the profound conviction of being right about an all-embracing theology or ideology results in intolerance toward others of different views. Thus most of the organized violence in the world has been caused by rigid religions and ideologies and superpatriotisms

ZYGON

controlled by authoritarian faiths. Such faiths, held by large numbers of people, give opportunities for power-hungry leaders—priests and kings and dictators—to exploit the ambitions of their followers and utilize their latent biological patterns of aggression for their own purposes. I believe more blood has been shed in the name of religion, thus broadly defined, than for any other reason, and that religion, as I understand it, cannot be very helpful in the control of international aggression and war, since, by its very nature, it promotes them.

The ethics of Judeo-Christian religion, and many of the other great religions, are based upon teachings of gentleness and the golden rule, and it is true that religions, including some primitive religions, have defused individual aggression and widened brotherhood to adjust personal conflicts among those of the in-group. But on a larger scale one thinks of the cruelty of the Crusades and the vicious Catholic-Protestant wars of the sixteenth and seventeenth centuries and of today in Ireland, the Mohammedan-Hindu wars, and our twentieth-century ideological wars involving facism, nazism, communism, militarisms, and superpatriotisms.

The role of the supernatural in religion has, to my mind, more often than not enhanced intolerance—after all, when authority for one's belief is revelation from God, there is little room for dissent. Warring nations have always claimed that God, or the gods, was on their side. In 1914, belt buckles of the German soldiers were stamped with the legend *Gott mit uns*.

I believe that, as a byproduct of advances in science, the supernatural has played, and will continue to play, a decreasing role. I am aware of the recent upsurge in interest in witchcraft and fortune tellers and understand that there are about ten thousand astrologers in the United States and only about one thousand astronomers, but I believe that this sort of thing is ephemeral and will pass. I hope that a humanistic religion can be found in which man, as a species, will acquire the loyalty now spread over quarreling national sovereignties and competing ideologies. Such an approach to human relations could mean profound improvements in our ways of living together, but so far I have seen little sign of its emergence; indeed, our era has shown enhanced fragmentation into hostile nation states.

Perhaps the time may come when nations can agree that the main aim of all their foreign policies is to live in a world with enforceable laws to prevent war. There would also have to be an educational system to teach the young that one has to be a human being before one can be American, Russian, Chinese, white or black, communist or

capitalist, and that basic human values worthy of loyalty and respect are independent of racial, national, political, or ideological boundaries. While all this may seem too utopian, it is nevertheless to be hoped that some of the rebellious students around the world may become leaders in developing such an educational system to advance world peace through world law.

NOTES

1. See, for example, M. F. Gilula and D. N. Daniels, "Violence and Man's Struggle to Adapt," *Science*, April 25, 1969, pp. 396-405; and K. E. Moyer, "Internal Impulses to Aggression," *Transactions of the New York Academy of Sciences* 31 (1969):104-14. Some books on the subject of this paper are: John Paul Scott, *Aggression*, Scientist's Library (Chicago: University of Chicago Press, 1958); J. D. Carthy and F. J. Ebling, *The Natural History of Aggression* (New York: Academic Press, 1964); and Konrad Lorenz, *On Aggression* (New York: Harcourt, Brace & World, 1966).

2. David M. Shoup, "The New American Militarism," *Atlantic Monthly* (April 1969), pp. 51, 56.

3. Richard Barnet, "On Living in an Arsenal," *Science*, April 19, 1968, p. 294.

4. Arnold J. Toynbee, "The Reluctant Death of Sovereignty," *Center Magazine* 1 (March 1968):28.

5. Hudson Hoagland, "Some Comments on Science and Faith," in *Conference on Science, Philosophy and Religion* (New York: Conference on Science, Philosophy, and Religion in Relation to the Democratic Way of Life, 1942).