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The Poison Weapons Taboo: Biology, Culture, and Policy

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Abstract. **Although the threat of chemical and biological warfare has grown, the actual use of poisons as weapons of war or terrorism remains rare. The reason rests in part on a long-standing taboo about poison weapons. This article explores possible biological and cultural explanations for the taboo; surveys the use of poisons by other species, by tribal groups, and by ancient societies; and considers the importance of snakes in developing attitudes about poisons. Reluctance to use poison weapons may have had its origin in the linkage of medicine, poisons, and mysticism common in societies everywhere. Whatever the reasons, however, antipathy to poison weapons is deep-seated, and most nations have embraced the norm that deems these weapons morally repugnant. Policies should be sought that enhance this attitude and therefore make the use of such weapons less likely.**

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THE THREAT OF CHEMICAL and biological warfare has grown dramatically in the past two decades. After the international community failed to stop Iraq's use of chemical weapons against Iran during the 1980s, more countries than ever began to develop these weapons. By the mid-1990s, as many as 25 had chemical weapons programs and 17 had biological weapons programs (U.S. Congress, 1993:82; Holum, 1994:1; Leitenberg, 1995). Worries about chem-bio terrorism also increased after the 1995 sarin nerve gas attack in the Tokyo subway by the cult Aum Shinrikyo.

But the heightened concern should not obscure an insistent fact: Historically, chemical or biological agents have rarely been used as weapons of war or terrorism. Understanding the reasons might lead to policies that reinforce this reluctance. This article explores possible biological and cultural explanations behind the reluctance, and their implications for policy.

Of the hundreds of wars and skirmishes during the twentieth century, perhaps a half-dozen involved chemical or biological weapons. Sustained chemical attacks occurred only in World War I and the Iran-Iraq War. The only confirmed use of biological agents against humans in battle was by Japan against China in the 1930s and 1940s (Harris and Paxman, 1982:80-81). As for chem-bio terrorism in this century, besides the Aum Shinrikyo episode, the only large-scale incident occurred in 1984 when the Rajneesh cult released salmonella bacteria in several Oregon restaurants (Török et al., 1997).

Explanations for the infrequent use of chemical or biological weapons have ranged from presumed difficulty in making them to uncertainty about their effectiveness. (On reasons for nonuse in war, see SIPRI, 1971:20-21; on terrorism, see Purver, 1995:40-45, 90-91). Yet others note that many chemical or biological weapons are cheap, easy to make, and potentially very destructive (U.S. Public Health Service, 1995; Cole, 1995:182-83).

The murkiness of our understanding of nonuse is underscored by such contrary views. But one reason that often

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goes unmentioned by specialists is the moral repugnance these weapons generate. The sentiment was aptly expressed in the Geneva Protocol (1925), which described their use as "justly condemned by the general opinion of the civilized world." Not that morality is the only explanation for the rarity of their use, nor, obviously, has it always succeeded as a means of prevention. But it is the backbone of a long-standing taboo about poison weapons.

Even scholars who emphasize the importance of the taboo differ about its origins. Mandelbaum (1981:38-39) suggests a genetic basis. Consonant with evolutionary biology, he postulates that an "inbred aversion to toxic substances" could have improved a person's chances of survival and discouraged their use as weapons. In contrast, Price (1997:6-7, 43) dismisses the notion that aversion to chemical weapons is rooted in human chromosomes. He believes the poison taboo emerged from the will of authorities to exclude "an indefensible weapon from the contestation of power."

For Moon (1993:673), the conundrum seems beyond understanding. While attaching great importance to moral opprobrium about poison weapons, he concludes that the origins of the taboo are "deep and ultimately mysterious." In affirming the value of the taboo, others do little more than note its existence (Robinson, 1993:40; Lederberg, 1995:2.177; Cole, 1994, 1996:64, 1998:213-14).

Only Price discusses the matter at length, though his investigation focuses on the chemical weapons taboo and its political construction during the past hundred years. His argument that genetic programming alone could not explain the taboo is sensible. Still, because repugnance about poison weapons has been expressed in many societies, ancient and modern, an exclusively cultural explanation also appears questionable. As proposed here, biological as well as cultural influences seem to have shaped the taboo.

Until the nineteenth-century discovery that microorganisms were the cause of infection, poison and disease were largely viewed as the same. Lethal substances had long been derived from minerals, plants, or animals, and their toxic effects were seen generically as poisonous. Pre-twentieth century observers did not categorically differentiate biological weapons (living microorganisms) from chemical weapons (nonliving materials) or toxins (chemical products of organisms). Thus, these contemporary distinctions would have been meaningless before this century.

Previously, firing poisoned arrows or catapulting plague-infected cadavers (an extremely rare occurrence) were virtual equivalents. The cadavers were more likely to cause contagion because, as was thought, the air nearby somehow became infected. But whether "biological" or "chemical," no matter the manner of delivery, poison weaponry was commonly considered insidious, subtle, and sneaky (Gentili, 1612; William of Malmesbury, 1991).

In seeking explanations for human reluctance to use poisons as weapons, this article examines the use of poisons by other species and by primitive and ancient humans. The linkage among poisons, medicines, and mysticism that was common in otherwise disparate societies may be central to understanding the roots of the poison weapons taboo. This linkage is exemplified in attitudes about snakes. As will be discussed, fears and phobias about snakes, which are extensive among humans and other primates, suggest a possible biological predisposition. But before exploring these notions, it is useful to recall the particular contempt that many societies have expressed about poison weapons.

Contradictory Tracks: Use and Condemnation

The poisonous effects of substances have been described through much of recorded history. Chinese medicinal texts mention drugs and poisons that were ostensibly discovered 5,000 years ago (Guthrie, 1946:34). The earliest preserved list of medicaments is the 3,500-year-old Ebers Papyrus. Produced in Egypt, it describes the effects of lead, antimony, hemlock, opium, and other vegetable and mineral poisons (Decker, 1987:3). Also, since antiquity, death by poison has in some societies been widespread, even deemed appropriate. Socrates' celebrated drink of hemlock in 339 B.C. was an unexceptional means of political execution in the Greece of his time. Assassination by poison was common as well in Europe during the Middle Ages (Doull and Bruce, 1986:6).

Yet, along with the history of poisoning-by-intention is a parallel history of special objections to the practice. As far back as 600 B.C., Hindu commentaries, called the Shastras, singled out the poisoner for disdain:

> A person who gives poison may be recognized. He does not answer questions, or they are evasive answers; he speaks nonsense, rub [*sic*] the great toe along the ground, and shivers; his face is discolored; he rubs the roots of the hair with his fingers; and he tries by every means to leave the house. The food which is suspected, should be first given to certain animals, and if they die, it is to be avoided. (Decker, 1987:2-3)

The Hindu Laws of Manu, also written in the millennium before the common era, excluded from battle "weapons that are concealed, barbed, or smeared with poison or whose points blaze with fire" (Doniger and Smith, 1991: chap. 7, sec. 90).

Gentili (1612: Book 2, chap. 6) cites ancient Greek and Roman writings that castigated the use of poisoned weapons as "abominable," "contrary to the laws of the Gods," "a violation of nature." In reaction to a spate of killings by poison, in 82 B.C. the Roman dictator Sulla issued the *Lex Cornelia*. The law, which remained in force until the fall of the empire, provided special penalties to poisoners, ranging from banishment to exposure to wild animals (Decker, 1987:7).

Disdain for poisons as war weapons was expressed during the Middle Ages by the monk/historian William of Malmesbury. In his twelfth-century opus on the kings of

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England, he observed that when someone "uses poisoned arrows, venom, and not valour, inflicts death on the man he strikes. Whatever he effects, then, I attribute to fortune, not courage, because he wars by flight and poison" (1991:84).

Jurists continued to castigate the use of poison weapons as contrary to the laws of war and/or nature—most prominently in the seventeenth century by Alberico Gentili (1612) and Hugo Grotius (1625), in the eighteenth by Emerich de Vattel (1758) and Robert Ward (1795), and in the nineteenth by Francis Lieber (SIPRI, 1973). The barring of poisons in war was later formalized in the 1874 Brussels Declaration and at The Hague Conferences of 1899 and 1907. But as demonstrated throughout history, laws and edicts might lessen the frequency of forbidden behavior, but not eliminate it.

The taboo was broken in World War I when the major combatants used poison gas, although even then within limits. Throughout the conflict, the British, French, Americans, and Germans were all reluctant to use gas against civilians. This was a "remarkable" development, according to Price, "given that inhibitions against air attacks against cities with explosive bombs were subject to gradual erosion during the war" (1997:63). (Price believes the reluctance was based as much on fear of retaliation against one's own civilians as on any moral inhibitions.)

After the war, the utility of poison gas was debated, with some arguing that it was militarily effective and less cruel than other weapons. But for many, the experience of large-scale chemical warfare was sufficiently horrifying to prompt calls for a ban. The resulting 1925 Geneva Protocol prohibited the use of chemical *and* bacteriological agents in war. Most major powers became parties to the agreement soon after. The U.S. Senate failed to ratify, although by 1927 the United States had effectively dismantled its gas arsenal (Price, 1997:92-95). (The United States ultimately became a party to the protocol in 1975.)

The text of the agreement reflects a sense of universal abhorrence about these weapons. Appealing to "the conscience of mankind," the protocol, as mentioned earlier, affirms that their use "has been justly condemned by the general opinion of the civilized world" (Geneva Protocol, 1925).

During the next 50 years, arms control treaties were established in a range of areas, from forbidding military weapons in Antarctica and outer space to curbing nuclear weapons testing and proliferation (United Nations, 1983). But none of these agreements described violations as uncivilized or unconscionable. Only in 1972, with the establishment of the Biological Weapons Convention, were these sentiments again expressed in a treaty. In banning biological weapons, their use was termed "repugnant to the conscience of mankind." Similarly, the 1993 Chemical Weapons Convention "reaffirms" the principles of the protocol and the biological convention, and seeks to ban chemical arms "for the sake of all mankind."

This special sense of repugnance reflects age-old attitudes about poison weapons, despite their use throughout history. Yet, even when poison weapons have been used, there often seems to have been simultaneous disapproval. The same can be said about other behaviors that have been widely disparaged. Taboos against cannibalism or incest are widespread and often presumed to have a biological basis (Dawkins, 1976:89-90; Pinker, 1997:455-60), although some think disapproval derives from culture (Harris, 1990:198-201, 428-30; Jones, 1997:14). Whichever the case, these behaviors also have been practiced throughout history, sometimes as a community norm. Cannibalism has been tied to rituals in primitive societies, and to survival under extreme conditions. Prehistoric humans may have eaten others as a means of social control or in reaction to stress (Gibbons, 1997:635; Bullock, 1997:1745-46).

In some societies, brother-sister incest was not only acceptable, but common, as was true in ancient Egypt. In the second century A.D., two-thirds of the married residents of Arsinoe were married to a brother or sister (Sigerist, 1951:239). Yet in most cultures, these behaviors—and several others that do not optimize group survival—have been disparaged.

Whether disdain about poison weapons arises from comparable impulses is the question to which we turn. In exploring possible biological as well as cultural antecedents of the taboo, we first examine the behavior of lower species. Does the use of toxins by invertebrates and other animals offer implications about human attitudes toward fighting with poisons?

Chemical Warfare among Other Species

Insects and many other creatures demonstrate no reluctance in using poisons as weapons of survival. In fact, among invertebrates the most common form of communication of all kinds is chemical. Chemicals that are used to communicate within a species are called pheromones. Their functions range from sexual attraction to inducing alarm and evasion. For members of a species, they may act as recognition odors, territorial markers, or agents to distinguish dominant from submissive animals (Wilson, 1975:231-34).

Given the importance of chemicals for communication and recognition among lower organisms, their role in defense is hardly surprising. A variety of animals use

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chemicals to repel attackers, from a skunk's malodorous spray to a bee's poisonous sting. The immediate effects of the chemicals differ. The skunk's odor discourages other animals from approaching; a bee's venom can kill insects and seriously injure birds and mammals (Gould and Gould, 1995:33-34).

Various insects, millipedes, caterpillars, and other arthropods eject noxious liquids when disturbed. A wide range of predators have been shown to be repelled by these emissions—ants, spiders, toads, lizards, jays, armadillos, mice (Eisner and Meinwald, 1966). But released agents are not limited to defense. Ants of the species *Formica subintegra* raid other ant colonies to loot their nests and enslave the victims. The attackers release acetates that "act at least in part as 'propaganda substances' because they evaporate slowly and help to alarm and to disperse the defending workers" (Hölldobler and Wilson, 1990:454). Agosta (1996:35) terms such action "aggressive chemical warfare." The behavior of another ant species, *Harpagoxenus sublaevis*, bears out this characterization as well:

> These belligerent ants boldly invade the nest of a chosen ant-victim. They throw out many of the resident ants or simply kill them, and then carry the victim's brood back to their own nest and raise them as slaves. During their raids, the slave-making ants bite their victims and spray them with a noxious liquid. The ant-victims defend their nest, but the spray confuses and terrorizes them. Under its influence, they turn upon their own nestmates and begin to fight among themselves. The chemical spray has brought a message that promotes dissension and civil war. (Agosta, 1996:175)

Poisonous snakes also engage in offensive poison warfare. While sinking their fangs into prey, they inject toxins that can cause paralysis or death, and ultimately provide a meal. Some snakes mount chemical warfare at a distance. Cobras spit toxins as far as ten feet with remarkable accuracy. Hitting the eyes of their prey, the venom causes temporary blindness, which allows the snake more easily to move in for the kill (Rage, 1997:41).

Snake venoms produce disparate effects. They can cause local inflammation, interfere with blood coagulation, or prevent nerve transmission (David, 1997:208-209). The neurotoxicity of some snake venoms is so potent that military analysts consider them potential warfare agents.

The use of chemicals by the bombardier beetle (*Brachinus* species) is particularly striking. The beetle's technique resembles the workings of advanced munitions in national chemical arsenals—binary weapons. A binary weapon contains two relatively safe chemicals in separate compartments. Upon launching, the chemicals combine to form a deadly agent. Much of the U.S. nerve gas inventory is housed in binary munitions. (Along with the rest of the U.S. chemical arsenal, they are being eliminated in accordance with international agreements, in particular the Chemical Weapons Convention, 1993.)

In the case of the bombardier beetle, two glands at the rear of the abdomen each contains two chambers. One chamber holds hydrogen peroxide and a mixture of phenols. The other contains common enzymes. If disturbed, the beetle opens a valve between the two chambers, resulting in a toxic mixture of quinones. With an explosive squirt, the mixture is then directed at a hostile target (Eisner and Meinwald, 1966:1349; Dean et al., 1990:1219-21).

Another form of animal chemical warfare is reminiscent of delivery systems that contain missiles with poison warheads. On the surface of some coelenterates, including jellyfish, sea anemones, and corals, are clusters of capsules called nematocysts. Each nematocyst contains a hollow thread and toxin. When the animal is disturbed, the nematocyst's cover opens and the thread-containing-toxin flies out and jams into the target. The thread remains attached to the nematocyst and is withdrawn from the targeted creature, leaving the toxin behind (Mariscal, 1974:129-78).

Thus, for many lower animals, especially invertebrates, chemical warfare is a prime means of both protection and aggression. But when chemicals are used as weapons, they commonly are directed against other species. In fact, whatever the weapon, targets of predation and killing are far more likely to be members of another species (O'Connell, 1989:15-17).

Reluctance to inflict serious injury in conspecific fighting is of evolutionary advantage to a species. No wonder that battles between same-species animals are commonly ritualized tournaments rather than mortal struggles (Eibl-Eibesfeldt, 1961:112). Fighting between conspecific poisonous snakes has been described as a wrestling match in which the winner pins the loser, then lets it escape (Eibl-Eibesfeldt, 1961:116; O'Connell, 1989:16).

Nevertheless, snakes have also been known to kill and even eat members of their species (Saint-Girons, 1997:177). While poisonous snakes sometimes seem unaffected by same-species venom, they are not entirely immune. One report tells of a rattlesnake that bit its own tail and died, apparently from its poison (Saint-Girons, 1997:177).

There are failures of restraint in other creatures as well: Varieties of ants may attack colonies of the same species. But whether for territory, predation, or slave-making, even among ants, fighting is less common within than between species (Hölldobler and Wilson, 1990:414-15).

Inhibition among lower life forms about using poisons as weapons seems no different from inhibitions about other methods of fighting: Lethal attacks against members of one's own species or colony, by poisons or other means, are rare. But against "others," chemicals seem no less part of the fighting armamentarium than biting, tearing, and crushing.

It is also noteworthy that at higher rungs of the evolutionary ladder, fewer creatures are naturally able to dispense poisons. Mammals by and large do not produce toxins in special glands or sacs. When encountering an enemy, they

may bite and tear, but the use of poisons is not a consideration. Thus, unlike the cases of ants and snakes, the release of poisons by humans is not a biologically ordained manner of fighting. An examination of war among pretechnological people suggests that many, though certainly not all, appeared reluctant to use toxin weapons.

Pretechnological Peoples and Poison Weapons

More than 60 years ago, Bronislaw Malinowski offered an anthropologist's view of warfare in primitive societies. He found "a bewildering variety in modes of fighting, raiding, and wholesale murder." Some tribes were pacific, others highly combative. The Trobrianders of New Guinea fought only in self-defense, yet were neighbors of headhunters who aggressively sought to exterminate their enemies (Malinowski, 1936:661-63).

The use of poisons in pretechnological societies is equally varied. Some groups, like the Yanomami in South America, reportedly fought with poisoned arrows routinely (Ferguson, 1995). Others, like the !Kung Bushmen in southwest Africa, freely hunted with poisoned arrows, but refrained from warring with them (Marshall, 1976:182, 288).

The lethal potential of poison weapons must have been widely understood. Behavior of the Hausas of northern Nigeria is instructive. Their choice of animal toxins, with which they covered their arrowheads, could hardly have been less sophisticated: "portions of the entrails of a dead monkey, heads of snakes, quantities of menstrual fluid, pus emanating from ulcers and guinea-worm sores and other *materies morbi*" (La Chard, 1905:26). Simple experience must have taught groups everywhere that introducing decaying animal matter into a person or animal could be deadly. Yet, while some tribes evidently showed no compunctions about tipping their arrows with such material, others demurred.

The Arawak and Carib of South America engaged in rudimentary chemical warfare (Turney-High, 1971:120). When the wind blew toward an enemy, they threw capsicum (chili peppers) into fires, and the noxious fumes supposedly disabled the targeted populations. While acknowledging that this form of chemical warfare was rare, Keeley (1996:52-54) contends that fighting with poisoned arrows was widespread. But his assertion is questionable.

A survey of literature on the subject suggests that most groups refrained from fighting with poison weapons of any kind. A bibliography of anthropological writings on "the technology of war" lists 170 publications since the late nineteenth century (Ferguson with Farragher, 1988:139-50). Only three titles explicitly refer to poison weapons (Codrington, 1890; La Chard, 1905; Carpenter and Hassrick, 1947). Perhaps other publications on the list also discussed poisons, although this could not be gleaned from their titles.

The *Encyclopedia of World Cultures* contains sketches of some 1,000 pretechnological societies. Derived from the Human Relations Area Files, the ten-volume work also has an index of subjects under which relevant groups are listed (*Encyclopedia of World Cultures*, 1996). Under "warfare," 183 are named. The sketches of the groups, however, rarely allude to their manner of fighting. Moreover, the index has no categories for toxins, poisons, or poison weapons. But under "curare," a poison from plants that can cause paralysis, seven societies are named. The seven, all from South America, used arrows or darts tipped with curare. But their sketches refer only to hunting with these weapons. Absent is any mention that the curare was employed against humans. Thus, the Panare hunted with "the blowgun, charged with curare-tipped darts." For the Puinave, "the blowgun was a common hunting weapon; darts were tipped with curare poison." The Tatuyo hunted with "the bow and arrow and the blowgun with curare-tipped darts" (*Encyclopedia of World Cultures*, 1994:265, 281, 323).

Failure to cite curare as a weapon of war does not mean that it could not have been used for that purpose. In fact, the encyclopedia's descriptions must be read with caution. The seven listings under "curare" did not include the Yanomami, who, as noted, hunted *and* fought with curare-tipped arrows. But for the scholars who wrote the sketches, curare in tribal warfare was not significant enough to warrant mention.

Other volumes about fighting techniques of pretechnological peoples typically make very few references to poison weapons (Murdock, 1934; Bohannan, 1967; Turney-High, 1971; Ferguson, 1984; Riches, 1986; Haas, 1990). A fair inference is that most tribal groups did not use them.

Even when their use is noted, descriptions are often cursory. Landtman (1927:150) reports that the Kiwai Papuans of New Guinea poisoned their arrowheads with "grease" from decaying bodies, and with other "medicines." But he says little else on the matter. Meggitt's book on the Mae Enga of New Guinea also makes passing reference to poisons in battle. The Mae clearly were a violent people; over time about 25% of adult males were killed in warfare (Meggitt, 1977:110).

Meggitt elaborates on the Mae's use of axes, spears, bows and arrows, and he notes the Mae were not squeamish about making victims suffer: Arrows tips were designed to remain embedded in human targets and cause a slow, tortured death. At the same time, he reports that "only a few Mae" used arrows that carried "in their grooves a cargo of decaying detritus that ensures infection of wounds" (Meggitt, 1977:56).

Meggitt leaves unclear why few Mae warriors applied poisons to their arrows. Similarly, Codrington (1890:215) does not explain why fighting in Melanesia with spears and arrows "which are not poisoned" was "common," but tipping the arrows with poison was only "occasional."

The Yanomami, largely isolated until the mid-twentieth century, live in the Brazil-Venezuela border area. Described as perhaps the most violent people on earth (Lumsden and Wilson, 1983:139; Booth, 1989:1138), in one region some 40% of the adult males had killed at least one other

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Yanomami (Chagnon, 1992:239). Throughout their society, raids and ambushes accounted for one-third of all adult male deaths (Harris, 1990:291). Moreover, the Yanomami often used curare-tipped arrows (Ferguson, 1995).

But accounts also suggest that their poisoned arrows were weapons of last resort. Violence between Yanomami groups was manifested by graduated expressions of aggression (Chagnon, 1992:214). The least violent form matched opponents who alternately punched each other's chests. Chest-pounding duels might escalate to more painful side slapping with stones in hand, and then to the use of clubs. Fighting could stop at any stage if one side felt vindicated or conceded defeat. But a dispute could also lead to all-out war, including the use of bows and arrows that were sometimes tipped with poison (Chagnon, 1992:211-14; Ferguson, 1995:294, 402-403). As with many other tribes, however, the Yanomami, this most fierce people, used their toxic weapons primarily for hunting (Chagnon, 1992:60).

Anthropologists have not associated the infrequent use of poison weapons in fighting with a sense of repugnance. Indeed, some suggest the opposite—that tribes that employed them did so to cause greater suffering to victims (Whitehead, 1990:150). Yet observers have also described groups in all parts of the world that used poisoned arrows to hunt animals, but never in wars against people. Besides the South African !Kung Bushmen, this was true of the Jibaro Indians in Ecuador, the Ainus in Japan, and the Aztecs in Mexico (Murdock, 1934:176, 379; Karsten, 1967:307-308). The reports do not discuss why these groups refrained from using poisons in battle. But the reasons were not likely related to production, deployment, or reliability of effects. After all, killing humans with poison weapons should have been no less effective than killing animals.

Broad investigations of the use of poison weapons are rare, and generalizations therefore must be cautious. Nevertheless, the available literature does allow for plausible inferences. For example, a 2,500-year-old manuscript by Sun-tzu (1993:108) about warfare in ancient China mentions the use of body armor, helmets, crossbows and bolts (arrows), halberds (pole axes), lances, and shields. It says nothing about poisons. Evidently, poison weapons were not used in war, or were so infrequently used that Sun-tzu felt the matter not worth mentioning.

A review of the anthropological literature about poison weapons suggests three conclusions. First, the potential of plant or animal toxins to injure and kill was broadly recognized. Second, several societies developed poison-tipped weapons, but many more did not. Third, among those that did, several used poisons only for hunting, not in wars against humans. Why would any tribe hesitate to use an easily obtained material that could inflict more harm on an enemy and enhance the odds of victory? The answer may lie in the seemingly mysterious action of poisons, and their linkage to medicines.

Poisons and Mysticism

The connection between poison, magic, and medicines is thoroughly reflected in the Yanomami use of mind-altering substances. Some of their poisons were hallucinogens, and tribesmen might scrape a small amount off their arrows and sniff it to get high (Chagnon, 1992:60-63). In fact, the men commonly inhaled drugs to contact spirits and attack the souls of their enemies. The drugs also played a part in healing rituals. A shaman might inhale hallucinogenic snuff to contact the spirits, and then chant and gesticulate to fight off someone's illness (Lizot, 1985:95; Chagnon, 1992:135-41, 158).

Drugs and poisons among pretechnological people had other mystical purposes as well. In some cultures, a person accused of sorcery or other crime might have to drink poison. Guilt would be confirmed by the person's death, innocence if the person vomited up the poison and survived (Warner, 1967:271-72; Gluckman, 1982:219). Associated with magic and the occult, poisons and medicines frequently were under the authority of the shaman, the medicine man, the witch doctor.

Whether a particular material is healthful or harmful is often a matter of quantity. The common origin of both poison and medicine was expressed succinctly by the sixteenth-century physician Paracelsus: "All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy" (Doull and Bruce, 1986:3). This understanding must have emerged among ancient tribes who found that potent herbs used in magical rites also proved useful as remedies (Allbutt, 1921:351-52).

Such discovery might well have aroused a mystique about poisons and medicines. Unlike tearing, breaking, or bludgeoning, the actions of poisons and medicines are subtle, less understandable, though no less profound. Carried within a single material is the contradictory potential to enhance life and to end it. It is not surprising, then, that poisons and medicine have been steeped in mystery. The association between the two is prehistorical and could have been the wellspring for the poison taboo.

To recognize that most peoples did not battle with poison weapons is not in itself evidence of moral behavior. Tribes that did not fight with poisons could otherwise be terribly

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vicious. A review of war among Fiji islanders in the nineteenth century discusses their frequent use of bows and arrows, spears, clubs, and slings, although nothing about poisons. But this was hardly an expression of moral sensitivity. Fijians reportedly were not above hacking off a prisoner's limb and eating it in front of him (Carneiro, 1990:197-203). Despite contradictory rivulets, however, the deeper current of self-preservation runs through all life. Central to the struggle for survival among humans is the quest for health.

The Medicine/Poison Proposition

In pretechnological and advanced societies alike, health has been deemed a self-evident value. Its centrality was enunciated unambiguously by the ancients. In the fourth century B.C., Hippocrates affirmed Greek attitudes by observing that "health is the people's most valuable possession" (Sigerist, 1961:243). Around the same time, Hindu writings maintained that "health is the supreme foundation of virtue, wealth, and enjoyment and salvation" (Sigerist, 1961:184). Babylonian letters frequently enjoined the gods Shamash and Marduk to "give thee health" (Sigerist, 1951:425). In today's world, the tradition is encompassed in Lorenz's observation that the "sanctity of the Red Cross is about the only one of the laws of nations that has always been more or less respected by all nations" (1966:289).

Whatever the ostensible cause of an ailment—evil spirits, an adversary's curse, a toxic agent—healing is encouraged through prescribed techniques. A !Kung shaman dances, shrieks, shudders, and groans to exorcise illness from a suffering tribesman (Thomas, 1959:129-34). A sick Navajo undergoes ceremonial days of sweat baths, icon waving, dancing, and sand painting (Sigerist, 1951:199-200). Mixtures of ritual, magic, and medicine have reflected the inexorable struggle for survival.

Poisons are also part of this mystical brew. Paradoxically, while the ends of medicines and poisons are opposed—to cure, and to sicken—the two are profoundly connected. But because they are often the same substance whose opposite effects are simply a matter of quantity, they may confuse our sense of order. Mandelbaum conjectures that by transgressing these boundaries, toxic weapons "may offend this deep-rooted sensibility" (1981:38).

The blurring of distinction between potions and poisons is fostered as well by their eerily similar manner of action. Before the age of scientific understanding, their introduction into the body would be seen as the start of an invisible, unfathomable process toward one end or the other.

Unlike weapons that smashed or palpably penetrated their target, poisons acted invisibly, subtly, often gradually. To the prescientific mind, their actions seemed mysterious and incomprehensible. No wonder the spirits were summoned and rituals performed to influence their effects. (We still remain awed by the forces of illness and healing. Even in the most advanced societies, prayers and rituals are invoked to encourage healing.) Could the connection between potions and poisons be at the root of the age-old reticence to use poisons as weapons? To fight with poisons would, in effect, risk disturbing the spirits.

Atkinson recalled that in pretechnological societies, the "doctor...was necessarily more or less of a sorcerer" (1962:13-14). The doctor/magician was called upon not only to heal, but to cast spells on foes. If his medicines and spells were deemed ineffective, he might be banished or threatened with death. The consequences of misapplying potions could be severe, and were a lesson to all. For the rest of the tribe, using poison weapons could have meant dabbling in mysteries that displeased the gods.

Prescientific peoples commonly ascribed misfortune to the anger of spirits whom they may have affronted (Gluckman, 1982:xix). Why risk a godly curse because of the errant use of a substance with mysterious properties? In the words of Gluckman (1982:232-33), "the power of what we can call 'good magic' [was associated] closely with the power of witchcraft and sorcery." The linkage was personified by the medicine man, the shaman who had the power both of "good" and "bad" magic.

In some tribes, the difference was based on a shaman's interpretation of the appearance or behavior of a single substance. The material housed a "duality [with] potential power for good and evil" (Gluckman, 1982:233). No substance would fit this description better than one containing the dual power to heal and kill.

The layman was not privy to the shaman's secrets. For the uninitiated, good magic and bad magic—medicine and poison—were mysteriously linked. All they knew was that using poisons might tempt the wrath of the spirits. These attitudes were surely nurtured by culture, but a glance at toxicology suggests a biological influence as well.

Toxicology

Ingesting materials that promote survival, and avoiding those that threaten it, are central to the quest for health and well-being. The earliest humans must have recognized that certain plants offered nourishment, but that others were harmful. They knew as well that products introduced by the bites of various insects, snakes, and other animals could cause injury and death. Moreover, certain minerals, plants, and animal products were seen to mitigate the effects of ailments. As medical historians frequently emphasize, human interest in finding antidotes and avoiding toxins "is rooted in prehistory" (Loomis, 1974:1; Casarett, 1975:4; Lu, 1985:4; Doull and Bruce, 1986:3; Decker, 1987:1; Hodgson and Levi, 1987:6).

Most of these descriptions assume that aversion to toxins is a learned response, a consequence of trial and error. None explores the possibility that the avoidance of toxins might have an innate component. Avoidance of poisonous foods

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has also been observed in a variety of animals, including birds, guinea pigs, and rats (Galef, 1989:57). Investigations of rats suggest that their avoidance behavior could have been learned by observing their mothers (Rozin and Kalat, 1971). But as one investigator recognizes, definitive explanations are elusive because observers can never be sure they have not disturbed the natural habitat (Galef, 1989:71).

At the same time, human attraction to nourishment and medicines is presumed by some to be innate. In the words of one medical historian:

> When illness has taken hold of the animal organism, instincts manifest themselves in a special way. The body craves what it needs to overcome the lesions and restore health. The dog taken by a fever seeks rest in a quiet corner, but is found eating herbs when his stomach is upset. Nobody taught him what herbs to eat, but he will instinctively seek those that make him vomit or improve his condition in some other way.
>
> And just as man in health sought and instinctively found the animal parts, plants, and minerals that his organism required for sustenance, so man in illness craved and instinctively found other plants, animal parts, or minerals that his body needed to overcome illness....(Sigerist, 1951:114; similarly, see Atkinson, 1962:16)

The depictions in this passage are so categorical as to appear suspect. But others have observed behavior in the wild in which animals evidently use plants for medicinal purposes. Work in this field, called zoopharmacognosy, reveals numerous instances of primates ingesting materials apparently to palliate ailments (Takasaki and Hunt, 1987; Huffman and Seifu, 1989; Newton and Nishida, 1990; Jisaka et al., 1992).

One report, for example, describes an ill female chimpanzee who was observed for two days in her natural habitat in Tanzania. When first sighted, unlike others in her company, she appeared lethargic and without appetite. While the others were eating their standard fare, the sick chimp sought out a highly bitter plant called *Vernonia amygdalina*, which is commonly used in African societies to treat parasites and intestinal upset. She sucked its juices during the afternoon. By the next afternoon, her stamina and appetite had noticeably improved (Huffman and Seifu, 1989:53-58).

The observers summarize their findings in the context of similar studies:

> The low frequency and lack of seasonality in the usage of this plant suggest that it is sought after for reasons other than as a food source. These factors suggest that for chimpanzees, the consumption of this plant is primarily medicinal. The symptoms displayed by the female are the same as those experienced by people throughout tropical Africa who utilize this plant as a medicinal treatment for them. (Huffman and Seifu, 1989:51)

If humans and other animals are innately attracted to plants that nourish and repelled by those that cause illness, a deep-seated aversion to harmful chemicals would not be surprising

Did the chimpanzee's behavior arise from an innate attraction to the palliative material, or was it learned from others in her community? The studies generally do not weigh the question. Michael Huffman, however, a contributor to many of the primate/medicine reports, is currently investigating the interplay of physiological mechanisms and social conditioning. In a personal communication in July 1997, he indicated to me that "an innate mechanism is no doubt one of the factors which molds self-medicative behavior."

If humans and other animals are innately attracted to plants that nourish and repelled by those that cause illness, a deep-seated aversion to harmful chemicals would not be surprising. The existence of such an imprint in the human brain, and its effect on attitudes toward poison weaponry, can only be conjectural. But a review of reactions to snakes, the most famous purveyors of poisons, sheds light on this.

Attitudes about Snakes

Insofar as the tie between poisons, medicines, and mysticism might bear on the matter, attitudes about snakes are of particular interest. A preeminent symbol of veneration and evil, the snake bears venom that has long been appreciated as both medicinal and poisonous. Anxiety about snakes is common among a variety of primates. African monkeys, including guenons and vervets, broadcast particularly strong alerts when they spot snakes that can harm them, such as pythons, cobras, and puff adders. Chimpanzees also become apprehensive and send out warning calls in the presence of snakes (Mundkur, 1983:218-29; Wilson, 1984:93-94).

Snakes appear to evoke fear and fascination among humans everywhere. They are commonly considered strange or endowed with supernatural power. "Generally seen as a treacherous and cruel animal, [the snake's] image has long been used by various civilizations to represent the most dangerous forces of evil" (Fourcade, 1997:185). This imagery appeared in numerous cultures, including ancient Greece, Rome, and Mesopotamia, in Jewish, Christian, Moslem, and Hindu traditions, in early and modern Africa and Asia, and among New World Indians, African Zulus, and Australian aborigines (Wilson, 1984:85; Fourcade, 1997:184-93). The Yanomami believed that death by snakebite was not caused by the animal itself, but resulted from spells cast by sorcerers or shamans (Lizot, 1985:110).

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In his book of teachings, Buddha used the snake as a metaphor for the bane of enlightenment: "You must break the bonds of worldly passions and drive them away as you would a viper" (*The Teaching of Buddha*, 1988:24). The ancient Egyptians believed that the god of the underworld, Apop, was a huge snake that embodied darkness and evil. According to the Ebers Papyrus, produced around 1500 B.C., the sun god Ra sought to protect gods and humans from snakes after he received a venomous bite. The words imputed to Ra suggest the strange terror of the experience:

> I have been stung by a serpent which I could not see. This is not the same as fire; it is not the same as water. But still I am as cold as water and then again as hot as fire. All my body sweats, and I tremble. (Minton and Minton, 1980:172-76)

In Genesis, the personification of evil is the serpent, who entices Eve to ignore God's admonition not to taste the forbidden fruit. "Because you did this," said God to the serpent, "more cursed shall you be than all cattle and all the wild beasts" (*Tanakh*, 1985:6). Other biblical passages characterize snakes as ominous, crafty, insidious. Their venom was seen as the "epitome of evil," according to Muntner. "The snake stood for sheer malice and spite, striking even without profit to himself" (Muntner, 1966:65-68).

Moses Maimonides, the twelfth-century physician and Jewish religious philosopher, fully appreciated the centrality of the snake in consideration of poisons. His classic *Treatise on Poisons and Their Antidotes* (1966) included discussions of mineral and vegetable poisons as well as the toxins of snakes, scorpions, spiders, bees, and rabid dogs. But he named only the snake in the title of his section on animal toxins: "Concerning the Bites of Snakes and Some Other Poisonous Animals." The other sources of poison seemed incidental.

Why such special attention to the viper? Several scientists have conjectured that revulsion toward snakes has a biological basis—that venomous bites "left some subtle trace of fear in the brains of man's prehuman ancestors" (Minton and Minton, 1980:51), and that innate fear explains why some "people dread snakes without ever having seen one" (Pinker, 1997:388; see also Blakeslee, 1997:F4).

Noting that many human and nonhuman primates exhibit anxiety in the presence of snakes, biologist Belaji Mundkur postulates that neural programming began 25 million years ago. Primitive primates would have been selected to respond nervously to sinuous serpentine movements that presaged an attack. Reinforced by the fear of venomous bites, the neural effects carried into succeeding generations. Mundkur (1983:224, 242) concludes: "The biological factors that impel man to fear and loathe the serpent were in existence eons before he acquired the cultural traditions that nurture his bias even in modern societies."

For Mundkur, the snake's poison was important to the development of the bias. For Edward Wilson (1984:96), it was central. The reason that humans fear snakes is "direct and simple," he writes: Their venom has been a major cause of sickness and death throughout history. This generations-old experience has led to a genetic imprint that has been stitched into human cultures.

> Here, then, is the sequence by which the agents of nature appear to have been translated into the symbols of culture. For hundreds of thousands of years, time enough for the appropriate genetic changes to occur in the brain, poisonous snakes have been a significant source of injury and death to human beings. The response to the threat is not simply to avoid it, in the way that certain berries are recognized as poisonous through a process of trial and error. People also display the mixture of apprehension and morbid fascination characterizing nonhuman primates. They inherit a strong tendency to acquire the aversion during early childhood and to add to it progressively, like our closest phylogenetic relative, the chimpanzees. (Wilson, 1984:97)

Some people appear comfortable about handling snakes, Wilson concedes, but their inborn anxiety must have been overcome through "special effort" (Wilson, 1984:95). Even if Wilson's view of pervasiveness is exaggerated, snakes do—as discussed in the next section—commonly elicit phobic reactions (Davey, 1995a). Moreover, whether or not genetic programming is responsible, snakes capture extraordinary symbolic attention. In many societies, snakes have been prominent in art and religion. Central to the fabled history of varied cultures, they appear in rituals as signs of awe and power. They are prominent in old and new societies as symbols of divinity, cosmogony, fertility, and of the sun, moon, and heavens.

Mundkur (1983:74) recounts the breadth and significance of the "fear of venom" in attitudes toward serpents. This fear, he contends, has prompted ambivalence in humans that is manifested as veneration and revulsion. Frightening and mysterious, the snake has been worshipped for its medicinal power in societies as distant from each other as the Indians of Bolivia and the Bushmen of Africa (Mundkur, 1983:74, 176).

The snake-entwined caduceus was a symbol of the healing arts in pre-Hippocratic Greece (Atkinson, 1962:29). It has since become the universal emblem of the medical profession. At first depicting a single serpent, the emblem later came to show two snakes wrapped around the staff of Mercury, facing each other in perfect symmetry. In considering the tie between poison and medicine, the duality is striking. The linkage also drew from ancient deities like Gula, who was the Mesopotamian goddess of potions and also the goddess of poisons (Sigerist, 1951:433).

Though rooted in history, the potion/poison linkage is exemplified by the various medicinal properties of snake venoms. In mainstream medicine these venoms have been

used as pain relievers, anti-coagulants, anti-convulsants, in the treatment of arthritis, and more (Minton and Minton, 1980:121-24).

Could the seemingly contradictory association between medicine and poison have contributed to reluctance to use poisons as weapons of war? The way the snake and its venom have been perceived across time and cultures reinforces the likelihood. Furthermore, the prevalence of snakes as phobic stimuli suggests the possibility of a biological basis for the association.

Phobias and Evolution

For behavioral psychologists, the presumption that phobias are rooted in biological cause is a matter of continuing discussion. Nearly three decades ago, Martin Seligman suggested a connection between phobias and evolution. In the interest of "survival of the human species," he wrote, phobias are "highly prepared to be learned by humans." His concept of biological preparedness was grounded in the observation that

> by and large, [phobias] comprise a relatively nonarbitrary and limited set of objects: agoraphobia, fear of specific animals, insect phobias, fear of heights, and fear of the dark, etc. All these are relatively common phobias. And only rarely, if ever, do we have pajama phobias, grass phobias, electric-outlet phobias, hammer phobias, even though these things are likely to be associated with trauma in our world. (Seligman, 1971:312)

Seligman's idea spawned a generation of behavioral scientists who sought to test the preparedness proposition. A recent article by Graham Davey (1995a:289-97), while questioning the proposition, reviews various experiments on the matter. Davey's article is accompanied by 19 commentaries, including several from authors whose investigations he critiqued. The narratives offer a picture of the spirited discussion that has evolved over the decades.

Beginning in the 1970s, for example, investigators tested reactions of human subjects to "fear-relevant" stimuli and "fear-irrelevant" stimuli. The former were slides of snakes and spiders, the latter slides of objects like houses and flowers. In some experiments the subjects were conditioned to fear the images by receiving an electric shock as they viewed each slide. After conditioning, the slides were shown unaccompanied by shocks. The result: subjects remained fearful of snakes and scorpions but not of houses and flowers (Öhman, Fredrikson, and Hugdahl, 1978; Öhman, 1995:310-11; Rosenhan and Seligman, 1995:236).

In subsequent experiments, the images of houses and flowers were replaced by guns and electric outlets. Although fear-relevant, the latter were presumed too recent in human history to have affected any genetic predispositions. In fact, the guns and outlets could no more induce persistent fear than houses and flowers. But fear of snakes and spiders continued to resist extinction (Davey, 1995a:290-91).

Primate studies also suggest evidence in behalf of biological preparedness. Laboratory-bred monkeys observed videos of other monkeys behaving fearfully in the presence of certain objects. The videos were spliced so that the demonstrator monkeys seemed to behave as fearfully in the company of toy rabbits as toy snakes. When later shown these objects, the observer monkeys consistently exhibited fear toward toy snakes, but not toy rabbits (Davey, 1995a:291-92; Mineka and Cook, 1995:307-309).

Davey believes that neither the human nor monkey experiments exclude the possibility of nonbiological causes for the reactions. In the case of the human tests, he would not rule out "expectancy" born of culture as the key influence. As for the monkey studies, he wondered if they were not marred by "the degraded signaling power of video presentation" (Davey, 1995a:291-92).

Investigators who conducted these experiments dismissed Davey's doubts. Arne Öhman (1995:310), who ran many of the human experiments, allowed that bias or Pavlovian conditioning has some bearing on phobic behavior. But the studies on humans and monkeys provide "decisive information [in support of] the role of evolutionary contingencies in phobias." Similarly, Mineka and Cook (1995:309), who performed the monkey tests, concluded that "evolutionary memories...quite probably underlie the widely observed uneven distribution of human fears and phobias."

Most of the other commentaries also maintained that biology is central to phobic behavior. Even the more equivocal ones would not exclude the possibility of biological preparedness (Davey, 1995a:297; Edelmann, 1995:299; Schell and Dawson, 1995:312-13). Moreover, none appeared to doubt that snakes and spiders evoked uncommon fear. And throughout the narratives, snakes were the most frequently cited fear-provoking stimuli.

Whatever their differences about the cause of phobias, observers agree that snakes are a preeminent phobic object. Scarcely mentioned in the commentaries was the fact that snakes and spiders are broadly perceived as poisonous. Only Davey alludes to the fright induced by "venomous snakes" and that "spider phobics believed that spiders were poisonous" (1995b:319, 321). But the poison association was implicitly ever-present in the repeated casting of snakes and spiders as fear-inducing creatures.

In considering human aversion to poison weapons, Price (1997:6-7) rejects the possibility of a biological influence. If genes counted, he asks, "why would we not have a 'genetic aversion' to cutting steel, napalm, bullets, and shrapnel?" The answer may lie with the empirical work on the causes of phobias. As related to human lore, history, and fears, purveyors of poison—whether snakes, scorpions, or certain people—are often viewed differently from users of guns and steel.

Whether the poison stricture arises essentially from nature, from culture, or more likely a combination of both, it has become so universal a value that it can lend great authority to policy

Policies: Agreements and Tranquillity

The notion that the poison taboo is connected to an innate sense of repugnance remains only suggestive. Some animals and insects freely use poisons as weapons, although not usually against their own species. But based on the treatment of poison weapons by diverse peoples—primitive, ancient, and modern—the possibility of a natural aversion to their use cannot be dismissed.

In World War II, the Germans refrained from chemical warfare on the battlefield. Yet they did kill millions of Jews and others they deemed "subhumans" with gas. By believing their victims to be vermin, they could override compunctions about using poison weapons against them. Two centuries earlier, a similar deprivation of a people's humanity allowed a British general to encourage their extermination by disease. Sir Jeffrey Amherst considered his Indian foes savages and urged that blankets infected with smallpox be given to them "to extirpate this exorable race" (Stearn and Stearn, 1945:44-55).

As demonstrated in World War I, however, even when foes are not dehumanized, the poison taboo has not always been respected. But neither have other forbidden behaviors. If the ubiquitous disparagement of incest, cannibalism, and homicide derives from an evolutionary impetus, the same might be said of the poison taboo.

Whether the poison stricture arises essentially from nature, from culture, or more likely a combination of both, it has become so universal a value that it can lend great authority to policy. Arms control agreements and efforts to fight disease are examples of how the sense of abhorrence might be used to enhance policy objectives.

Strong Agreements

In appealing to the conscience of mankind, the treaties that ban biological and chemical weapons reinforce preexisting inclinations against their use. Strong agreements that provide for verification and punishment of cheaters are as necessary as laws that proscribe other immoral behavior. The Chemical Weapons Convention (1993), which went into force in 1997, substantially advances the effort. Unlike any earlier treaty, it contains provisions to verify compliance, including on-site inspections of suspicious locations. Negotiations to add similar provisions to the 1972 Biological Weapons Convention are also underway (Toth, 1997).

In the end, effectiveness of strong treaties depends on the will to enforce them. As the twentieth century draws to a close, the willingness to sustain another pivotal agreement is being tested. After the 1991 Gulf War, Iraq agreed to comply with UN Security Council Resolution 687 (United Nations, 1991), which required the destruction of Iraq's weapons of mass destruction, including its biological and chemical arsenals. Trade sanctions that had been imposed in 1990 when Iraq invaded Kuwait were to be lifted after the forbidden weapons were accounted for or destroyed. A special commission (UNSCOM) was established to oversee implementation of the agreement. During the following years, UNSCOM inspectors destroyed tons of prohibited materials, but Iraqi cooperation remained sporadic (United Nations, 1996).

In April 1998, UNSCOM determined that Iraq still had not issued the required "full, final, and complete disclosure" about its forbidden programs. In particular, the inspectors worried that Iraq had not accounted for all its biological weapons (United Nations, 1998). Nevertheless, members of the Security Council, notably Russia, China, and France, began to urge easing of sanctions because they were causing hardship to the Iraqi people (Crossette, 1998).

The United States and the United Kingdom continued to demand full compliance before altering the sanctions. Their positions reflected sentiments expressed by President Bill Clinton (1998): Failure to obtain full accountability from Iraq would signal to others that they can develop biological and chemical weapons with impunity. The consequence would likely be a twenty-first century rife with these weapons.

Clinton's fears were entirely appropriate. Insisting on Iraqi compliance restates the moral norm that has long placed poison weapons beyond the bounds of legitimacy. By 1998, 159 countries had signed the Biological Weapons Convention and 168 the Chemical Weapons Convention, including Russia, China, and France. The three countries had also ratified and become parties to both agreements. They need reminding of their contractual obligation, both moral and legal, that holds such weapons "repugnant to the conscience of mankind." Parties to the conventions have no legitimate choice but to insist on Iraqi compliance, and effectively strong treaties.

Days of Tranquillity

Salutary policies need not be limited to strengthening and enforcing treaties. Another possibility, especially relevant to biological weapons, emerged in the 1980s in the form of a quest for health.

In the past dozen years, warring parties around the world periodically suspended hostilities to permit programs of immunization against polio and other diseases. The prototypical experience occurred during El Salvador's civil war. From 1985 until 1990, when the conflict ended, the United Nations Children's Fund (UNICEF), the Pan American

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Health Organization (PAHO), and the local Catholic Church arranged for three cease-fires a year between the government and guerrillas. Termed "days of tranquillity," the aim was to give every child in the country immunization and booster shots (Schneider, 1991).

The Salvadoran experience emboldened international health officials to encourage similar truces elsewhere—in Uganda, Lebanon, Sudan, the Philippines, and Sri Lanka (Hay, 1990; Vittachi, 1993; Hull, 1997). Whether the immunization cease-fires helped resolve the conflicts is uncertain. But the programs contributed to the worldwide effort to eradicate polio, manifested in an 80% decline in reported cases since 1988 (Hull, 1997).

The connection of all this to the prevention of biological warfare should be obvious. One can scarcely imagine a program more likely to reinforce the notion of abhorrence about using biological agents for hostile purposes. A party that suspends fighting in order to eradicate disease one day is far less likely to spread it the next.

Days of tranquillity should be widely celebrated as humanitarian battles *against* pathogens. Of course, heralding such events cannot guarantee good behavior elsewhere. But they graphically reinforce the norm that biological weapons are unacceptable among civilized people.

Not all the tranquillity efforts went well. The program in Bosnia was halted after a UNICEF official was killed. But overall success can be measured by the large number of warring parties from vastly different cultures who suspended harsh conflicts to permit immunizations.

Even terrorists are part of the cultural norms and values of this world. They tend to use the weapons that governments use (Leitenberg, 1995). Aum Shinrikyo, the cult behind the 1995 sarin attack in Tokyo, apparently became interested in chemical weapons by the publicity about the Iraqi arsenal (Jenkins, 1997:49).

The world's nations were largely silent as Iraq used chemicals against Iran between 1983 and 1988. The terrible consequence was a weakened taboo, and many other countries then felt they could develop chemical and biological weapons with impunity.

The international community now has at hand the means to reassert the attitudes that prevailed for nearly seven decades after World War I. Until the Iraqi transgressions in the 1980s, chemicals were rarely used, and biologicals even more rarely.

Those who insist that biological weapons are the weapons of the future must explain why they have not been weapons of the past. Why have these easy-to-make, easy-to-disseminate, inexpensive weapons almost never been used? The answer, at least in part, rests in reasons that inspired the days of tranquillity. In the human psyche resides a deep-seated aversion to disease and agents that cause it. Fostering this attitude is no less important than enhancing export controls, intelligence, and other measures to avert biowarfare.

In our lifetime, the elimination of all military conflict is no more likely than the elimination of all disease. That reality, however, does not lessen our human obligation to minimize the misery of disease, or the frequency and brutality of conflict.

Conclusions

The origins of the poison weapons taboo can only be presumptively understood. Incomplete historical records and variations in human behavior, both among individuals and societies, are impediments to the quest. Nevertheless, the patterns of behavior reviewed here suggest that in most societies throughout history, poisons were explicitly or implicitly deemed inappropriate weapons of war.

Animals and insects that use chemicals as weapons deploy them mainly against members of other species. Many pretechnological groups, ancient civilizations, and modern nations have refrained from using toxins, although their effects were widely understood. Reluctance to use poison weapons may have had its origin in the linkage of medicine, poisons, and mysticism common in societies everywhere.

Health is a prized value in all societies. Shamans and spirits that could bring people health also had the power to impose sickness. The pervasive symbol of the snake, found in cultures everywhere, often represented a powerful connection between venom and medicine. Moreover, the seemingly mysterious action of poisons could have discouraged their use by warriors who did not want to anger the spirits.

Experiments suggest that the fear induced by snakes, and implicitly their poisons, may derive from biological programming. But whatever the reasons for the poison weapons taboo, whether based on biological or cultural influences, or both, most nations have embraced the norm that deems these weapons especially repugnant. Policies should be encouraged that enhance this attitude, like strong treaties and "days of tranquillity," which make their use less likely.

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