Bloomsbury Advances in Semiotics

WARNING SIGNS

THE SEMIOTICS OF DANGER

MARCEL DANESI

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Warning Signs

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The Semiotics of Danger

MARCEL DANESI

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Preface

Signs of danger are everywhere. Some are human-made ones designed as specific warnings, such as the typical labels indicating the presence of poison in bottles or the hazard placards alerting people to the presence of toxic waste at specific locales. Others are immanent in the environment, including extreme meteorological events such as hurricanes and tsunamis, which are natural warning signs of danger to human life. How do we understand warnings and the dangers they represent? What do they tell us about the sense of danger itself? How have humans perceived and dealt with danger across time and across cultures? Are paintings on prehistoric cave walls the first recorded images of danger and fear? Are ancient flood myths cautionary warning tales of human destructive activities?

These are the kinds of questions that fall directly under the analytical rubric of semiotics—the science of signs. But, as far as can be told, this discipline has been used only once in the past to study danger and warning sign systems explicitly—namely by the late American semiotician, Thomas A. Sebeok, who was commissioned by the US Department of Energy in 1981 to come up with a set of recommendations for designing effective warning signage to be placed at the Yucca Mountain nuclear waste depository site in Nevada that would withstand the test of time, remaining understandable to people 10,000 years into the future, given that the radioactive waste at the site would remain dangerous until then. Sebeok's recommendations were published in a report in 1984 (*Communication Measures to Bridge Ten Millennia*)—a report that is still being discussed to this day, perhaps because of some of its seemingly quirky suggestions (as will be discussed in this book). Significantly, it was instrumental in laying the groundwork for a new branch or subfield of semiotics to emerge, *nuclear semiotics*, bolstered by the publication of a special 1984 issue of the German periodical, *Zeitschrift für Semiotik,* dedicated to the study of the different ways in which warning signage could be made effective and enduring across long stretches of time in the future.

However, very little has been done in this subfield since then, with only a handful of studies having come forth that utilize semiotics in the context of the dangers that environmental crises pose to human survival (for example, Leone 2012 and Abbati 2019). It was not, actually, the initial goal of nuclear semiotics to extend its purview in this way. However, because Sebeok

examined methods for making signs withstand meaning decay and how danger can be communicated effectively, a broader reach of nuclear semiotics was implicit from the outset. The objective of this book is, in fact, to extend the reach of nuclear semiotics, applying it to the general study of danger and warning signage, in the hope that it can provide relevant insights on current crises, such as climate change and the rise of infectious diseases, from the angle of how they are perceived and represented (in language, in images, in stories, and so on). This line of inquiry may, itself, suggest ways of devising meaningful social action to curb the destructive human activities that may have brought them about. As far as I know, nuclear semiotics has rarely been envisioned in this way—as a means to suggest a course of action that will hopefully be beneficial to enhancing human survival. While this might seem to be an extravagant claim, the argument will be made throughout this book that it is not.

The fear of extinction that people have always faced has been an unconscious archetypal theme in all representational modes, from the early cave-wall drawings and ancient flood myths to subsequent narratives and poetry. All these semiotic artifacts have withstood the test of time, in line with what Sebeok himself emphasized. The warnings placed on ancient Egyptian tombs, alerting visitors of the dire consequences they would face if they entered them, are as understandable today as they were when they were created. The tales of apocalyptic scenarios portrayed in the ancient myths, harboring warnings of impending doom and existential uncertainty, similarly resonate with us to this day. As Alaszewski (2015: 205) has aptly put it: "All societies have [had] to cope with uncertainty, the essential unpredictability of the future and account for past misfortunes." In his fieldwork with the Trobriand Islanders, the Polish-born British anthropologist Bronislaw Malinowski (1922) discovered the importance of rituals, stories, and sayings as part of an unconscious folkloric code for coping with uncertainty. Much can be learned from studying such codes from the past, since they persist in different forms to this day (Douglas 1966). Science is also a strategy for taming uncertainty, based on empirically-testable predictions rather than mythical ones. Epidemiologists, for example, correlate the incidence of a pandemic disease to its spatial, temporal, and social distribution, so as to provide a statistical basis for anticipating or preventing future incidences of the disease. Nevertheless, as will be discussed throughout this book, reliance on folkloric-mythical-symbolic codes as effective warning systems has not disappeared in an age of science, as Sebeok emphasized in his 1984 report.

The first two chapters of this book present an overview of what a semiotic study of danger might entail. Chapter 3 revisits Sebeok's report in order to glean from it any insights that are germane to an expanded nuclear semiotics. It also looks at the emergence of this branch and what kinds of early ideas it

put forth that can be incorporated into a broader framework today. The subsequent three chapters examine the different ways in which dangers have been represented over time. The final chapter then puts forth a set of notions and principles that derive putatively from examining these representations. My treatment is aimed at a general audience, given the urgency of the topic today. So, I have purposely made the writing as non-technical as possible—and when specialized notions are required, I have attempted to explain or illustrate them concretely.

My hope is that semiotics can "make a difference," to use a common cliché, providing insights that can be used in dealing with current crises that enfold great peril, from pandemics to climate change. As Albert Camus put it in his 1947 novel, *The Plague:* "All I can say is that on this earth there are pestilences and there are victims—and as far as possible one must refuse to be on the side of the pestilence."

Marcel Danesi
University of Toronto, 2021

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Perceiving and Communicating Danger

Prologue

Working as a fire-prevention engineer in the late 1920s, Benjamin Lee Whorf recounted an experience he had in his essay, "The Relation of Habitual Thought and Behavior to Language" (Whorf 1956: 135), which alarmed him so intensely at the time that he decided to pursue the academic study of linguistics shortly thereafter. The incident in question occurred during one of his inspection visits to a chemical plant where he noticed the workers carrying out tasks in a careful and cautious way inside a room with full gasoline drums, avoiding the smoking of cigarettes; but in another room, containing gasoline drums labeled *Empty*, he noticed instead that they smoked carelessly around the barrels. Whorf surmised that the workers were unaware of the danger that this posed: Had someone flicked a cigarette stub into one of the empty drums, there would have been an explosion. Whorf believed that this carelessness was related to the *Empty* label itself, which predisposed the workers to disregard the danger. He explained his assessment as follows (Whorf 1956: 135):

> Around a storage of what are called 'gasoline drums,' behavior will tend to a certain type, that is, great care will be exercised; while around a storage of what are called 'empty gasoline drums,' it will tend to be different—careless, with little repression of smoking or of tossing cigarette stubs about. Yet the 'empty' drums are perhaps the more dangerous, since they contain explosive vapor. Physically, the situation is hazardous, but the linguistic analysis according to regular analogy must employ the word 'empty,' which inevitably suggests a lack of hazard.

This anecdote illustrates in microcosm that human beings rarely perceive reality directly, including the presence of danger in some situations; rather, they tend to filter it through the signs they use, such as words or pictures. Of

course, all humans have an instinctive sense of danger that goes beyond the language they speak or the pictures they devise. But this sense can be turned off or on (so to speak) by language or pictography. The gasoline drum incident shows how it was turned off by a word label, which impelled the workers to *think* that the drums were harmless, because of the word's meaning as "containing nothing." That meaning was mapped onto the situation, obscuring the danger that the drums actually posed.

Whorf's ideas became known and discussed widely after his death in 1941, leading to debates and research on the relation between language, thought, and reality that are still ongoing within linguistics (Seuren 2013; Danesi 2020). In the case of dangerous situations, this relation requires special attention, as the example above makes clear. By identifying the source of the misinterpretation, one can then come up with appropriate or viable solutions to rectifying the situation at hand. For instance, it might have been preferable to attach labels like *Explosive, Combustible*, or *Volatile* to the gasoline drums rather than *Empty*, since these describe the kind of danger that the drums actually presented. A pictogram of an explosion, such as the one below, could also have been used, showing the danger inherent in the drums via iconicity—the semiotic term for signs that represent something by resemblance (Figure 1.1).

It was an intuitive grasp of the relation between warning signage and the perception of danger that likely spurred the US Department of Energy to seek the advice of semiotician Thomas A. Sebeok in 1981, assigning him the task of devising an effective warning system about the dangers at the Yucca Mountain radioactive nuclear waste site in Nye County, Nevada, that could withstand decay in meaning 10,000 years in the future. This will be called "Sebeok's problem" in this book, defined as the problem of creating effective warning systems, relatively free from misinterpretation, and able to withstand meaning deterioration in the future. The project led to a (then) new branch of semiotics, "nuclear semiotics," which will be discussed in Chapter 3. It was the first time that semioticians considered the connection between signs and

FIGURE 1.1 *Explosion image (Wikimedia Commons).*

danger in a Whorfian way—that is, in terms of how signs mediate the perception of danger, turning the danger sense either on or off.

Nuclear semiotics initially caught the imagination of the general public, receiving unexpected attention from the mainstream media—arguably because of the expanding danger of nuclear wastes and radioactive pollution at the time, and because of the seemingly offbeat solutions put forth by Sebeok and other semioticians. Dangers from human litter have always existed since prehistoric times—people have always produced waste materials, burned them, tossed them into waterways, buried them, or dumped them haphazardly above ground. These consisted mainly of food scraps and substances that were broken down by natural decay processes. Consequently, the dangers that they posed were minimal. However, nuclear wastes do not break down in a similar way—hence, the need to warn people about them both in the present and in the future. The original goal of nuclear semiotics was to ensure that the warnings related to such wastes would retain their alerting power well into the future. As such, it opened the theoretical door to the semiotic study of danger and how signs mediate our perceptions of it. However, this line of inquiry was never pursued in any continuous way, other than a special 1984 issue of the *Zeitschrift für Semiotik*, which was dedicated to considering Sebeok's problem from various angles.

Solving Sebeok's problem semiotically today would imply broadening its scope to encompass dangers that have existed since the beginning of time, in contrast to the threats posed specifically by nuclear waste sites. In this book, the term *existential danger* is used to refer to any situation that imperils the existence of living things, if allowed to continue without refrain. Existential dangers are massive in scale, and include the threats to human survival posed by climate change, nuclear warfare, pandemics, or unchecked human-generated pollution. The semiotic study of such dangers would lead potentially to asking key questions about the choices people and institutions make, as well as how people themselves perceive imminent and impending dangers. A semiotic analysis of climate change, for instance, would allow for a particular kind of Whorfian framing of this phenomenon as an existential threat to human civilization—a framing that might turn on the danger sense of many people.

Existential dangers posed by floods, volcanic eruptions, and other natural phenomena greatly preoccupied ancient peoples, as can be seen by the fact that they inscribed them on cave walls and recounted them in myths. These ancient warnings have withstood meaning decay, having become an intrinsic part of human history. In an expanded nuclear semiotic paradigm, therefore, solving Sebeok's problem would entail studying cross-cultural warnings, past and present, extracting from them common patterns in how danger is perceived by all humans, and how this can putatively be applied to understanding how people grasp current dangers, from climate change to the

rise of infectious diseases. This line of inquiry might be suggestive of how to best motivate people and societies to take precautions and averting actions.

Perceiving Danger

The meaning of the term *danger* cannot be easily pinned down. Generally, it refers to any situation that sets off an inner sense of uncertainty, apprehension, or fear with regard to its potential for causing harm, injury, pain, suffering, trouble, difficulties, or death. This sense can be triggered by an imminent peril, such as the threat posed by a fire, or by an existential threat, such as that posed by climate change to human survival. Sigmund Freud (1894) saw the sense of danger as connected to a defensive response system guided by anxiety (*Angst*), fright (*Schreck*), and fear (*Furcht*).

Any situation can activate this response system, depending on context or individual. The following are typical situations that set it off to varying degrees, activating specific responses or strategies (Öhman and Mineka 2001):

1. *Physical:* situations in the immediate physical environment that pose an imminent danger, thus raising the anxiety and fear level considerably—aggressive animals or humans, fire, strong winds, etc. Defensive responses include: running away, raising one's hands in a defensive posture, fighting physically, finding a protective shelter, etc.
2. *Biological:* bacteria, viruses, mold, fungi, harmful plants, dust, vermin, etc. that people have learned to fear as presenting specific kinds of dangers to the body through upbringing. Defensive strategies include: staying away from certain locations where pathogens may reside, avoiding the intake of certain substances, immunizing oneself medically (such as via vaccinations), avoiding places where dust can become injurious, etc.
3. *Chemical*: toxic chemicals, explosive materials, radioactive wastes, etc. that are known to be dangerous from either experience or background information. Defensive strategies include: avoiding contact with the substances, using medications or therapies that can counteract their impacts, etc.
4. *Objects*: exposed wires, spiked fences, burning materials, etc., that people know can be harmful from experience or an instinctive sense of fear or anxiety with regards to certain physical features (spiked fences) or events (combustion). Defensive measures include: avoiding

contact with the objects, devising ways to protect oneself (such as protective clothing), moving away from the situation, etc.

5 *Places*: places and locations that may lead to situations of danger, such as narrow ledges on mountainous terrain, labyrinthine dark caves from which escape is problematic, nuclear waste sites, etc. The sense of danger in this case is partly instinctive and partly activated by background knowledge. Defensive strategies include: avoiding the places and locations, gaining expertise on how to move around in (or on) them, etc.

6 *Existential*: this refers to the sense of apprehension or anxiety that may be activated (consciously or consciously) because of environmental warning signs, such as weather events (increasing hurricanes, tsunamis, etc.) that might be traceable to climate change. Defensive responses include: using science to combat or prevent the causes of such dangers, developing social strategies for altering the behaviors that contribute to or are involved in bringing the dangers about, etc.

7 *Homeostatic*: situations, personages, or groups who pose a threat to the balance in social, cultural, or political systems, such as dictators, imperialist nations, powerful sinister individuals, etc. Defensive responses include: uprisings, protests, persuasive arguments, political activism, etc.

8 *Psychological*: situations and interactions that can adversely affect wellbeing, such as verbal abuse or social marginalization; this category includes hate speech as a contributing factor to escalating the danger to the lives of targeted individuals or groups, since it might induce some people to take aggressive actions against them. Defensive strategies include: communicating the danger to others, seeking legal help, developing verbal strategies to respond effectively, etc.

All animal species are endowed with an instinctive sense of danger that warns them of imminent threat, such as the presence of a predator or of natural signs of impending situational danger, such as a coming storm. They are also equipped with biologically specific signal systems for conveying the danger to other members of the species—primates and birds use auditory alarm calls; insects and fish use chemical pheromones; deer and other four-legged animals employ tail flashes; and so on. Animals are also able to identify which signals are authentic (from the same species) and which are not, allowing them to disregard those of other species (Lemon 1975; Zuberbühler, David, and Redouan 1999; Baker 2001). Humans are similarly endowed with an instinctive danger sense; but, in contrast to other species, humans have

also developed a higher-level (non-instinctive) sense of danger, defined here as the perception that something is potentially dangerous, as guided by learning, memory, expectation, and attention mechanisms.

It is this perception that can be "turned on or off" either by happenstance, as was the case with the *Empty* label misplaced on gasoline drums, or by design (by lying, deception, camouflage, etc.). Consider a hypothetical example of the latter. Suppose we mischievously attach the warning label *Poison* to a certain bottle containing an unspecified liquid, knowing full well that the liquid is actually harmless. Now, those who come across the bottle would automatically interpret the liquid as harmful, even if this is not so. In this case, the label turns the danger sense on, not off, as was the case with the *Empty* label. The same perceptual modulation can be seen with regard to existential dangers, such as those posed by climate change. The term itself—*climate change*—is hardly a neutral social one. It evokes different perceptions, reflecting political-ideological-subjective attitudes or beliefs. If the term is changed to *climate crisis*, a different portrayal of the same referent is intended, given the meaning of *crisis* as referring to a time of extreme difficulty, trouble, or uncertainty. Whether or not this label change actually provokes a corresponding change in attitudes towards the climate problem is open to question, as we shall see subsequently. The point here is that warning labels, and sign systems generally, influence the sense of danger in humans, activating or de-activating it as the case may be.

Perceptions may become part of habitual thinking, conditioning people to see something as dangerous or not, whatever the reality. In the study of danger perception, therefore, one cannot ignore the effects of conditioning—a notion that comes initially from the well-known experiments conducted by the Russian physiologist Ivan Pavlov (1902), which can be summarized as follows here for convenience. At the start, Pavlov presented a piece of meat to a hungry dog, a stimulus that produced the expected response of salivation in the dog. He called this the unconditioned response, since it is part of instinctual canine behavior. Then, Pavlov would ring a bell at the same time that he presented the meat stimulus, doing this a number of times. He discovered that the dog eventually salivated only to the ringing of the bell, without the presence of the meat stimulus. The bell ringing, which would not have triggered the salivation initially, had brought about a conditioned response in the dog, via a systematic pairing of the bell with the meat. The dog would subsequently salivate every time it heard the bell, even if there was no meat physically present. It had become a habit of mind that conditioned the dog's response mechanisms and behaviors.

Analogously, the pairing of the word *Empty* with the meaning of "nothingness," or of the word *Poison* with "dangerous substance," conditions the human mind to perceive a situation to which either label is applied according to these meanings, in the absence of qualifying information. All this

brings out the veracity of an implicit semiotic principle—the human brain is designed to react to meaning, not just physical stimuli; but meaning is highly variable, as will be discussed throughout. As a case in point, consider two colors—red and blue—as options for designing a warning sign that is intended to indicate the presence of some hazard in a particular location. Which of the two would likely be interpreted as best representing the danger involved? Most people living in Western culture would answer red, because this color has been associated with danger historically in all kinds of cultural representations—in traffic signage, in hazard pictography, etc. If we were to use blue instead, it is unlikely that the sense of danger would be activated, since that color has been used instead to encode other kinds of meanings that have nothing to do with danger, from hope to loyalty. So, if we were to use blue on our hazard sign, it is unlikely that a Western viewer would interpret it as indicating danger. To reiterate, as simple examples such as this one bring out, the sign structures we use to alert people to danger (labels, colors, images, etc.) will affect how the danger is perceived, if at all.

This semiotic principle applies to larger existential dangers as well, whereby entire discourses and narratives, rather than single words or images, constitute textual structures that not only reflect acquired habits of mind but may also be used to induce people to think and act in a certain way, as has become saliently obvious with the diffusion of *hate speech*, or the use of language to denigrate a group of people for some specific reason, which falls into the *psychological danger* category discussed above. With the advent of the Internet and social media, this type of linguistic behavior has become especially pernicious, showing how discourse can be manipulated to condition people to react to others in prejudicial ways.

No one is born hating others. Hatred of groups is acquired in either rearing and/or broader social contexts, by simple exposure to hate discourses. These have been used throughout history to turn people against one another for the self-serving interests of particular (dominant) groups or individuals. While the hate-inducing rhetoric will vary according to the language spoken and the specific society involved, the subtext of hate speech has not varied much across time—namely, "others" pose serious threats to social stability and so their rejection and even violence against them is seen as necessary. The intent is to verbally assail those who may be different in some way with hateful rhetoric, as well as nonverbal representations (cartoons, caricatures, etc.), and conspiracy narratives. Over time, these engender what journalist Walter Lippmann (1922) called fixed "pictures in the mind"—simplified images of others that become deeply-rooted. It is no coincidence that such "pictures" have been used to justify the exclusion and eviction of immigrants from a society. In 1915, for example, newspaper headlines designed to cleanse Armenians from the Ottoman Empire referred to them as "malignant weeds" that needed to be uprooted (Kuper 1981: 91).

It is also no coincidence that this type of rhetoric preceded widespread violence against the Armenians and their mass displacement.

As Hobbs and Antonopoulos (2013: 44) argue, in the case of immigrants, hate speech can sometimes be connected to a more general "alien conspiracy" narrative, constituting a means to attack or blame the foreigner for endemic social ills. A well-known historical example is the hate speech directed against Italian immigrants to the US in the first decade of the twentieth century. The verbal attack was centered on the image of Italians as "Black Hand" criminals (Nicaso and Danesi 2020). The Black Hand scheme consisted of letters sent to victims demanding money; each letter was signed with the picture of an ominous black hand. The newspapers and the movies at the time portrayed the scheme as a form of corruption imported to American society from Italy. As a result, Italian immigrants were viewed as either part of crime families or as sympathetic to them. They were perceived, in effect, as a "dangerous class," a term that is traced initially to an 1840 book by Honoré Antoine Frégier, in which he links criminality to Italian character.

The forgoing discussion raises an important social-justice question: Should hate speech be curtailed? This is a serious question since it involves the notion of freedom of speech—a staple of democracies. Some have criticized the censoring of hate speech, seeing it as anti-democratic and essentially ineffective, if not counterproductive. The more it is exposed, the more likely are the chances of counteracting it. If it recedes into a social underground, it becomes much more pernicious. A subtext of this book is that a semiotic understanding of the causes of prejudice, as embedded in structures such as signs and texts, can help expose them openly through their deconstruction and thus potentially obvert them.

Communicating Danger

Each member of a species is endowed with instinctive signal warning systems for communicating danger to the other members of the species. In humans, warning others of imminent physical dangers similarly involves the deployment of an instinctive signal system, from facial expressions to spontaneous vocalizations such as screams, shouts, shrieks, howls, and the like. But, because humans are endowed uniquely with the language faculty, and other faculties, such as the ability to draw (and sculpt), they have also developed sophisticated semiotic strategies and systems for communicating dangers, as for example, the use of images such as the explosion one above and the creation of phraseology such as *Don't touch! Look out! Be careful! Watch out!* and so on (Cole 2012). The phrase *Don't touch!*, for example, can be attached to an object that can cause harm to the hands; the expression *Be*

Careful! can be written on a sign near a dangerous cliff to alert someone about the danger of falling off; and so on.

Even the word *danger* itself has the capacity to turn the danger sense on, even if it is applied to a situation that is not actually dangerous (similar to the *Poison* label mentioned above). An example is the archeological site named *Danger Cave*, located in the Bonneville Basin of western Utah in the Great Salt Lakes region—a site that features artifacts dating from around 9000 BCE. The cave got its name from an incident that occurred during its excavation when several huge boulders fell from a rocky ledge overhanging the cave, scaring the excavators, who were however not injured by the fall. Excursions to the cave pose absolutely no "danger" to visitors; yet, travel agencies have consistently reported resistance on the part of tourists to visit the site, and the reason they typically provide is the label of *Danger Cave*, which appears to inveigle people to assume that the cave must have some dangerous aspect to it, even though this is not the case. Interestingly, the cave was discovered in the 1930s and investigated in the 1950s by archeologist Jesse D. Jennings (1957) of the University of Utah. Jennings found that the very dry cave had provided the ideal conditions for the preservation of artifacts, fragments of plant species, and the bones of many species of animals. His data and analysis suggested that the desert culture around the cave had a sparse population, which focused on everyday survival—a situation recorded by the symbols and complicated rituals devised by the inhabitants, which allude to the imminent dangers all around them and to the cave as a shelter from them.

Nonverbal warning signs can also turn the danger sense on or off, as mentioned; it is relevant to note that they are considered to be more universally comprehensible than verbal labels—a premise on which Sebeok worked as well (Chapter 3). Consider the following pictogram, used commonly as a sign for hazardous products—adopted officially by the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) (Figure 1.2).

The individual features of this pictogram were chosen because it was thought that they were broadly understandable in the same ways across

FIGURE 1.2 *Hazard pictogram (Wikimedia Commons).*

cultures. But this assumption turned out to be unfounded. There are three features: (a) a triangular contour, (b) which is colored in red, and (c) a black exclamation mark in the center. The choice of these features was guided by their purported meanings. As discussed, the color red has historically symbolized danger. In the medieval era, a red flag in warfare communicated the intent to fight to the death; in traffic signs today, red indicates "stop" or "danger ahead." Interestingly, studies have suggested that red does indeed seem to elicit a strong reaction, which decreases in intensity gradually with the colors orange, yellow, and white respectively (Karkowski 2006: 1518). The effectiveness of the triangle shape as a cue of danger has also been supported by various psychological studies, such as the one by Ma et al. (2018: 1), in which the researchers found that subjects responded to the triangle as a warning shape more so than the circle form:

> Experimental data indicated that the shape of an upright triangle had larger arousal strength and more negative valence than the shape of the circle. People get stronger negative information from the upright triangle shapes than from the circle. This finding might be helpful for designing the surrounding shapes of warning signs.

The exclamation mark is associated with the imperative tense in the writing systems of many languages, and used often as an alerting sign to the danger involved in some situation (*Stop! Be Careful! Watch out!* etc.). However, the problem is that the meanings associated with these three symbolic elements—the color red, the triangle, the exclamation mark—are not universal, or at least equally comprehensible across cultures, as assumed by the makers of the pictogram. The triangle represents the Trinity in Christian cultures. The color red might be understood as referring to love and passion, rather than danger. In Thai culture, red is associated with the sun god, Surya, who was born on a Sunday, and thus has sacred connotations. In Chinese culture, red is a symbol of commemoration or celebration. The exclamation mark will be sensed as a warning cue by those who use it as such in their writing system; it would have little or no meaning to those in non-alphabet-using cultures. The list of such semiotic variability is an extensive one, if cultures across the world are taken into account. The semiotic principle at work is that signs—verbal or nonverbal—will not be interpreted in exactly the same way cross-culturally.

A major part of the solution to Sebeok's problem was, in fact, to find signs for creating warning systems that had the potential to transcend the effects of the culturally based shaping of meaning (as will be discussed in Chapter 3).

Incidentally, a different version of the hazard pictogram is now used more commonly than the one above, in which the triangle contour has been replaced

FIGURE 1.3 *Revised hazard pictogram (Wikimedia Commons).*

by a diamond-shaped one, likely to avoid problems of interpretation with regard to the triangular form (Figure 1.3).

The GHS was established in 1992 as an international agency for developing standardized warning systems managed by the United Nations; it replaced the hodge-podge signage schemes that had been used previously around the world. A central goal of the GHS has always been to devise warning signage that veers towards universal, language independent understanding. To achieve this, it has embraced the following design principles:

1. The sign should reflect the nature of the hazard.
2. It should be highly comprehensible regardless of the culture in which it is used.
3. It should be consistent with the construction of other signs to reduce confusion.
4. It should take into account all existing research and any new evidence on how people perceive danger and on how they react to specific warning cues.

In its quest to ensure universal comprehension, the GHS relies heavily on visual signage, because it is (largely) language independent—that is, it does not require knowledge of a particular lexicon, grammar, or writing system. For example, the pictogram below was devised to indicate what a hazardous substance will do to someone—showing how the substance assails the body (in outline form), as indicated by a fracture of the chest area (Figure 1.4).

To decipher its meaning, however, one still has to have been exposed to the meanings of the visual features it enfolds, such as the meaning of the fracture image. We are rarely aware of the fact that we pick these up by living in a specific society; they are hardly universal visual images, understood in the same way across the world.

FIGURE 1.4 *GHS hazard pictogram (Wikimedia Commons).*

GHS signs have a specific communicative objective—to warn people of the kinds of dangers posed by locations, objects, waste materials, etc. Throughout the years, the GHS system has become the standard, spreading throughout the globe. A communication problem that falls outside the purview of the GHS is, however, how to design warnings related to larger existential dangers, such as those associated with climate change or pandemics. How could we devise a hazard sign that would convey concretely the kinds of dangers that climate change poses? Where would we locate it? Clearly, using a singular sign, such as a hazard pictogram, placed in a particular locale, does not apply in this case. So, we must look to other ways to communicate the relevant warnings, including the use of narratives and paintings, which are location independent, conveying danger in an abstract way. Historical records indicate that this broader approach to communicating danger has been used since antiquity. Accounts from the Late Antique Little Ice Age (LALIA), for instance, show how people in the sixth to seventh centuries CE documented the factors that brought about a pandemic in that era through the narrative medium (Büntgen et al. 2016). One of these accounts, by the Byzantine chronicler Procopius, describes the sudden appearance of a "dust veil" in 536 CE, which dimmed the sun and thrust the Northern Hemisphere into a protracted period of bitter cold—conditions that set the stage for a plague to crystallize. Other accounts mention crop failures, summertime snowfalls, and fruits withering out of season around the same time frame. Significantly, Procopius, identifies human wastes as the likely source of the so-called "Justinian plague"—named in this way because it also afflicted the eponymous emperor, who recovered from it in 542. Archeological studies and geological assessments of mound volume conducted near a Byzantine urban settlement in the Negev Desert have confirmed the massive dumping of domestic and construction wastes, coinciding closely with the beginning of the Justinian plague in the year 541.

Another way to communicate warnings of existential dangers is through pictorial art, which emerges in caves around 35,000–40,000 years ago. The

FIGURE 1.5 *Cave of Beasts, Gilf Kebir, Libyan Desert (Wikimedia Commons).*

precise reasons for such art are still being debated (Curtis 2006), but the warnings evident in the art are still perceivable to this day. The cave paintings convey warnings via images of animals and humans entangled in some form of dangerous interaction, with bodies strewn around or else fleeing or scurrying away from each other, as can be seen in the painting above, from the Cave of Beasts (Gilf Kebir, Libyan Desert), estimated to be around 7,000 years old (Figure 1.5).

A common interpretation of the painting is that it depicts the dangerous aspects of hunting, with headless horses, gazelles, giraffes, ostriches, and other beasts running around menacingly, seemingly chasing or attacking humans randomly. The subtext appears to be that animals are needed and to be feared at the same time—a paradoxical perception that may have been the basis for many early rituals. This was the essential argument made by ethnologist and geologist Henri Breuil (1906), who was among the first to study the cave art of the Paleolithic era, claiming that it recorded the dangers of hunting in ritualistic form.

The cave paintings are remarkably similar throughout the world, portraying large wild animals, outlines of human bodies, and various symbols that were likely connected to the attendant rituals of the hunt. Some archeologists and geologists have suggested that the cave art may actually portray the negative effects of climate change in prehistory, endangering animals and humans alike. Geologist Kieran D. O'Hara (2014), for example, has claimed that

the scenes of animals running around wildly, along with the pigments used, which seem to suggest natural colors, from green (for the natural and plentiful environment) to red (for blood-shedding), are signs that can be mapped against the effects of climate change, as recorded by the prehistoric artists. Whatever the truth, these paintings certainly need to be explored from the perspective of semiotics as visual media for communicating existential dangers, alongside the narrative medium—as will be discussed throughout this book.

Climatological events that involve existential danger, such as disasters, floods, volcano eruptions, and the like, have actually been the subject of pictorial artists across time. Such "disaster art," as it can be called, constitutes a visual means to grapple with catastrophes and to reflect upon them (Chapter 5). For instance, the painting below, by William Marlow in the eighteenth century, captures the ominous, dark power of Vesuvius erupting at night, depicting the menace and threat that those living around the volcano would have felt, as well as a sense of mythic gloom and foreboding that is associated with Nature (Figure 1.6).

Disaster art comes in different forms and media, including sculptural and architectural compositions. In the 1990s, the architect Michael Brill created physical landscapes that were foreboding and repulsive with giant, menacing jagged shapes that appeared to retrieve the mythic images of dangerous

FIGURE 1.6 Vesuvius Erupting at Night, *William Marlow*, c. *1768. Oil on canvas. 36 × 50 in (91.5 × 127 cm). Berger Collection (Wikimedia Commons).*

places, such as Hades. These were intended to forewarn people about the dangers they were wreaking upon themselves with their environmentally destructive lifestyle activities. Brill was subsequently enlisted in 1992 by the Sandia National Laboratories of the US Department of Energy for the Waste Isolation Pilot Plant (WIPP) to prepare a so-called *hostile environment* (discussed in Chapter 3), which he called a *Spike Field,* as a means of discouraging people from visiting a particular site.

In sum, as a source for understanding how humans perceive and communicate existential dangers, narratives and pictorial art constitute insightful sources for an extended nuclear semiotics to analyze in terms of their implications for how the sense of danger can be turned on, even without its immediate presence. Art and narrative also do not decay in meaning over time as quickly or as drastically as does singular signage (word labels and pictograms) intended to convey the immediate presence of hazard dangers such as nuclear wastes.

In antiquity, stories of dangerous mythological creatures such as the Minotaur and Cerberus of Greek culture, the Kraken of Scandinavian legends, and the Banshees of Celtic traditions, were personifications of danger—that is, they symbolized the role played by natural forces in bringing about disasters. The ancients also used divination as a means for forecasting danger—a source that is also immensely valuable in understanding danger representation in folkloric terms. Beerden (2014: 23) puts it as follows:

> In the ancient Greek world—forecasting was practiced by use of a particular method: that of divination. Divination was the interpretation of signs perceived to have been sent by the supernatural. This practice can be seen as an ancient alternative to risk assessment/analysis and to scenario studies. The study of divination shows that ancient Greeks believed there were multiple futures—and not one predetermined future—from which man attempted to select the best, aided by the flexible tool that divination appears to be. The Greek future is, perhaps, more like our own than it may previously have been assumed. Ideas about how this future should be come to terms with, however, differ significantly. The absence of concepts of risk and probability are one difference, the use of the supernatural to assess uncertainties is another.

The mythic-divinatory stories were based on metaphorical language, from which many folkloric rituals and practices evolved, as will be discussed in Chapter 3 (Belfiore 2000). As Karen Armstrong (1993: 4) has aptly observed, the ancient myths were "metaphorical attempts to describe a reality that was too complex and elusive to express in any other way." Mythic accounts of disasters abound across the world, and are often used as cautionary tales of

disasters to come. An example is the legend of the Laboon, "the wave that eats people," told by the Moken, a tribal society that lives on one of the Andaman Islands in the Indian Ocean. According to the legend, the Laboon comes at specific times to cleanse the island of all evil and impurity. The story has actually had preventive functions, akin to the functions of singular hazard pictograms, preparing the islanders for tsunamis, guiding them to seek safety on higher ground. Records show that the islanders have survived tsunamis essentially unscathed, unlike the inhabitants of other islands in the path of the same tsunamis, who lacked a similar mythic legacy.

Geologist Dorothy Vitaliano (1975) even sees the ancient myths and legends as records of real geological events that are passed on to subsequent generations as warnings of things to come. Her approach has come to be called *geomythology*. Vitaliano systematically matched the symbols and plots contained in cultural myths about disasters to modern scientific geological information. Learning how to crack the mythic code, she suggests, provides actual historical data on the occurrence of real disasters. An example of geomythical analysis concerns the massive ancient flood in China around four millennia ago. A legend states that the Emperor Yu the Great succeeded in draining the floodwaters in the Yellow River basin, an event that the many stories about it claimed that it had led to the establishment of the Xia dynasty and the birth of Chinese civilization. It was not known whether Emperor Yu was a real person or whether the floodwaters he harnessed actually existed until a study by Wu et al. (2016), based on stratigraphic data and radiocarbon dating, verified that the flood occurred around 1900 BCE, which is when the Xia dynasty did indeed begin, thus providing support to the legendary claim that the flood and the establishment of the Xia dynasty were co-occurrent. Strengthening this finding was the fact that the researchers found evidence of drainage projects in the Yellow River delta that were realized within the time frame that the story describes. So, while the Wu study does not actually prove that the great flood they reconstructed was actually the flood associated with the Emperor Yu legend, it definitely raises this possibility.

Geomythology aims to decode the ancient mythic stories of natural disasters as rooted in real events, interpreting folkloric traditions in metaphorical terms (Montgomery 2012). For example, there is a traditional story told in areas along the coastline of Chile which relates how two great snakes fought each other to determine which one could make the sea rise more, setting off an earthquake and sending a great wave ashore during the conflict. The key to decoding this myth lies in the metaphorical-symbolic interpretation of snakes in the folklore of the indigenous cultures of the region. In the Chilean legend, serpents represent vehicles used by celestial gods, such as the sun and the stars, which allow them to cross the heavens in an unobstructed fashion. Any conflict among snakes, however, would imply a disruption that causes upheavals in Nature and human life.

The symbolism of snakes seems to be a widespread one, as can be seen in the story of the horned viper in Assyrian folklore and of the "furious serpent" in Akkadian mythology, both of which describe serpents as magical protective creatures. The subtext in many of these narratives is that when serpents are destroyed by humans, their protection dissipates, affecting the natural order and setting off disasters that lead to scarcity and famine.

As Adrienne Mayor (2004: 86) points out, while geomythology is a modern-day term, its premises were actually known to the ancient Greeks:

> Although the term "geomythology" was coined by the geologist Dorothy Vitaliano, and it is often considered a new field of study, the concept was known and applied since antiquity. Euhemerus, a Greek philosopher (ca 300 BC) held that myths about divinities and their activities were poetic accounts of real people and events. His approach, called euhemerism, was taken up by other classical scholars who rationalized myths by stripping away supernatural and impossible details to reveal an underlying core of facts. Some of the rationalizing deconstructions of hero and monster myths by the Greek euhemerist Palaephatus (4th century BC) may seem contrived, but others, such as his interpretation of the myth of Cadmus sowing the dragon teeth, are quite sophisticated. Palaephatus suggested that the tale represented an ancient misunderstanding of fossil elephant molars, which were frequently found in the ground and treasured by kings in archaic Greece before knowledge of elephants was brought back from India by Alexander the Great in the 4th century BC.

Vitaliano has even claimed that geomythology can help solve many mysteries of the past connected with climate change. For example, in 1999, a frozen mummy called Kwaday Dan Sinchi ("Long Ago Person Found"), was discovered in a melting glacier between the Yukon Territory and northern British Columbia, Canada, presenting a geo-morphological mystery to the discoverers (Mayor 2004: 89). Who was the individual? What was his connection to previous cultures? Radiocarbon dating of the mummy indicated that it was young male who had lived in the 1400s. The individual was found with a waterproof hat, a leather bag containing dried fish, a cloak made from the hide of gophers, and tools made from local trees. This discovery confirmed an ancient story told by the local Champagne and Aishihik First Nations, which describes how their ancestors used the glaciers as reference points along trade routes between the interior and coast.

Given the apparent power of folkloric traditions to withstand meaning decay over time, it is little wonder that Sebeok (1984) wanted to create an analogous folkloric code with the ability to communicate danger in the future, since it could be passed on to future generations and understood in the same

way of the ancient myths. In effect, Sebeok sought a geomythical solution to his problem. As Mayor (2004: 91) puts it: "the mythmaking process itself allows us to learn more about the mechanisms of preserving and perpetuating ancestral human memories over millennia."

Semiotic Relativity

Studying the ways in which paintings, myths, and folkloric traditions have communicated danger warnings would constitute a substantive part of the overall objectives of an expanded nuclear semiotics, as will be discussed throughout this book, since these provide valuable insights into: (a) how to make warnings about contemporary existential dangers more efficacious; and (b) how to develop effective strategies to counteract opposing strategies, such as conspiracy theories.

Two semiotic notions that are of particular relevance are: *semiosis* and *representation*. The former term was introduced by the American philosopher Charles S. Peirce (1931–58), although it was implicit in the work of the Estonian-born German biologist Jakob von Uexküll (1909). It is defined, essentially, as the capacity to produce and comprehend signs and signals. Semiosis varies across species, constituting an ability that is vital for an organism to grasp the world in ways that subserve survival functions. Representation is the use of signs to compose something in a displaced (non-instinctual) way (Lotman 1991). Representations project semiosis into expressive forms, including words, drawings, stories, and the like. This projection then shapes perception, cognition, and beliefs (Lee 1996: 21). A simple example is the linguistic representation of the anatomical part starting at the shoulder and ending at the fingertips. In English, for instance, it is represented as consisting of two parts, as evidenced by the use of two main lexical items—*arm* and *hand*—to name it. Refinements to this representational dichotomy exist (*upper arm, wrist*, etc.), but they are connected categorically to either the hand or the arm. In Russian, no such distinction has been encoded lexically. The word *ruká* refers to the whole appendage (*arm* + *hand*). Russians can refer to the difference between arms and hands in other ways, however, if the situation requires them to do so. In effect, the ways in which reality is named, affects how it is understood.

Representation spans a broad range of meaning-making, including texts such as stories and artworks. As briefly mentioned above, existential dangers have been a common theme in human representational activities, as evidenced by the early flood myths and the images of danger perceivable in cave art. Studying such representations in terms of the warnings they hold for humanity is especially urgent today, given the misrepresentations of existential dangers

found everywhere, especially in social media, which engender false beliefs that become unconscious habits of thought, inducing irresponsible behaviors. As Charles Peirce (1931–58, volume 5: 398) aptly observed: "the essence of belief is the establishment of a habit; and different beliefs are distinguished by different modes of action to which they give rise."

The relevance of Peirce's observation was brought out saliently during the coronavirus pandemic of 2020–1, when many people engaged in risky behaviors—not wearing masks or standing safely apart. Some did so because of what the media called "pandemic fatigue," referring to the desire of many to return to habitual routines of living, despite the dangers this posed to their health at the time. Many others ignored the dangers of the pandemic because of the belief that it was a "hoax"—a belief generated largely by the conspiratorial discourses in online media that were designed to support and promote a particular ideology. The emergence of such false beliefs lends credence to Whorf's theory that thought is shaped by language and discourse—called the linguistic relativity hypothesis. This hypothesis can actually be considered to be a specific instantiation of a more general hypothesis, called *semiotic relativity*, as linguist John Lucy (1997) has designated it, which states that thoughts and beliefs are shaped by all kinds of sign systems, not just language.

The Russian psychologist Lev S. Vygotsky (1962; 1978) was among the first to study semiotic relativity effects empirically, documenting how mental states were forged in childhood by the signs and sign systems to which the child was exposed (Mertz and Parmentier 1985; Gordon 2007). These affect both the construction of knowledge by children and their understanding of the world. Vygotsky's work is clearly in synch with Whorfian theory. The different manifestations of semiotic relativity in the representations of danger would obviously constitute a primary analytical objective of nuclear semiotics. The various dimensions of semiotic relativity can be summarized as follows:

1. *Linguistic:* linguistic relativity refers to how the vocabulary, grammar, and writing practices of a particular language affect the sense of danger, turning it off or on, as discussed above vis-à-vis word labels such as *Empty* and *Poison*.

2. *Metaphorical:* metaphorical relativity is considered separately from (1), because it is a psychologically powerful form of language based on the unconscious operation of inference, association, and analogy in sense-making. It is a common strategy in the framing of existential dangers. For example, characterizing climate change as an *enemy to be defeated* portrays this phenomenon as a personified entity—an enemy warrior—who must be defeated, in order to avoid being

vanquished by it. This type of semiotic relativity affects the emotional intensity and sense of urgency posed by existential dangers.

3 *Pictorial:* pictorial relativity refers to the semiosic effects of pictorial representations (paintings, sculptures, etc.) on the perception of both imminent and existential dangers. The study of the former would focus on simple warning pictography, such as hazard pictograms, and the latter on how visual art forms have been used to represent existential dangers throughout history.

4 *Narrative:* narrative relativity refers to the semiosic effects of story-telling—mythical, fictional, etc.—on the perception of existential dangers. As discussed above, myths can be examined in terms of how people perceived dangers in the past and how they used the narrative medium to warn future generations about them. A similar type of narrative warning system can be found in fictional works (such as novels and films) that deal with plagues and climatological disasters.

5 *Symbolic:* symbolic relativity refers to the effects of specific symbols on the perception of dangers. For example, in the design of some hazard pictograms, the skull and crossbones is used as a symbol of death (as will be discussed). In the case of existential dangers, symbols might be used to represent a specific ideology. An example of this was during the 2020–1 coronavirus pandemic when the wearing of a mask became symbolic of political or ideological affiliation, rather than a simple protective measure.

6 *Ritualistic:* ritualistic relativity refers to the kinds of folkloric activities, celebrations, rites, etc. that are performed repetitively to neutralize or prevent anxiety with regard to the occurrence of some existential danger, or as part of divinatory practices intended to get people to prepare for future dangers.

7 *Discursive:* discursive relativity refers to the kinds of relativistic effects that certain discourses have on the perception of existential dangers, some of which have the power to shape and even fabricate false beliefs.

To elaborate on the last type, it has become saliently obvious that understanding the discursive relativity connected with existential dangers is particularly critical, because it is the main generator of false beliefs in the contemporary world. A belief is an attitude that something is true, even if it is not objectively or verifiably so. It dissects the world into a binary scheme—true and false—with no possibility in between. Collective beliefs emerge when people start using the same type of discourse in group-based

communications. When this happens, they become what Émile Durkheim (1901: 45) called "social facts," which become embedded in groupthink as being true, making them almost impossible to eradicate. One plausible reason for the resistance to the truth by those who hold false beliefs is that abandoning them induces a form anxiety that the American psychologist Leon Festinger (1957) called "cognitive dissonance." To resolve the dissonance, believers will seek out information that confirms their beliefs, avoiding information that is in conflict with them. Festinger came up with his notion after researching a UFO doomsday cult which had been told by its leader that the end of the world would come to pass on a certain date. The prediction, however, was incorrect. Festinger interrogated the group, finding that the prediction, supposedly communicated by aliens to the leader, turned into a disconfirmed expectancy that caused anxiety (cognitive dissonance) in all group members. Some abandoned the group when the prophecy failed, but most attempted to downplay the event by constructing a new belief, namely that the planet was spared because of the group's resolve and faith.

People become uneasy when they are confronted with information that conflicts with their beliefs; so, they develop strategies to attenuate the dissonance, even turning the contrasting information on its head, accommodating it to comply with their beliefs. In his book *When Prophecy Fails* (written with Henry W. Riecken, and Stanley Schachter), Festinger puts it as follows (1956: 3):

> A man with a conviction is a hard man to change. Tell him you disagree and he turns away. Show him the facts or figures and he questions your sources. Appeal to logic and he fails to see your point.

Climate change deniers have developed dissonance-reducing strategies, interpreting contrasting evidence as false or else adapting it to conform with their beliefs. So, an effective response to false beliefs, as Festinger claimed, cannot be based on logical argumentation, but, as Sebeok suspected, on different types of semiotic strategies, such as visual art, narratives, and poetic texts (Cancino-Montecions, Björklund, and Lindholm 2018). The cumulative effects of climate change are likely to be devastating. These can no longer be denied, as increasing temperatures, extreme weather, and increased competition for scarce environmental resources, compounded by existing inequalities and disproportionate impacts among groups and nations, are already affecting everyone directly or indirectly. This situation can be highlighted by scientific warnings, but these have little effect on those who possess contrary beliefs. As Norman Solomon (1998) has cogently argued, the goal of fake news is ultimately an Orwellian one—"to destroy the meanings of things as we commonly understand them."

While false beliefs have always been a part of human life, the modern-day phenomenon of conspiracy theories and fake news emerges in a specific cultural context and era—the advent of yellow (tabloid) journalism in the nineteenth century. One episode in particular is seen as the start of the phenomenon—a series of six articles, starting on August 25, 1835, on the purported discovery of life and civilization on the moon by British astronomer John Herschel, published in the *Sun of New York City* newspaper. Subsequently known as the "Great Moon Hoax," the articles were highly popular, generating widespread belief in the fake moon story, with readers wanting to read more and more about it, no matter what the truth of the matter. The *Sun* never retracted it—likely because it was profitable, gaining the newspaper a large circulation, and because it would have been useless to do so, since believers appeared reluctant to accept any evidence to the contrary, either denying it or ignoring it completely. What this event showed for the first time in journalistic history is that people *enjoy* conspiracy theories, preferring them to bland reports about science and mundane politics. They are a form of modern-day gossip, nurturing belief systems (Dunbar 1996).

Demystifying conspiracy theories is clearly an urgent semiotic undertaking, as will be discussed in Chapter 4. To do this, the intent of the conspiratorial narrative must be taken into account. In the case of the Great Moon Hoax, the intent was likely entertainment of the kind that would be provided by the emergence of science fiction as a literary genre soon after (near the end of the nineteenth century). In other cases, it could be a form of satire, aiming to amuse or to make a socially relevant argument indirectly, rather than to deceive. The type that is of relevance here is the one that is embedded into a broader discourse that influences the beliefs of many, such as the belief that climate change is a hoax. Conspiracy theories resist counter-argumentation because they cannot be disproved. Moreover, as Hofstadter (1964) has aptly remarked, whoever spins such stories becomes a protagonist in them, seeing the world in apocalyptic terms and living constantly on edge:

> The paranoid spokesman sees the fate of conspiracy in apocalyptic terms—he traffics in the birth and death of whole worlds, whole political orders, whole systems of human values. He is always manning the barricades of civilization. He constantly lives at a turning point. Like religious millennialists he expresses the anxiety of those who are living through the last days and he is sometimes disposed to set a date for the apocalypse. As a member of the avant-garde who is capable of perceiving the conspiracy before it is fully obvious to an as yet unaroused public, the paranoid is a militant leader. He does not see social conflict as something to be mediated and compromised. Since what is at stake is always a conflict between absolute

> good and absolute evil, what is necessary is not compromise but the will to fight things out to a finish. Unlike the rest of us, the enemy is not caught in the toils of the vast mechanism of history, himself a victim of his past, his desires, his limitations.

Clearly, the need to deconstruct conspiratorial discourse can be seen as a primary goal of nuclear semiotics, because it is omnipresent on the Internet, which has become its major propagator and legitimizer. This requires turning discursive relativity effects on their head (as will be discussed subsequently).

Epilogue

The empty gasoline drum anecdote described at the start of this chapter brings out, in a nutshell, how semiotic relativity works at the level of language and what risks it harbors in the area of danger communication. As Lindhout and Ale (2009: 247) observe, it has concrete implications for the identification of workplace risks:

> Language issues are not picked up as a safety risk on the shop floor by current safety management systems. These safety risks need to be identified, acknowledged, quantified and prioritized in order to allow risk reducing measures to be taken [by investigating] the nature of language issues related danger in literature, by experiment and by a survey among the Seveso II companies in the Netherlands.

The two researchers found that the "readability of safety related documents used by the companies" was very poor, becoming a source of accidents. Whorf (1956: 137) described other similar situations, coming to the following conclusion: "Such examples, which could be greatly multiplied, will suffice to show how the cue to a certain behavior is often given by the analogies of the linguistic formula in which the situation is spoken of, and by which to some degree analyzed, classified and allotted its place." Edward Sapir (1929: 211), who was one of Whorf's professors at Yale University in the 1930s, provides the following relevant observation, which is worth repeating here, given its relevance to the theory of semiotic relativity:

> Human beings do not live in the objective world alone, nor alone in the world of social activity as ordinarily understood, but are very much at the mercy of the particular language which has become the medium of expression for their society. It is quite an illusion to imagine that one adjusts to reality

> essentially without the use of language and that language is merely an incidental means of solving specific problems of communication or reflection. The fact of the matter is that the "real world" is to a large extent unconsciously built upon the language habits of the group. No two languages are ever sufficiently similar to be considered as representing the same social reality. The worlds in which different societies live are distinct worlds, not merely the same world with different labels attached. We see and hear and otherwise experience very largely as we do because the language habits of our community predispose certain choices of interpretation.

The language with which Whorf became fascinated was Hopi, a Native American language spoken in the southwest region of the United States (Whorf 1956)—a language and culture to which we shall return in this book. Today there are only about 11,000 Hopi people, half of whom live on a reservation in Arizona, consisting of eleven villages on or near three high mesas (tablelands). The relevant aspect that concerns us here is that the Hopi language classifies and represents dangers very differently from Western languages and cultures (as we shall see). The Hopi people perceive the sense of danger as a body-mind-environment state—one affecting the other holistically. Whorf claimed that this mirrored the Hopi worldview overall, which guided how they organized their lives and social system.

Relativity effects result from all kinds representational forms, from artworks to mythologies. Studying how these unfold in the referential domain of danger has practical consequences, allowing for the extraction of a common taxonomy of meaning-making tendencies inherent in the different cultural codes of danger that manifest themselves across the world and across time. In turn, this taxonomy can provide concrete insights into how to construct and convey warnings effectively about both imminent and existential dangers, thus attempting to solve Sebeok's problem in a more general way.

2

Representing and Interpreting Danger

Prologue

As a science of signs, semiotics has developed a number of key notions that shed light on the interconnection between signs, perception, belief, and understanding. Of particular relevance for the present purposes is the notion that there is an intrinsic correlation between representation and interpretation. The former is the process of creating and using signs and sign structures, such as in pictorial and narrative texts (Chapter 1), and the latter of extracting meaning from these. In semiotic theory, a *text* is defined generally as a meaning-bearing arrangement of sign elements with the structural properties of these elements, allowing for the creation of complex messages. So, at a basic level, a verbal text such as a novel is constructed with the lexical and grammatical properties of words; a visual text, such as a painting, with the structural features of visual images and forms; and so on. Now, the meaning derived from a text is not equivalent to the aggregate meanings of its constituent sign structures—it inheres in deriving a holistic interpretation from it. For instance, if we ask someone who has just read a novel what it meant, we would receive the person's overall interpretation of the text, not an analysis of its separate words, sentences, and parts.

While there are many other aspects to texts in semiotic theory, including the allusion within a text to other texts (intertextuality), and the role of the author and reader in shaping the text's meaning, for the present purposes, this general characterization will suffice (Petöfi 2010; Marrone 2021). The interpretation is not a predictable process; it is shaped by a host of variables, such as the different contexts in which a text occurs, namely, the physical, psychological, social, cultural, situational, historical conditions and factors that constrain what range of meanings can be extracted from a text. As an example

FIGURE 2.1 *Trefoil pictogram (Wikimedia Commons).*

of a rudimentary semiotic analysis of a simple visual text, consider the above trefoil hazard pictogram, which was designed to convey the danger associated with nuclear radiation in a specific way (Figure 2.1).

The pictogram was created in 1946 at the Berkeley Radiation Laboratory, at the University of California. It was designed as a visual representation of what a radiating atom might look like in outline form: The atom is represented by the small middle sphere and the radiation by the three "blades," which emanate from it, standing for wave forms (Stephens and Barrett 1978). But, as straightforward as this representation of a specific danger might appear on the surface, it has led to problems of interpretation at various levels (Kathren and Ziemer 1980). The US Office of Civil Defense originally wanted to locate it near fallout shelters, but this was rejected because the shelters themselves represented "safety," whereas the pictogram was meant to represent the "danger" associated with radiation—hence a dissonance in meaning. The magenta background was chosen because it was thought to be neutral in terms of meaning, but there was doubt about this from the start, because of the various cultural-aesthetic meanings elicited by this color, including its symbolic meaning of universal love in various cultures. Finally, the "blades"—standing for radiation waves—have been interpreted as representing a Japanese battle flag, a boomerang, and grass-cutting blades, rather than radioactive waves (Dunn 2012).

In effect, this seemingly unambiguous pictogram turns out to be a problematic one, showing how the representation-interpretation dynamic is shaped by variable factors such as the context with which the sign is associated and the meanings of its separate visual sign elements, such as color and shape. The original goal of nuclear semiotics was to find ways to tame this type of interpretive variation in the creation of a specific kind of warning sign system (Sebeok's problem); an expanded goal would be to examine how it unfolds in the different media used across time to represent existential danger, from language to art and

narrative, so as to be able to better understand what common elements can be seen to turn the danger sense on (or off) across the world.

Representation

The trefoil pictogram above reveals the use of three representational modalities in tandem—iconicity, indexicality, and symbolism—which, as is well known, were put forth as fundamental semiosic tendencies by Charles Peirce (1931–58). The first is defined as representation by resemblance or simulation; the second by indication or collocation; and the third by convention:

1. *Iconicity:* The overall pictogram was created to represent radioactive atomic activity by resemblance (in outline form). The small sphere in the center was chosen to stand for the shape of the atom, because the designers likely believed that this was an image that people would recognize, even though it is an obsolete one for nuclear scientists, given that it dates back to the Dalton Billiard Ball model, developed by John Dalton in the nineteenth century. The "blades" escaping from the atom, representing radioactive waves, have been used in the gamma ray model of the atom, which the designers seemed to assume would also be broadly recognizable.
2. *Indexicality*: The pictogram was intended, as mentioned, to be located near a fallout shelter, literally "indicating" its location, even though this plan was abandoned because of the dissonance of meaning that this would entail.
3. *Symbolism*: The fact that the pictogram was not interpreted by everyone who saw it as representing nuclear radiation (Kathren and Ziemer 1980) is the result of a tendency to interpret signs and texts in symbolic ways, guided by conventional associations between signs, texts, and their meanings.

These three modalities occur across codes and representational media. For example, in language, iconicity can be seen in verbal labels that represent the nature of a dangerous situation in terms of the sounds that it produces—*Boom!* (explosion), *Woosh!* (rushing toxic liquid), etc. Indexicality involves the use of signs or sign elements to indicate where a danger is—arrows, for example, are visual indexes which point to the physical location of danger. Symbolism involves conventionalized or culture-specific meanings, such as the use of the color red to represent danger. The pictogram above also enfolds two primary levels of meaning—denotation and connotation. The former refers to the intent of the pictogram to communicate the danger associated

with radioactivity by showing how it emanates from an atom; the latter refers instead to the accrued meanings that the images (the blades, the magenta color) used in the pictogram bear, which are the sources of interpretive variation. Roland Barthes (1964) referred to denotation as *uncoded* meaning, and to connotation as *coded* meaning—a distinction which will be discussed in more detail subsequently.

The question now becomes: What principles of representation make a warning sign or text effective psychologically and resistant to variation and even meaning decay (Sebeok's problem)? Various principles will be elaborated in due course that address this very question, extending Sebeok's own recommendations beyond his problem. A fundamental principle is that effectiveness correlates with the degree of emotivity built into the representation, defined as the level of feeling and memorability that the representation is capable of evoking. As Sebeok (1984) argued, iconicity is a primary mode of representation for evoking emotivity to some degree. The hazard pictogram above has a relatively low emotivity effect, especially when compared to a painting such as *The Scream*, by Norwegian artist, Edvard Munch, which produces a much higher emotivity effect (Figure 2.2).

Munch himself described the inspiration for the painting as follows, which he added to the frame of his 1895 pastel version:

> I was walking along the road with two friends, the sun was setting, the Sky turned a bloody red, and I felt a whiff of melancholy. I stood still, deathly tired, over the blue-black fjord and city hung blood and tongues of fire. My friends walked on; I remained behind, shivering with anxiety. I felt the great scream in Nature.

The agonized, desperate expression on the face of the person screaming, blocking out the "great scream of Nature" by covering the ears, has been interpreted in various ways. It is sufficient to note simply at this point that it has a powerful emotive effect on viewers, transmitting a sense of intense fear and foreboding, alerting us to the presence of extreme danger. Now, it will come as little surprise that a simplified version of this marvelous painting became one of the pictograms that was considered by the US Department of Energy in 2004 for use as a sign to warn future generations about the dangers of radioactive waste (Figure 2.3).

There is considerable loss of emotivity in this pictogram version, rendering it virtually ineffectual, as the Department itself discovered in feedback it gathered after the sign had been made public. Some interviewees even felt insulted, seeing it as a caricature and desecration of Munch's art. Nonetheless, some agencies have continued to believe that this caricature of Munch's painting is nonetheless useful as a non-language-specific symbol of danger.

FIGURE 2.2 The Scream, *Edvard Munch, 1893. Oil, tempera, and pastel on cardboard, 91 × 73 cm. National Gallery of Norway (Wikimedia Commons).*

FIGURE 2.3 *US Department of Energy danger symbol, 2004 (Wikimedia Commons).*

For instance, WIPP (Waste Isolation Pilot Plant), located twenty-six miles southeast of Carlsbad, New Mexico, has considered including it in its "code of danger," which it intends to complete within the next decade or so.

Interestingly, the original painting, and modified versions of it, surfaced as Internet memes during the 2020–1 coronavirus pandemic, perhaps because it subconsciously represented the anxieties created by the pandemic itself. Some of the online versions modified the image of the screaming person in the painting as showing anxiety about face-touching; others transformed the face into the recognizable shape of the coronavirus; others still showed screaming Munch figures fleeing cities desperately. The appearance of such memes in a time of crisis suggests that visual representation might constitute an emotional safety valve to vent collective fears. It is relevant to note that Munch himself fell victim to the Spanish Flu pandemic, surviving it to become inspired to depict his terrifying experience in his *Self-Portrait with the Spanish Flu* (1919) (Figure 2.4).

In this painting, Munch portrays himself as isolated, slumped in a wicker chair, wrapped in a robe and blanket. He appears emaciated, with a sickly facial pallor, staring at the viewer with recessed eyes that suggest delirium. A key feature is his gaping mouth, which is reminiscent of the shape of the mouth of the figure in *The Scream* (Goldstein 2020). As Potter (2003: 407) has written, Munch's self-portrait suggests that great artists are inspired by tragedies, such as those that are caused by pandemics, as symbolic of the human condition:

FIGURE 2.4 Self-Portrait with the Spanish Flu, *Edvard Munch, 1919. Oil on canvas, 150 cm × 131 cm. National Museum of Art, Architecture and Design, Oslo (Wikimedia Commons)*

> Munch's preoccupation with suffering in this self-portrait is fully understood by those who study the Spanish flu pandemic. Erupting during the final stages of World War I, this global disaster reinforced the era's nihilism and apocalyptic visions of despair. Specimens from the remains of flu victims buried in permafrost provide some clues about the 1918–1919 strain. Highly contagious and unusually virulent, the deadly flu, circled the globe, taking its toll among the youngest and healthiest. Medicine was then only beginning to understand infectious diseases and to take modest steps towards diagnostics and therapy. Infectious disease medicine has come a long way, yet Munch's specter of the flu is alarmingly current. Surveillance of circulating viruses is increasing and flu vaccination has entered the mainstream, but epidemics are still frequent and strains arising from antigenic shift keep the next flu pandemic just around the corner.

It is relevant to note that Olson, Doescher, and Olson (2004) have interpreted Munch's *Scream* painting as an actual visual record of a catastrophic natural event that took place in 1883, ten years before the painting was completed, during which time Munch was working on it. The researchers have suggested, in fact, that the sky in the *Scream* reflects the effects of the 1883 Krakatoa eruption as seen from Norway—the volcanic eruption that occurred on the small island of Krakatoa, between Java and Sumatra, that destroyed most of the island. They came to this conclusion because the painting shows the moon, not the setting of the sun, and a sky full of whirling clouds that seem to be on fire. This was not an artistic choice by Munch, but a matter of optics: That is, it was a portrayal of the devastating effects of the eruption as seen from the artist's perspective, and the fearsome implications it had for human survival. Whether or not this interpretation of the painting is viable, it certainly cannot be excluded, given the fact that the cataclysmic Krakatoa explosion brought about a volcanic winter around the world, affecting the environment for many years thereafter, lowering global temperatures by around 1.2°C.

Another research team—helmed by the same lead investigator, Donald Olson (Olson, Robertson, and Doescher 2006)—examined one of Munch's other paintings, *Girls on the Pier* (1904), to corroborate the theory put forth above (Figure 2.5).

The painting shows three women leaning against a railing, looking down into water in which the images of houses are reflected. A peach-colored orb can be seen in the sky, but, strangely, it casts no reflection in the water, likely because the sky was ashen in color. The team had traveled to Åsgårdstrand, Norway, the resort town where Munch created the painting in the summer of 1901. By using maps of the area and examining old postcards, they determined the exact location of the original pier (which had since been torn down), and

FIGURE 2.5 Girls on the Pier, *Edvard Munch, 1904. Oil on canvas, 136 cm × 125 cm. National Museum of Art, Architecture and Design, Oslo (Wikimedia Commons).*

the spot where Munch likely stood to sketch his painting. They then retraced the paths of the sun and the moon across the sky at the same time, coming to the conclusion that the sun did not appear in that section of the sky, and thus that the orb in the sky was the moon (as in *The Scream* painting).

The Olson team also looked at three other Munch masterworks, from the year 1893, *Starry Night*, *The Storm*, and *Sunrise*, identifying the time and place (Åsgårdstrand) of their creation (Olson et al. 2009), by using topographic measurements and computer calculations, thus documenting a previously unknown visit by Munch to the port town. In *Starry Night,* the bright star above the horizon, interpreted by art scholars to be the planet Venus, was identified by the researchers instead as Jupiter, because the calculations indicated that Venus remained below the horizon at the estimated time of year. The researchers also identified the white line visible among shadowy trees, which had traditionally been interpreted as a reflection of the hidden moon, as a flag pole. In *The Storm*, the researchers examined weather records for the time period it would have been created, discovering that the painting may have depicted the strong thunderstorm that hit Åsgårdstrand on the evening of August 19, 1893. Finally, using similar computational techniques, in *Sunrise* the researchers were able to pinpoint the precise position of the rising sun and the glitter path reflected in the fjord at the end of the summer of 1893.

Artistic representations of actual catastrophic events go back to ancient times, as will be discussed in Chapter 5. Cumulatively, they form a genre that deals with existential dangers via the pictorial medium. Some visual artists today have even become climate and public health activists, using their artwork as a platform to raise awareness of the dangers of climate change and to encourage people to imagine a different and more environmentally safe future. There is now even an artistic movement termed *Earth art,* which aims to warn people about the dangers that they face today through various types of artistic representations (Boetzkes 2020). The movement emerged in the 1960s in Europe and the United States; artists within the movement utilize materials of the Earth, such as soil, rocks, vegetation, and water to create sculptures and architectural objects that represent danger at a site.

The movement became broadly known from the installations called *Ocean Landmark,* by artist Betty Beaumont, between 1978 and 1980, which were sponsored by the US Department of Energy—the same one that approached Sebeok a year later, in 1981. Beaumont's work consisted of 17,000 neutralized coal fly-ash blocks dumped three miles off the coast of New York. The coal reached the floor of the Atlantic Ocean, where it has since morphed into an artificial reef. It remains an artistic reminder of the existential dangers that modernity faces, challenging us to reflect on the dangers of pollution, rampant urbanization, and climate change. Helping her realize her project was a team of scientists and engineers who were experimenting with coal-waste as a means to stabilize it in water. Because the enormous underwater sculpture is not visible to viewers, a virtual reality representation, produced by Beaumont in 2000, through New York University's Interactive Telecommunications Program, allows people to experience it vicariously.

Interpretation

The other side of representation is interpretation. As discussed with regard to the trefoil pictogram and the Munch paintings above, the same sign or text will produce different interpretations at various levels and within different contexts. Clearly, the range of interpretations of the Munch painting will be much broader than the range related to the pictogram. Even when the location and time frame of *The Scream* can be mapped with precision against the circumstances surrounding the Krakatoa eruption, and the features of the painting shown to correspond to the environmental effects of atmospheric volcanic ash, it cannot be assured that this was in Munch's mind when he drew the painting; nor can it be assured that people viewing the painting today would understand it in this way. Most people viewing *The Scream* tend to see the agonized face in the painting as symbolizing the anxiety that characterizes

the uncertainty of life or the fear of the dangers that life presents. Some Munch biographers see the painting as a traumatic reaction to his sister's consignment to a nearby lunatic asylum. Even Munch's own assessment of how he was inspired to paint it adds to the uncertainty of its meaning, as can be seen in the following citation (in Prideaux 2007: 83–4):

> The point is that one sees things at different moments with different eyes. Differently in the morning then in the evening. The way in which one sees also depends on one's mood . . . coming in from a dark bedroom in the morning into the sitting room one will, for example, see everything in a bluish light. Even the deepest shadows are topped with bright light. After a while one will accustom oneself to the light and the shadows will be deeper and everything will be seen more sharply. If an atmosphere of this kind is being painted it won't do merely to sit and gaze at everything 'just as one sees'. One must paint precisely the fleeting moment of significance—one must capture the exact experience separating that significant moment from the next—the exact moment when the motif struck one. In some circumstances a chair may seem to be just as interesting as a human being. In some way or another it must have caught the interest in which case the onlooker's interest must somehow be engaged in the same way. It's not the chair that should be painted, but what the person has felt at the sight of it.

Semiotically, all that can be said is that Munch's painting produces a high level of connotative variation and of emotivity, showing rather conspicuously that representation does not equal interpretation. The latter is mediated by various factors, as discussed in the previous chapter, which influence how it unfolds. A text can also convey meanings that may not have been evident previously—such as the interpretation of the Munch painting as a record of a catastrophic environmental event. A goal of semiotic analysis would be to determine if, within the connotative range that a text covers, there is a meaning core or limit to it, based on comparisons with similar texts in the same era.

In the case of artistic texts, interpretive variation tends to be high, making it difficult to locate the core meaning. Umberto Eco (1990) called such texts "open," that is, as producing an unlimited range of connotations, which can nonetheless be seen to converge around a core of meaning. So, while Munch's *The Scream* is an open text, it nonetheless falls within an emotive core of connotations that involve fear, anxiety, or fright; it would seem anomalous to interpret such a painting instead as indicating something humorous or ludicrous. Texts such as the trefoil above are "closed" ones, to use Eco's terminology adaptively, since they enfold a limited set of meanings that can be more easily constrained to a core. Consider the hazard pictogram that replaced the trefoil one above in some areas of the world in the first

FIGURE 2.6 *Radiation warning pictogram (Wikimedia Commons).*

decade of the new millennium. It was designed purposively to avoid the ambiguous interpretations of the former (Figure 2.6).

It was devised in February 2007 by the International Organization for Standardization (ISO) and the International Atomic Energy Agency (IAEA). The previous pictogram was described as having "no intuitive meaning and little recognition beyond those educated in its significance," while the revised one was seen as "conveying 'Danger—Stay Away' to anyone who sees it, regardless of their age, education, or cultural background." To constrain the interpretation of the pictogram, the designers incorporated the following symbols:

1. a skull and crossbones figure, standing for death;
2. the outline figure of a person running away in the direction indicated by an arrow, suggesting a hurried escape from the radioactive site to safety;
3. the original trefoil blades on top, modified by adding jagged lines to show the emission of radioactive charges;
4. a triangular contour;
5. the color red on both the contour and the background.

Like its predecessor, the makers soon discovered that they could not eliminate variation from its interpretation. For example, the skull and crossbones figure as a symbol of death is not universal, even though this meaning has some cross-cultural resonance. One of the earliest uses of the symbol is in an early Christian context, standing for *memento mori* ("remember you must die"), as discovered on various Christian catacombs around Italy, as far back as the second century CE; it is found with this meaning in Hindu temples and in Mesoamerican architecture (Mayer and Laux 1989; Wogalter et al. 2006) as well. At one time, it was one of the most feared symbols of piracy in the Western hemisphere. Its use as a warning label to indicate deathly

poisonous content in containers, such as strychnine bottles, is traced to the mid-nineteenth century (Argo and Main 1986). In the current era, however, it is typically associated with treasure, blockbuster pirate movies, or Halloween costumes, which influence how it is perceived connotatively and emotively.

A similar assessment can be made vis-à-vis the other elements of the pictogram. For example, the choice of the color red for the background and the triangular border were likely guided by the view that both symbolized danger universally. But this also turned out to be an unfounded assumption. As discussed in the previous chapter, the symbolism of red varies across the world, and so cannot be assumed to represent danger universally. Its use to indicate danger in hazard pictography is actually fairly recent, going back to the Vienna Convention on Road Signs and Signals of 1968; it was chosen in part since it is the brightest color in daytime and because it stands out against a blue sky, green trees, or gray buildings. The choice of the triangular shape also activates a range of meanings that cannot be tied down to a core, including spiritual or philosophical meanings associated with this shape. The blades symbol, with added jagged lines pointed outward, continues to be ambiguous (for the same reasons as discussed with regards to the original trefoil). Finally, the human figure shown running away has also been found to elicit different interpretations: Is the person fleeing from the symbolic death associated with the skull and crossbones or from the radiation?

The problem of constraining meaning is one of the oldest conundrums in semiotics and cognitive science generally (Ogden and Richards 1923). Consider again the intended meaning of the above pictogram, which the IAEA explicitly stated should be: *Danger—Stay Away*. This was its intended denotative meaning, which cannot be assumed, as we saw, because of the simultaneous operation of connotative mechanisms in the interpretive process. The designers had taken for granted that their own understanding of the images and symbols they used (skull and crossbones, the color red, the running figure) would be the same across the world. They were caught unaware by the fact that these sign elements had accrued connotations from their uses in different pragmatic contexts—the meaning of the skull and crossbones symbol in the context of a pirate story is different from its use on a strychnine bottle; the color red stands for different meanings when associated, say, with roses (love) or with a certain political ideology. To use the phraseology introduced by Roland Barthes (1964), liberally, the initial denotative intent of the pictogram was to create an "uncoded" meaning—a meaning that was free of pragmatic contextual influences. But the various sign elements in it, such as the skull and crossbones or the color red, assigned a set of "coded" meanings to it that could not be blocked.

The semiotic concept of *code* was introduced by Saussure (1916: 31). For our present purposes, it can be defined as the meaning-assigning mechanism

in interpretation. Although Saussure did not take connotation into direct account when he proposed the term, later theorists made it a central feature of language (and other sign systems) (Bloomfield 1933; Carnap 1942; Hjelmslev 1959; Barthes 1977; Bouissac 2010). In the danger pictogram, connotative meanings are mapped onto it via a color code (which enfolds the different meanings of red acquired in pragmatic contexts), a geometric code (the triangular form and its various connotations in various domains of meaning, such as religion), and so on. As a result, there is no way to pin down exactly what the pictogram will mean to specific people, because of coded meanings. Nevertheless, interpretation is not a completely open-ended process, as Eco argued (1990). It is constrained by social conventions, by communal experiences, and various contextual factors that place limits on the range of connotative meanings that are possible in a given situation—it is unlikely that the danger pictogram will be interpreted as, say, a sign of love.

Another semiotic problem is that of decay and durability of meaning. Will the pictogram above retain its intended meaning years into the future, or will it decay in meaning over time? It is relevant to note that the conclusion reached by WIPP saw this problem as a central one, as did the US government when it hired Sebeok (Chapter 3). Since the 1970s, WIPP has employed all kinds of experts in different fields to help it design effective and potentially long-lasting warning signage. An idea that emerged early on was that a warning symbol was more understandable if it was made to be highly iconic, such as the use of cartoon-like frames showing the location of the danger and people running away from it (as in the pictogram above). But this strategy assumed that people would universally understand how the visual frames were organized to suggest a specific action. Other suggestions by members of the WIPP task force involved a more physical approach, called "hostile architecture," which entailed altering the shape of the location by creating spike fields, forbidding blocks, pyramids, etc. that were assumed to capitalize on the instinct of fear and discomfort that such shapes would evoke. But even in this case, it could not be assured that the architecture would be interpreted as terrifying—it could easily be interpreted as fascinating; that is, as a work of bizarre art.

There is no definitive solution to Sebeok's problem, given the fact that connotation cannot be tamed to bring about what Terry Eagleton (1991: 197) called "semiotic closure," or the sealing of meanings by counteracting the disrupting diachronic (historical) and culture-based variation forces at work in semiosis. The original trefoil now appears on clothing and everyday products, having become more ordinary than extraordinary. Those who come across it for the first time today, therefore, are more likely to interpret it as a fashion logo, rather than a warning sign. On the other hand, as Sebeok discussed in proposing solutions to his specific problem, the principle of connotative

emotivity can be harnessed to make warning systems effective. As we saw with the Munch painting, the number of connotations that it evoked made it a powerful emotive artifact—hence its use as a danger pictogram by the Department of Energy and as a meme during the pandemic. The more connotations a representation evokes, the more emotively effective it is. Solving Sebeok's problem thus involves examining in systematic ways the relation between connotation, emotivity, and other semiotic forces at work in interpretation. Some of these will be examined in the remainder of this book.

Folkloric Warnings

One of Sebeok's main recommendations for making warning messages effective and long-lasting was to adopt folkloric-like traditions, such as the same style of the ancient warning myths, because, he claimed, these tap into a subconscious system of understanding danger that transcends time—that is, we still read the ancient myths as metaphorical cautionary tales of existential danger that are as understandable today as they were in the past and, thus, which will be presumably just as understandable in the future. American philosopher Sam Keen (1983: 31) has put it as follows:

> Myth is the system of basic metaphors, images, and stories that in-forms the perceptions, memories, and aspirations of a people; provides the rationale for its institutions, rituals and power structure; and gives a map of the purpose and stages of life. A living myth remains largely unconscious for the majority . . . The mythical mind is unreflective. It lives unquestioningly within a horizon of the culture's images, stories, rituals, and symbols, just as the religious person rests content within the liturgy and creedal structure of the church or cult.

Many of the ancient myths were folkloric records of actual glacial floods and volcanic eruptions (Nunn 2018). Some revolved around the theme of human recklessness and disregard for the environment as sources of the natural disasters. One classic example is the tale about the King of Thessaly who infuriates the goddess Demeter by cutting down her sacred trees. As a result, Demeter orders Famine to enter the king's stomach. The king then devours everything, until people flee from his palace, and he is left with only one resident, his own daughter. He begs her for food, but she escapes. As there is less and less food to be found, the king eventually devours himself.

The myth connects danger to hubris—a character trait that blinds people to reason, resulting in their downfall.

Another ancient example is Aesop's fable of *The Tortoise and the Hare*, which is about a hare who mocks a slow-moving tortoise. Tired of the hare's arrogance, the tortoise challenges the hare to a race, which the hare accepts with derision and mockery. As expected, the hare soon leaves the tortoise far behind, confident of winning. So, it decides to take nap midway. As the hare sleeps, the tortoise continues to crawl forward very slowly without stopping. When the hare awakes, it finds that the tortoise had crossed the finish line, and feels humiliated at being beaten by the ambling (if determined) reptile. This story, like that of the King of Thessaly, is an apologue—a narrative with a built-in moral lesson. Such stories serve to caution people that certain character traits are potentially dangerous, if left unchecked.

Similar stories are found in folk traditions worldwide. In a Native American Cherokee myth, for example, the apologue unfolds as a race between a hummingbird and a crane, to win the hand of the woman they are pursuing romantically (Mooney 1900). The woman initially preferred the hummingbird, but the crane was so persistent in pursuing her that in order to put him off once and for all she told him he must challenge the hummingbird to a race and that she would marry the winner—not knowing that the slower crane could fly all night, while the hummingbird would need to sleep. The two suitors agreed to race around world, with the one who came in first allowed to marry the woman. The hummingbird flew all day, but when night came it stopped to sleep, while the crane continued to fly steadily all night long. As a result the hummingbird lost the race. However, the woman declared she would never marry the crane, so she remained unwed.

Another folkloric tradition involves astrology, a divinatory craft for predicting future dangers and uncertainties. Western astrology originated in ancient Mesopotamia as a symbolic code to help people decide when to plant crops and to prepare for potential perils (Barton 1994). Interestingly, Carl Jung (1971) saw psychotherapeutic value to the use of astrology (Hamaker-Zondag 1990)—that is, he saw it as a folkloric means to extricate hidden fears from his patients. The validity of Jung's evaluation of astrology as an emotional safety valve became obvious during the 2020–1 coronavirus pandemic which saw a widespread resurgence of interest in online horoscopes, constituting a form of collective psychotherapy in a time of fear and danger.

Before medical germ theory, it was actually common for practitioners to use astrology in their everyday diagnoses. Some doctors were also astrologers. One of the best-known examples is Nostradamus, doctor and seer, who helped the victims of the bubonic plague medically, at the same time that he interpreted their zodiacal signs, providing solace to them, given that his patients (like himself) firmly believed in astrological forces at work in the universe. It is relevant to note that the term *influenza* is derived from the astrological idea that the disease was caused by the "influence" of the stars

on human health. Public health predictions were also frequently based on the astrological theory of conjunctions—that is, pandemics were seen as a result of certain planets approaching each other in the sky, whereupon catastrophic events were expected to occur. A famous example of this occurred when the bubonic plague hit France in 1348, whereby the king asked his physicians to account for its origins. They explained to the king that it was caused by a conjunction of Saturn, Mars, and Jupiter, which apparently satisfied the king, although it did not help to eliminate the plague. The English astrologer John Gadbury (1672) even produced one of the earliest astrological treatises of plagues, suggesting that if the conjunction of the planets caused them, then different planetary conjunctions could also stop them. The medical advice in Gadbury's book certainly would not stand up today nor could it be used literally by most people; however, the use of astrology as an unconscious coping mechanism in dangerous times is still prevalent. The therapeutic value of astrology in the modern era was examined by the sociologist Marcello Truzzi (1972), who found that most astrology believers do not see it as a precise science, but rather as a means of the "tension-management of anxieties."

Folkloric systems of existential danger representation continue to be emotionally powerful. Natural disasters, pandemics, and the social upheavals associated with them have always been grasped concretely by people throughout history via the narrative medium. Pandemics have even inspired the creation of new narrative genres, beyond the mythical genre. Narrative fiction, for example, emerged during the years of the Black Death (bubonic plague), in the writings of medievalists such as Giovanni Boccaccio and Geoffrey Chaucer. The difference between this type of narrative and the ancient myths is that the latter revolved around an interaction between the divinities and humans; while the former revolves exclusively around humans. Boccaccio's *Decameron* (*c*. 1348) is a compilation of the fictional stories of its characters, who had fled Florence to a secluded villa in order to escape the Black Death. First-person, fictionalized accounts of living through the plague became popular subsequently. One well-known example is Samuel Pepys's *Diary*, in which he records first-hand observations of the Great Plague of London in 1665. Later works, such as Albert Camus' novel *The Plague* (1947), explore the social and psychological effects of plagues, along with the individual's existential confrontation with mortality (Chapter 6).

Interestingly, the folkloric narrative traditions of Indigenous peoples has caught the attention of policy-makers searching for ways of preserving the environment in the midst of crises such as climate change. The Intergovernmental Panel on Climate Change (IPCC) was established by the United Nations in 1985 to access these traditions for their intrinsic wisdom. In its 2007 report (Chapter 15, section 15.6.1), the IPCC stated that Indigenous

knowledge is "an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change." Three specific observations made in that report are of particular relevance and thus worth repeating here, especially since these traditions may be breaking down under modernization pressures, as can be seen in observation (3):

(1) Among Arctic peoples, the selection pressures for the evolution of an effective knowledge base have been exceptionally strong, driven by the need to survive off highly variable natural resources in the remote, harsh Arctic environment. In response, they have developed a strong knowledge base concerning weather, snow and ice conditions as they relate to hunting and travel, and natural resource availability . . . This Arctic indigenous knowledge offers detailed information that adds to conventional science and environmental observations, as well as to a holistic understanding of environment, natural resources and culture.
(2) The generation and application of this knowledge is evidenced in the ability to detect safe sea ice and weather conditions in an environment with increasingly uncharacteristic weather [using] the knowledge and skills required to hunt marine species in open water later in the year under different sea-ice conditions.
(3) Their ability to cope with substantial climatic change in future, without a fundamental threat to their cultures and lifestyles, cannot be considered as unlimited. The generation and application of traditional knowledge requires active engagement with the environment, close social networks in communities, and respect for and recognition of the value of this form of knowledge and understanding. Current social, economic and cultural trends, in some communities and predominantly among younger generations, towards a more western lifestyle has the potential to erode the cycle of traditional knowledge generation and transfer, and hence its contribution to adaptive capacity.

In light of the destruction of the environment and despoiling of Earth's natural resources by reckless activities, scientists are starting to cooperate with folklorists and other culture analysts to find ways to help promote practices that will persuade people to engage in more environmentally healthy activities that might also enhance sustainability. Native folkloric wisdom, as Holthaus (2013) maintains, can help chart a social path for achieving a sustainable culture, since it is based on fostering a respect for the Earth; it also has produced a deep understanding of the warning signs produced by Nature. In some Arctic communities, for example, the inhabitants have correlated the changes in the behavior of animals in recent years as ominous

signs, including the over-abundance of jellyfish and seals with bald spots that have never been seen before (Huntington, Quakenbush, and Nelson 2017). Their observations forewarn us about the dangerous shifts in ecological and animal life that are now unfolding—shifts that have been themes in many of their historical myths.

In sum, the study of folkloric traditions is of particular utility in the study of warning systems. As Osemeobo (1994) points out, these were meaningful cultural prescriptions for promoting conservation. Osemeobo (1994: 48) based his observation on the basis of the myths of the indigenous people living in Edo State in Nigeria:

> This study investigated the significance of folklore on environmental conservation in the rainforest belt of Edo State, Nigeria. Data were derived from a questionnaire survey involving 400 respondents in six rural settlements between May and November, 1992. From the analysis of these data, most indigenous folklores influenced the conservation of the environment. Nevertheless, the changing religious beliefs of the people in a heterogeneous composition of settlements, market-based agricultural production, and changes in the recreational activities of young people have disintegrated the traditions on which the folklores were based. Thus, the role of folklore in biotic conservation has diminished considerably, even though it has ensured long-term preservation of the existing pockets of natural forests.

The gist of the foregoing discussion is that the folkloric stories are representations that continue to resonate with contemporary peoples. They are as understandable today as they were in antiquity—a premise that Sebeok adopted in his attempt to solve his particular problem, seeing folklore as incorporating common elements of understanding that have the ability to withstand meaning decay. A granite hieroglyphic inscription, known as the Famine Stela, found on Sehel Island near Aswan in southern Egypt (Lichtheim 2006: 94–8) is more than 4,000 years old. It tells of seven years during the reign of the ancient Egyptian pharaoh Djoser when the Nile failed to go through its flooding cycle, causing a devastating drought. It bore a dire warning: The natural rhythm of the Nile is crucial to the survival of people in the area, and any disruption of this rhythm will bring about dire consequences. The implicit prescription was a change in the wasteful habits of those who lived near the river. Egyptian officials are worrying today about the very same disruption of this ecological system due to population growth, climate change, and a giant hydropower dam built by Ethiopia on the Nile. Contemporary Egyptians thus face the same plight as those living in the era of King Djoser. As Sebeok understood (Chapter 3), a possible solution to such

problems, which reach back to ancient times, is through a partnership between science and semiotics. That partnership may, however, present its own set of problems of interpretation and perception, as engineer Samuel Forman (1976: 27) warned a while back, since it might revolve around a self-defeating jargon, which could have been a reason why Sebeok's report was never taken seriously into consideration (as will be discussed subsequently):

> Sanctimonious slogans have a way of lulling well-meaning people, and at the same time providing self-seekers, with means to frustrate the very controls that are most needed. Take, for example, a report entitled, "The Engineer's Responsibility in Environmental Pollution Control," submitted in 1971 to the government's Council of Environmental Quality by the National Industrial Pollution Control Council. The report is an amorphous collection of noble generalities. It conjures up a vision of a crusading army of engineers, thousands abreast, marching in unison. The banner of this army is "cooperation." Its mission is to "coordinate," "unify," "interact," "centralize efforts," and "pool resources." Its weapons are "shared objectives," "common goals," "interdisciplinary concepts and techniques." The cloud of pieties serves, not to enlighten, but to obscure the real truth, which is that environmental pollution control can never be achieved by the worthy sentiments of industrial spokesmen, but only by government regulation.

There is another risk that is worth mentioning here about the partnership that Sebeok envisioned. While folkloric medicine has actually been beneficial when used in tandem with scientific medicine (Ang et al. 2020), it cannot replace the latter, as was claimed often in online "cures" during the coronavirus pandemic of 2020–1. The partnership must be a balanced one, not a skewed one.

Epilogue

A major focus of the semiotic study of danger is to look at the relations between representations of danger and their interpretations. A general discussion of some these relations has been the objective of this chapter. These can be summarized schematically as follows:

1. Representations in any code or medium (language, art, narrative, etc.) are constructed with a blend of semiosic processes—iconicity, indexicality, symbolism.

2. The interpretation of a textual representation does not equal the sum of the meanings of its constituent signs.
3. Connotation is a major contributor to interpretive variation, constituting a culturally coded level of understanding.
4. Increasing the connotative emotivity of a warning sign or text is likely to increase its effectiveness and memorability; decreasing it might produce the opposite effect.
5. Folkloric traditions and representations are important as keys to unlocking common patterns of understanding danger across time and cultures.
6. Mythological traditions are particularly important in grasping how people have framed their perceptions of existential dangers, and what these tell us about these dangers in the present.

As a further example of the last point, consider the Greek myth of Phaethon, who asked his father Helios, the sun god, to let him drive the sun chariot across the sky. Helios scorned the request at first, realizing that his son was brash and foolish in wanting to control the elements; but eventually he fulfilled Phaethon's wish, advising him about the risks that this reckless desire would entail. Using a whip that Helios had forbidden, Phaeton caused the horses to go wild, losing control of the chariot, wreaking havoc in the sky and on Earth. In reaction, Zeus (Helios' brother and king of the gods) threw a lightning bolt into the sky, which hit Phaethon, sending him hurtling to Earth, thus stopping the chaos in the skies. The moral is one that resonates with people to this day—Phaethon thought he could control Nature, not realizing that he would destroy it (and himself) in so doing.

Recalling this very myth, Steven Best's (2020) commentary on the relation between human intervention into the environment and its consequences is worth repeating here:

> Like humans, pathogens do not respect species boundaries. Overall, nearly eight billion people, many with advanced technologies and rapacious appetites, are tearing ecosystems apart and within these ecosystems live millions of different kinds of viruses, bacteria, and other pathogens . . . society operates with an erroneous paradigm of disease, treating diseases as foreign invaders into our territory, when in fact we are the invading species encroaching on the habitat and communities of animals and ecosystems. It is wrong to say that these diseases are happening to us, rather they are the unintended results of what we are doing to the natural world. Speculations about accidental laboratory origins of outbreaks

> and COVID-19 conspiracy plots of bioterrorism draw attention away from actual systemic structures and dynamics of human exploitation of nature . . . Hardly unexpected or accidental, viral outbreaks are the inevitable consequences of human growth and expansion. All too often, we are the causes, not effects, the culprits, not victims, of pandemic-inducing pathogens.

Best goes on to observe that despite the fact that scientists have been constantly warning us about the dangers of ecological destruction and its connection to pandemics, we continue to believe, like Phaethon, that we can control Nature, taming it to our desires, thus ensuring that "there will be plenty more pandemics and catastrophes to come." Chemist James Lovelock and microbiologist Lynn Margulis have framed the danger in terms of a Gaia Hypothesis (Lovelock and Margulis 1974), which states that organisms interact with their inorganic surroundings to form a synergistic complex system that helps to maintain and perpetuate the conditions for life—any infraction of this system will lead to disaster. Gaia was the goddess who personified the Earth in Greek mythology. The central idea in the myth is that living things on Earth must work in concert to ensure mutual survival; thus, when humans disrupt this balance with their reckless behaviors, the Earth will respond punitively.

Paleontologist Peter Ward (2009) has challenged the Gaia Hypothesis, by referencing another Greek myth—that of Medea. Medea was the wife of the Argonaut Jason who killed the children they had together out of jealous revenge for Jason's infidelity. Ward's argument is that life will cause its own end, as implied by the Medea story, no matter what humans do. Whatever the truth, it is relevant to note that famous scientists have resorted to ancient mythology to articulate their theses. The Gaia Hypothesis resurfaced in the midst of the COVID-19 pandemic, when some used it to explain the pandemic as a "correcting mechanism" against the dangers to survival posed by human overpopulation and the extinction of some species. This might be a simplistic way of explaining existential dangers, but one thing is certain: It impels us to rethink the state of the world, which was a primary function of ancient mythology.

Since Boccaccio's *Decameron,* the warning functions of the ancient myths have been assumed by fictional narratives. A contemporary example is the 2011 film *Contagion*, which tells the story of a virus sweeping the globe, transmitted by airborne droplets. The plot revolves around the efforts of doctors and public health officials to contain the disease, the concomitant loss of social order, and the introduction of a vaccine to halt its spread. The movie was inspired by the 2002–04 SARS outbreak and the 2009 flu pandemic, but it eerily reflected the situation associated with the COVID-19 pandemic that erupted globally nine years after its release. Such movies are continuations of the cautionary functions of the ancient myths.

3

The Sebeok Report

Prologue

As mentioned several times, the first time that a governmental agency considered semiotics as a field that could help address the problem of making warnings effective came in 1981, when Thomas Sebeok was approached by the Human Interference Task Force (HITF)—a group of physicists, engineers, and social and behavioral scientists assembled by the US Department of Energy and Bechtel Corporation—to prepare a set of recommendations from the perspective of semiotic analysis on how to efficaciously warn future humans from unintentionally intruding on buried radioactive waste at the Yucca Mountain nuclear repository, in Nevada, near the California border, approximately 160 km northwest of Las Vegas. The result was a report titled *Communication Measures to Bridge Ten Millennia* (1984). Other semioticians on the HITF, chosen by Sebeok, included Vilmos Voigt, who (along with the others) later contributed to a special issue of *Zeitschrift für Semiotik* dedicated to nuclear semiotics (Posner 1984).

The lands surrounding the waste site are seen as highly meaningful to the Western Shoshone and Southern Paiute peoples, who use them for their ritualistic sacred ceremonies and social events—an aspect that may have influenced Sebeok to take a folkloric stance in one of his recommendations. The HITF would collate Sebeok's recommendations with other suggestions in order to prepare a report to the US Nuclear Regulatory Commission, under the auspices of the National Waste Terminal Storage Program. The objective of the task force was formulated by Sebeok himself in the prefatory part of his report, namely to come up with "a reasonably fail-safe means of communicating information about the repository and its contents, such that the system's effectiveness would be maintained for up to 10,000 years" (Sebeok 1986: 149). This has been designated as Sebeok's problem here—the specific problem of devising a relay warning system that would not decay in meaning over a long stretch of time.

Because some of his recommendations struck many as quirky, such as the establishment of an "atomic priesthood," Sebeok's report attracted much attention, both within semiotics and in society broadly, even drawing great interest from the mainstream media—an interest that has persisted to this day. Sebeok's ideas have, in fact, been characterized as everything from brilliant to claptrap. Leaving the praise and criticism aside, his report showed for the first time in the history of semiotics that this discipline could be used practically for studying warning representational systems and the interpretations they might entail. It laid the foundations for nuclear semiotics, whose initial aim was to study effective ways of warning people about, and deterring them from, intrusions into nuclear waste sites in the far future. As argued in this book, Sebeok's problem became the impetus for the systematic semiotic study of warning signage, and it opened up new vistas for semiotics. However, while there was much enthusiasm initially over the larger promise of nuclear semiotics, especially after the publication of the special 1984 issue of the *Zeitschrift für Semiotik,* it gradually waned, leaving only a few traces of interest in the subsequent literature (for example, Wyck 2004; Leone 2012; Ozias-Reno 2014; De Angelis and Dumont 2018).

The purpose of this chapter is to revisit Sebeok's report and nuclear semiotics more broadly, examining the kinds of ideas put forth by Sebeok and their implications for the design of effective warning systems, as well as their significance for the overall study of danger from the semiotic perspective. Some of these have been discussed indirectly in the previous two chapters, and will be elaborated and expanded in subsequent chapters. While Sebeok's report did not resolve the problem of how to warn people effectively of danger in any definitive way, its underlying premise that the sense of danger can be influenced by appropriate representational strategies can no longer be ignored; pursuing nuclear semiotics today, in terms of the larger existential dangers humanity faces, has become rather pressing.

Sebeok's Problem

Sebeok describes the origin and purpose of the HITF, and his assigned role in it, in a book that he published two years later, *I Think I Am a Verb* (Sebeok 1986: 149):

> Shortly after the inauguration of Ronald Reagan as the 40th President of the United States, my services were engaged by the Bechtel Group, Inc., as a consultant to the Human Interference Task Force, assigned responsibility for "reducing the likelihood of future human activities that could affect geological high-level waste repositories." The specific

assignment of this Task Force was to prepare a report on this topic for submission to the U.S. Nuclear Regulatory Commission, via the U.S. Department of Energy. It was prepared under the auspices of the National Waste Terminal Storage Program, which directs both the development and the implementation of the technology required for designing, constructing, licensing, and operating repositories.

Sebeok submitted his report in September 1981, which the HITF published subsequently in 1984. However, as he complained a little later, the recommendations that he laid out were never adopted, or even considered, by the Department of Energy, perhaps because they might have seemed far-fetched to anyone unfamiliar with semiotics, which at the time was still a relatively obscure discipline outside of a few disciplines in the humanities and social sciences. But several of Sebeok's recommendations nonetheless made an unstated or unrecognized impact. In 1993, a report prepared by Sandia National Laboratories (SNL)—a research and development laboratory of the National Nuclear Security Administration—contained its own recommendations that clearly dovetailed with those proposed by Sebeok and other early nuclear semioticians, even though the SNL report did not make any direct references to Sebeok or nuclear semiotics as such (Trauth, Hora, and Guzowski 1993). One of its proposals, for example, exactly reflected the ideas of David B. Givens (1984), which he had published in the special issue of *Zeitschrift für Semiotik* on nuclear semiotics—namely, four key levels of meaning in warning systems identified by Givens:

1. *Rudimentary*. This refers to warning signage designed denotatively to inform people about the contents at a site (*Waste Buried Here)*.
2. *Cautionary*: This refers to warning signage that is strengthened emotively by adding cautionary elements to it (*Dangerous Waste Buried Here*).
3. *Basic*: The refers to the addition of meaning-intensifier forms designed to increase the emotivity level of the warning system (*Highly Dangerous Nuclear Waste Buried Here*).
4. *Complex*: This refers to the use of nonverbal signs and systems that convey the danger in complex ways (for example, the use of pictography, cartoon sequences, and the like).

The SNL team also explored the use of hostile architecture, that is, of physical markers, structures, and impediments that would deter people from intruding into the radioactive site, including the following (Trauth, Hora, and Guzowski 1993):

1. spikes of different sizes protruding in all directions, intended to inhibit people from traversing a site by posing risks of impalement or body puncturing;
2. large mounds of earth resembling burial sites, so as to convey a sense of deathly danger;
3. huge slabs of black-dyed concrete, conveying that the land is uninhabitable;
4. large piles of dynamited rock, communicating a sense of destruction;
5. hundreds of large stone blocks, colored black to suggest a dangerous landscape.

Finally, like Sebeok, the SNL team came to the conclusion that any design for warning systems would likely decrease in efficacy or decay in meaning over time as society evolves technologically and culturally. So, their final recommendation was to establish a team whose constituency would change over the years to update the warning system in relevant new ways—a recommendation that clearly mirrored Sebeok's suggestion of creating an "atomic priesthood" (a term that may have provoked many of the unjustified subsequent critiques of nuclear semiotics).

Sebeok described his overall goal at the start of his report as developing "a semiotic analysis of the problem, examining it in terms of the science or theory of messages and symbols" (Sebeok 1984: iv). This would allow him to devise "a relay system of recoding messages that would contain a mixture of iconic, indexical, and symbolic elements, [so as to ensure] a high degree of redundancy" (Sebeok 1984: iv). The notion of redundancy adopted by Sebeok came from communication theory, referring to features in a message that reduce the chance that it will be misinterpreted, while in turn emphasizing its meaning (Shannon and Weaver 1949). For instance, in verbal communication the high predictability of certain words in some formulaic utterances ("Roses are red, violets are . . .") and the patterned repetition of elements ("Yes, yes, I'll do it; yes, I will") are redundant features that increase the likelihood that a verbal message will be received and understood successfully. Semiotically, redundancy refers to the different representational modalities (iconicity, indexicality, and symbolism) that, when used in tandem, will likely reinforce the message—as discussed with regard to hazard pictograms in the previous chapter.

As mentioned, Sebeok's recommendations were never adopted explicitly; but they seem to have seeped into the mindset of subsequent task forces, such as the SNL one, in an unwitting or unrecognized way. Another task force that similarly recommended Sebeokian-type strategies, without any due

acknowledgment, was the team set up by the Waste Isolation Pilot Plant (WIPP) project (Chapter 2). Standing out from the WIPP team's recommendations is the use of visual iconicity in various representational forms, including comic-book-style diagrams such as the one below (Figure 3.1).

The panels of this visual text are sequenced in such a way as to form a narrative warning. The first one shows a stick figure representing a human being with arms outstretched, standing over the nuclear waste site, the danger of which is represented by the two trefoil pictograms at the bottom. The panel to the immediate right shows a sonde and a drilled hole. The human figure holds some object in its hand, perhaps aiming to drop it into the hole. The next panel shows the hole reaching the bottom, along with the sonde, with radiation starting to rise up, as the human figure puts its hand over its ears in a display of fear, recalling Munch's *Scream* painting, and dropping the object on the surface ground. Finally, in the last panel, the radiation is shown escaping into the immediate atmosphere, resulting in the person being knocked down from the effects of the radioactive emissions on the human

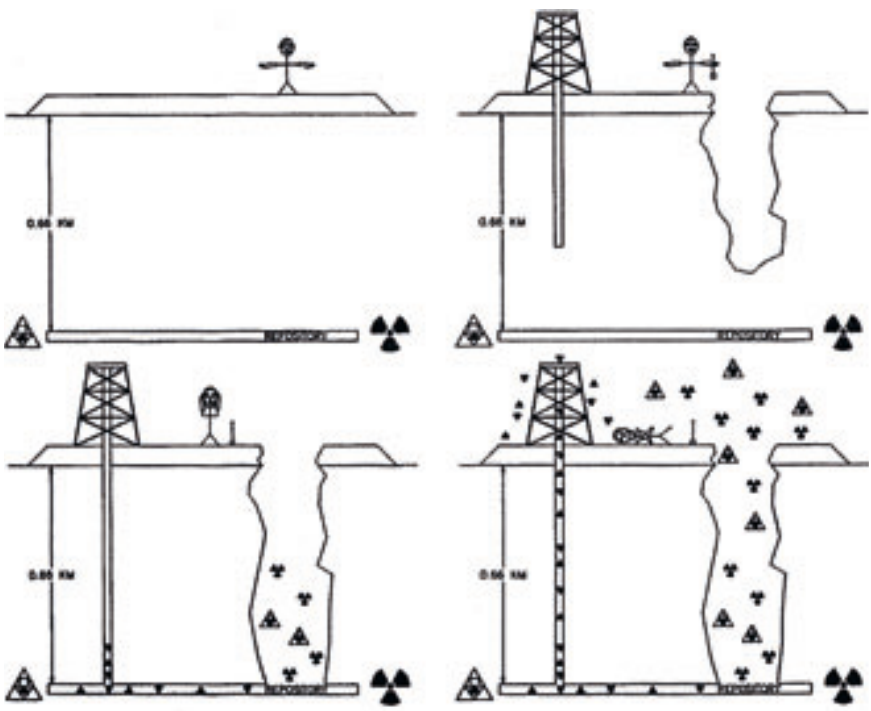

FIGURE 3.1 *WIPP's warning text (Wikimedia Commons).*

body. This shows that an iconically constructed visual warning system has a greater chance of remaining meaningful in the future than a verbal warning system, because images are less susceptible to meaning decay and interpretive ambiguity. Nevertheless, problems of meaning preservation will likely still arise: (a) Will people thousands of years in the future still be familiar with the comic strip genre in the same way that we are today? (b) Will they interpret various features in the text correctly, given that the trefoil diagrams may no longer exist, and the sonde may have been replaced by some other technological machinery?

WIPP also came up with an iconically based conceptual design for its own plant, which contained an "Information Center" laid out as shown below (Figure 3.2).

The building was designed to be open (with no roof) and constructed with solid granite measuring 12.2 m × 9.8 m × 3.0 m, containing warning messages on internal slabs, which would be laid out as files in a cabinet. The building would also have devices or designs built into it, such as an architectural feature that would allow a distinctive whistling sound to be heard when the wind blew through it, constituting a kind of natural siren alarm system. It is relevant to note that the idea of designing a building as an iconic warning structure matches a recommendation put forth by Vilmos Voigt in the *Zeitschrift für Semiotik*'s special 1984 issue. Voigt's architectural blueprint also included warning signs in the most widely spoken global languages, installed in a concentric way within the plant. As time passed, Voigt suggested, new multilingual signs reflecting new sociocultural realities would be added to the configuration.

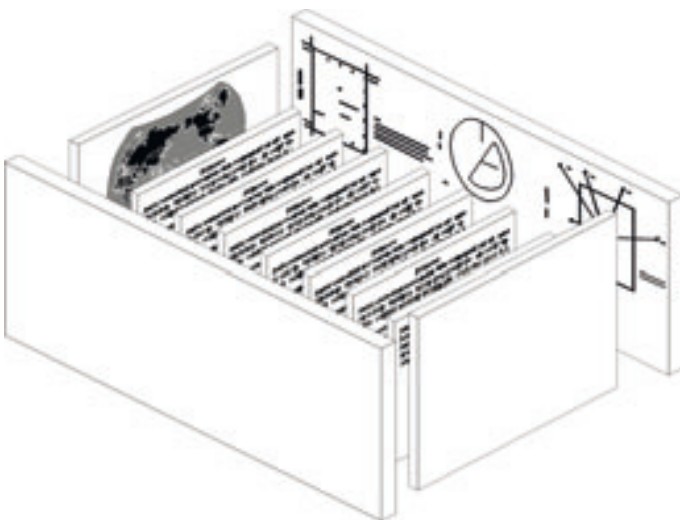

FIGURE 3.2 *WIPP's information center (Wikimedia Commons).*

Recommendations

Sebeok made several key recommendations that became key topics for developing nuclear semiotics. The first one was to create a warning system that was analogous in its style and social functions to past folkloric systems (mythologies, rituals, etc.), given that these are based on cultural memory and thus more likely to retain their meanings into the future (Chapter 2). In other words, such systems are not just part of an individual's private experience, but of a collective experience that has become embedded in cultural codes. He put it as follows (Sebeok 1984: 24):

> These persistent and widely diffused mythological and iconographic resonances of the assignment to which the Task Force is seeking a resolution lead to the first recommendation, to wit: that information be launched and artificially passed on into the short-term and long-term future with the supplementary aid of folkloristic devices, in particular a combination of an artificially created and nurtured ritual-and-legend. The most positive aspect of such a procedure is that it need not be geographically localized, or tied to any one language-and-culture (although, clearly, when linguistic and ethnic boundaries are crossed, both the verbal component and the associated set of rites are likely to undergo changes and an attenuation of the original rationale).

This recommendation was not taken into consideration, neither by the HITF nor by subsequent task forces (such as the SNL and WIPP). There are three plausible reasons for this: (1) it was likely difficult for the task forces to envision how to create warning signage using folkloric themes and traditions in any practical way; (2) the task forces likely did not see the recommendation as relevant in any concrete way to solving the specific problem of constructing meaning-lasting warning signage; and (3) the recommendation was doubtless perceived as strange by some of the task force members, who were scientists and government officials, not semioticians.

Sebeok was keenly aware that his recommendation might be misinterpreted as superstitious nonsense. But his premise was that most people respond to folkloric ideas more naturally than scientific ones. So, the folkloric strategy would be used as a "false trail," not as factual information: "The legend-and-ritual, as now envisaged, would be tantamount to laying a 'false trail,' meaning that the uninitiated will be steered away from the hazard for reasons other than the scientific knowledge of the possibility of radiation and its implications; essentially, the reason would be accumulated superstition to shun a certain area permanently" (Sebeok 1984: 24). Sebeok did admit, however, that the rationale for adopting the folkloric approach would be "unclear" to many, given

that the situation at hand (nuclear waste site dangers) had "no precedent," other than "the well-known, but ineffectual, curses associated with the burial sites (viz., pyramids) of some Egyptian Pharaohs, e.g., of the 18th dynasty, which did not deter greedy grave-robbers from digging for 'hidden treasure'" (Sebeok 1984: 24). In sum, Sebeok's intent was to utilize folkloric systems because they have withstood the test of time—to this day, people resort to myth and legend to understand things. So, apart from the representational and logistic problems of incorporating folkloric artifacts into a warning system, Sebeok's recommendation was a solid one, when examined retrospectively, and will be discussed further in a subsequent chapter.

Another of Sebeok's recommendations was to adopt the relevant mathematical symbolism to complement (not replace) the folkloric mode of representation, given that mathematics is not subject to meaning erosion and could thus be used to create accompanying (not exclusive) technical messages that could be stored in archives: "the exclusive use of mathematical communication is not recommended, especially not for rite-bound messages, it is reasonable to anticipate a limited use in (a) metamessages [messages about messages] and (b) technical messages to be 'permanently' stored in archives, libraries, computers, and other long-term repositories" (Sebeok 1984: 25).

Combating meaning loss, Sebeok then recommended creating a "relay system" that would be updated periodically in subsequent generations, so that "the efficiency of a communication system can be brought up to the desired standard by improvements in the encoding source (i.e., in our present time)," especially since "information tends to decay over time (i.e., the entropy continues to increase, eventually resulting in total incomprehensibility)" (Sebeok 1984: 25–6). Sebeok explains the relay system as follows (Sebeok 1984: 25):

> What to do to counter the passage from negentropy to ultimate entropy? What is being proposed here is a so-called "relay system" of information transmission, which rests on a very simple scheme: to divide the 10,000-year epoch envisaged into manageable segments of shorter, and presumably, reasonably foreseeable periods. Assuming that 10,000 years is equivalent to 300 generations of humankind, it is recommended that the messages at the burial site be designed for only three generations ahead, to wit, our children, grandchildren, and great-grandchildren. A clear advantage of any such system would be that the verbal portion could be Modern English, while the averbal portion could easily be extrapolated from existing and universally understood pictorial emblematic strings (e.g., cartoons, stick-figures, or the like).

It is notable that Sebeok suggested that the relay system be designed with only three subsequent generations in mind, perhaps because he knew that

the technologies of his era were incapable of producing effective "averbal" warning messages, which today would be called "multimodal." When Sebeok wrote his report, the world of digital technologies was just coming into existence, having led today to the capacity to create sophisticated multimodal texts that might have a better chance of withstanding meaning decay. However, as he claimed with his folkloric recommendation, a change in communication technologies would not affect the meaning of folkloric texts in any significant way, for reasons discussed above. As Walter Ong (1982) similarly argued at around the same time, new technologies do not create new meaning-making systems, but actually retrieve ancient ones, including mythology—a theme which will be discussed subsequently.

Aware that his assignment was to create a relay system that would go beyond the three generations, Sebeok used his knowledge of semiotic theory to suggest a blending of semiotic modalities as a means to enhance meaning durability: "Because of the long period of time involved, the report recommends that a relay system of recoding messages be initiated; that the messages contain a mixture of iconic, indexical, and symbolic elements" (Sebeok 1984: iv). It is the combination of these three modes that will likely enhance meaning sustainability, since they augment the redundancy level (Sebeok 1984: 22):

> Each mode of communication—iconic, indexical, symbolic (or emblematic)—has a set of advantages and a corresponding set of disadvantages, which are both context-bound (see further Sebeok 1976, Ch. 8). Since the context is far from predictable at any stage over the next 10,000 years, and, with the passage of time, is bound to become increasingly equivocal, it will be recommended that all signs be constructed of a mixture of the three modes. While this intermingling will still not be fail-safe, it is certain that the more redundancy is built into the system, the more this will tend to ensure accurate decoding by any destination.

As discussed in the previous two chapters, this semiotic blending strategy is used in the creation of hazard pictograms by international agencies, albeit unwittingly, as a means to limit meaning ambiguity. However, as a semiotician, Sebeok knew that such ambiguity cannot be totally obverted, even in the use of visual iconicity (Sebeok 1984: 23):

> At this point, some comments are in order about certain predictable problems involving iconic, specifically, image-based coding . . . It should be stressed that there is substantial disagreement on the extent to which pictorial perception depends on specific cultural experience, certainly a major source for human individual differences. Obviously, pictures give some humans some information on some occasions; but the "how" and

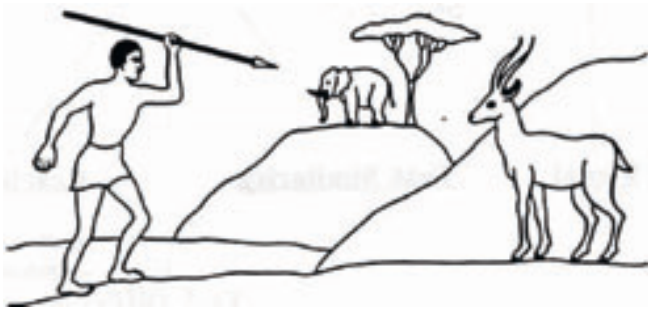

FIGURE 3.3 *Line drawing (Hudson 1960).*

> "when" are complicated questions, and the answers are neither obvious nor should be taken for granted in circumstances as delicate as our project demands.

To illustrate what he means concretely, Sebeok uses an example taken from John Kennedy's book, *A Psychology of Picture Perception* (1974), which shows how picture interpretation is invariably mediated by cultural filters. Kennedy himself had commented on William Hudson's (1960) experiments using line drawings to test groups of subjects in South Africa of mixed backgrounds and ethnicities in order to determine how the groups would interpret them. One of these is shown above (Figure 3.3).

The subjects were asked: "What is the man doing?" Indigenous respondents in Zambia would answer that the man was aiming the spear at the elephant, but many of them added that this was not realistic since no one would normally do so. Other subjects said that the man was throwing the spear at the antelope in the picture, not the elephant. Others still said that the picture was nonsensical. Sebeok's point in using this example was that a picture in itself has no meaning until it is assigned one.

The Atomic Priesthood

The question of how the relay system would be passed on to successive generations for updating (recoding) led Sebeok (1984: 28) to make what turned out to be his most controversial recommendation, namely the formation of an "atomic priesthood":

> To be effective, the intended messages have to be recoded, and recoded again and again, at relatively brief intervals. For this reason, a "relay-system" of communication is strongly recommended, with a built-in

> enforcement mechanism, for dramatic emphasis here dubbed an "atomic priesthood," i.e., a commission, relatively independent of future political currents, self-selective in membership, using whatever devices for enforcement are at its disposal, including those of a folkloristic character.

He then specified that that commission should be composed of "knowledgeable physicists, experts in radiation sickness, anthropologists, linguists, psychologists, semioticians, and whatever additional expertise may be called for now and in the future. Membership in this priesthood would be self-selective over time" and would be "charged with the added responsibility of seeing to it that our behest, as embodied in the cumulative sequence of metamessages is to be heeded—if not for legal reasons, then for moral reasons, with perhaps the veiled threat that to ignore the mandate would be tantamount to inviting some sort of supernatural retribution" (Sebeok 1984: 27).

Sebeok envisaged his "priesthood" as a group of rotating members in subsequent generations—comparable to the model of the Roman Catholic Church which, he pointed out, had preserved its core message for over two millennia. There is little doubt, however, that it was the infelicitous choice of this term that produced the controversy that has always followed Sebeok's report in an age where science and religion are seen as irreconcilable—a situation that Peter Harrison (2015: 171) traces to the nineteenth century:

> When did people first begin to speak about science and religion, using that precise terminology? This could not have been before the nineteenth century. When we consult written works for actual occurrences of the conjunction "science and religion" or "religion and science" in English publications, that is exactly what we discover.

This perceived irreconcilability has been the source of various critiques of the atomic priesthood recommendation. Dusek (1997: 89), for example, remarked that "Not only is the stability of such a human created institution questionable, but the desirability of this type of priesthood is lacking. Most religions provide hope for followers. A 'religion' centering on the concept that the ground is poisonous lacks the appeal of more mainstream religions." Susan Garfield (1994: 15) even saw it as a manipulative and insulting proposal:

> Sebeok's reliance on secrecy, manipulation and deceit—and the accompanying perceived need to create an elite he calls an "atomic priesthood" that holds the secrets and does the manipulating—suggest lack of respect for human capabilities. Such assumptions reflect the political era in which this report was written and critiquing them may help clarify the radically different values and assumptions of nuclear guardianship.

She even compares Sebeok's priesthood to totalitarian-style commissions, which distrust common people: "Foremost is an implicit mistrust of human nature—dangerous because it is implicit and assumed to be well founded. He never openly addresses the issue of whether we can trust humanity now and in the future to face up to its problems and so does not envision the conditions that would allow this confidence to be well founded" (Garfield 1994: 15). An obvious retort to her critique is that all science is "secretive" in the sense that it is not easily accessible to non-scientists. Moreover, the interaction among members of the priesthood, covering different disciplines, is itself a safeguard against the kind of manipulation that Garfield envisions; in effect, it shows trust in diversity of views, not its exclusion. In the same critical vein, Juliet Lapidos (2009) dismissed Sebeok's report outright because "not only must intruders understand the message that nuclear waste is near and dangerous; they must also believe it."

Leaving aside such politically or subjectively motivated critiques, the main scientific critique of the atomic priesthood idea can be encapsulated as follows: Because it would be tasked with updating the warning system by adapting the folkloric and representational elements in it across successive eras, it remains obscure to this day how this might be realized.

In contrast to the negative critical responses to Sebeok's recommendation, it should be mentioned that it has also received praise. Musch (2016: 626), for instance, sees it as analogous to the ideas of "science fiction writers like Isaac Asimov and Arsen Darnay," connecting the atomic priesthood "with the utopian/dystopian aspects of nuclear power." Sebeok's report actually inspired Polish science fiction author Stanisław Lem, who proposed the construction of satellites that would beam warnings back to earth and the cultivation of "information plants" that would convey the danger around nuclear sites to future humans—a proposal he published in the special issue of the *Zeitschrift für Semiotik* (Lem 1984).

Natalie Zutter (2018) also sees inherent validity to the atomic priesthood notion, pointing out that it elevates the dangers of nuclear radiation to a "supernatural" level metaphorically:

> It sounds like incredible fodder for awesome dystopian stories: To protect future generations from nuclear fallout, but also to account for evolving languages and social mores, establish a religion whose "priests" pass down knowledge of how to avoid radiation zones. Knowledge, and a healthy bit of fear, zhuzhing the truth to make nuclear fallout akin to a supernatural danger—putting the fear of God, as it were, in our descendants.

It is relevant to note that in 2011 an artist, Bryan McGovern Wilson, and an art professor, Robert Williams, took the idea of the atomic priesthood a step

further, aiming to explore "the power of Atomic folk objects, costumes, objects and rituals intended to create an oral tradition around the sites on Cumbria's nuclear coast so that they will never be forgotten" (cited in Piesing 2020). The two researchers designed hypothetical vestments of an Atomic Priest and then photographed someone dressed in them at archaeological sites in Cumbria. There is no written account of what they accomplished with this situation. However, the very fact that they tried pays homage to Sebeok and to the intuitively-felt importance of his proposal, based on a blend of folklore, science fiction, and science.

In an obituary assessment of Roland Posner's work—an early pioneer in nuclear semiotics and the editor of the *Zeitschrift für Semiotik*—Opletalová and Siefkes (2020) argue that the German semiotician aimed to eliminate the negative connotations in the atomic priesthood notion via a political solution built "on the assumption that democratic societies are fully able to preserve collective knowledge under certain circumstances." Posner (1990) suggested a "three-chamber system," with the third chamber added to all parliaments in the world alongside the regular chambers. He also proposed the creation of a democratically elected council (*Zukunftsrat*) to represent the interests of future generations. As Opletalová and Siefkes (2020) observe, this "would ensure the transmission of information about nuclear waste (its properties, radiation intensity and location) and other dangers, but it could also ensure that less waste is produced in the first place." But Posner's idea received virtually no serious attention from either scientists or politicians, even though it would ostensibly help solve "environmental, technological, and social issues, as well as problems connected with limited resources, [which] are currently often sacrificed for the short-term goals and interests of the currently living, and voting, humans" (Opletalová and Siefkes 2020).

What may have been obscured in the whole debate around the goals and outcomes of the HITF is the fact that it did not assign any role to the Shoshone people who lived around the site and who claimed that Yucca Mountain did not belong to the federal government. The government has replied that it purchased the land legally during the Civil War. But the Shoshone dispute this, claiming that the government only made a fraction of the promised payment. The Yucca Mountain plan is currently on hold, lacking in funding and interest—a predicament that makes Sebeok's atomic priesthood proposal a moot one. In its place, waste is temporarily being stored at WIPP in New Mexico. The plan there is to use written warnings in seven languages: the six official languages of the UN and Navajo. In the end, the only realistic solution to Sebeok's problem is to make it irrelevant by stopping nuclear waste from being dumped to other sites, and to develop scientific alternatives to nuclear power.

Nuclear Semiotics

To help solve Sebeok's problem, the *Zeitschrift für Semiotik* conducted a survey of scholars and scientists between 1982 and 1983, asking them the following question:

> How would it be possible to inform our descendants for the next 10,000 years about the storage locations and dangers of radioactive waste?

A special issue of the journal (edited by Posner 1984) then published some of the responses to the survey as specific approaches to Sebeok's problem—some of the articles were written by members of the HITF along with Sebeok. Sebeok's suggestion to make the relay system based on semiotic redundancy (blending different representational modalities) was adopted and expanded by Tannenbaum (1984); his proposal to use mathematics as a symbolic means to complement his folkloric solution was given a special twist by Stanisław Lem (1984), who proposed a mathematical coding of the DNA of plants, which would thus reproduce themselves automatically. These "atomic flowers" would be placed at the storage site, programmed to contain the relevant information about the location and its contents.

An interesting solution to the meaning-erosion problem was put forth by Voigt (1984), as discussed above—namely to compensate for language change by reformulating the warning message by taking into account what linguists knew about the systematicity of language change, and incorporating the relevant insights into new (diachronically adapted) language "translations," and then placing them concentrically around the radioactive site. After a certain period of time new translations would be installed, but the old ones would not be removed. The newer signs would be posted progressively farther away from the waste site, thus representing the time element with an iconic placement strategy, whereby distance from the site correlates with distance in time. Carrying out the translations and deploying the sign posts strategically would be the task of a group of "message protectors." Locating the message propitiously was a theme in several other articles, including one proposing the creation of an artificial moon in the sky to transmit the message (Sonntag 1984), and another suggesting the prevention of the misuse of the message by developing a code that would keep the details of the message secret (Rehder 1984). One of the more influential studies in the issue was the one by Givens (1984), adopted subsequently by the SNL task force (above), in which he delineated four levels of meaning, from purely denotative at the verbal level to highly suggestive at a nonverbal level, for which he provided a detailed list of criteria for designing warning signs at each level. Two articles argued

that Sebeok's problem could only be solved by eliminating the source of the problem itself, nuclear waste, through political action (Blonsky 1984; Hauser 1984).

The article in the issue that has generated the most controversy, even superseding the controversy surrounding Sebeok's atomic priesthood idea, was the one by Françoise Bastide and Paolo Fabbri, in which they put forth what they called the "ray cat" solution—namely, breeding a species of cats that would react with discoloration when exposed to radiation. The nuclear-warning role of these cats would be embedded into collective awareness through the creation of new fairy tales and myths about the cats, transmitted through poetry, music, and painting. The premise was that this would resonate with people because of the symbolic power of cats. The Oglala Native American society, for example, believe that cats have magical powers, and are capable of putting curses on people; in Egyptian culture, cats are perceived as sacred animals, as evidenced by myths in which cat goddesses play prominent roles; Christianity in the medieval period associated cats with evil, hanging or burning them along with people convicted of heresy; some cultures see cats as symbolic of rebirth and resurrection, having "nine lives"; other cultures regard them as symbols of darkness and mystery, since they are nocturnal animals; and so on. The point is that cats are hardly seen as just feline creatures worldwide. They resonate with symbolism across many cultures. It is this resonance that Bastide and Fabbri aimed to harness. This proposal caught the attention of the mainstream media, which characterized it contrastively as both interesting and ridiculous at the same time (Schwartz 2015). The main objection was that subjecting cats to radiation would be illegal at best, and inhumane at worst. On the other side of the controversy, the ray cat idea influenced popular culture in various ways, constituting the inspiration for various narratives and songs (as will be discussed subsequently).

As fantastical as the above proposals may seem, they laid the foundations for addressing Sebeok's problem in a diversity of semiotic ways, leading to the establishment of nuclear semiotics, the initial aims of which can be condensed into nine main questions:

1. What is a warning?
2. How can danger be conveyed effectively via specific representational strategies?
3. How can the sense of danger be turned on, and how can its modulation be increased or adapted contextually?
4. How can warning messages be made to be both scientifically correct and culturally effective the same time?

5. How can the different representational media (language, pictography, scientific diagrams, etc.) be used in tandem to produce meaning effectiveness and enhance meaning preservation?
6. What cultural strategies and artifacts can be used to turn the danger sense on in an effective way (myth, pop culture, rituals, legends, etc.)?
7. What kind of sign system is capable of surviving and remaining interpretable for 10,000 years?
8. How can connotation and emotivity be harnessed practically?
9. What kinds of folkloric systems are relevant?

Because initially nuclear semiotics constrained its purview to solving Sebeok's problem, interest in it gradually withered. However, by expanding its theoretical range, it can be seen to constitute a valuable intellectual tool for exploring how best to represent existential dangers, thus attenuating the negative reactions that it initially garnered, especially the view that the atomic priesthood was an "elitist" notion, whereas Sebeok simply saw it as an extension of the traditional scientific commissions, organizations, and institutions. Vincent Ialenti (2020) actually sees the reaction to science as an elitist enterprise as a major obstacle to solving current existential dangers. He excoriates the current widespread rejection of expertise due to false messages on the Internet, which have created an irresolvable tension between science and conspiratorial narratives. The solution, Ialenti suggests, is to reassign authority to geologists, astrophysicists, biologists, climatologists, archeologists, historians, and other humanists working together, clearly recalling Sebeok's atomic priesthood recommendation. This group of experts is the key to tackling the emergency caused by human-generated environmental transformation—known as the Anthropocene, a term coined by chemist Paul Crutzen (2006), referring to the current geological era where human impact on ecosystems has reached a critical mass (Best 2014). The problems emerging in the Anthropocene cannot be considered in terms of science alone; they are best approached via a cooperation of scientists, humanists, and artists, given that they entail not only scientific questions, but also questions of philosophy and history.

It should be noted, however, that the Anthropocene notion has been critiqued from several angles, including the fact that it ignores issues of social inequality that have contributed to ecological degradation. Jason Moore (2015: 206) encapsulates this critique as follows:

> The *Anthropocene* makes for an easy story. Easy, because it does not challenge the naturalized inequalities, alienation, and violence inscribed in

> modernity's strategic relations of power and production. It is an easy story to tell because it does not ask us to think about these relations at all. The mosaic of human activity in the web of life is reduced to an abstract Humanity: a homogeneous acting unit. Inequality, commodification, imperialism, patriarchy, racial formations, and much more, have been largely removed from consideration . . . Are we really living in the Anthropocene, with its return to a curiously Eurocentric vista of humanity, and its reliance on well-worn notions of resource- and technological-determinism? Or are we living in the Capitalocene, the historical era shaped by relations privileging the endless accumulation of capital?

While this critique is significant, the Anthropocene remains, at the very least, a useful construct for discussing and framing the sources of current existential dangers. Historian John McNeill has traced the Anthropocene to the unprecedented impact of industrial technologies since the nineteenth century and how these have, themselves, changed attitudes about the environment in a socially destructive way. Historian of science Naomi Oreskes (2004) has argued that political and business self-interests have delayed responses to the climate change crisis, undermining trust in science in various sectors of the populace. Dipesh Chakrabarty (2009) sees the main problem in the fact that the traditional humanist distinction between natural history and human history has been obliterated, leading to a neglect of the human element in climate change.

The Anthropocene concept has also been used to explain the rise of infectious diseases, in line with the Gaia Hypothesis (Chapter 2). For instance, Skórka et al. (2020) envisioned linkages between the Anthropocene and COVID-19:

> Severe acute respiratory syndrome coronavirus 2, the virus that causes coronavirus disease 2019 (COVID-19), has expanded rapidly throughout the world. Thus, it is important to understand how global factors linked with the functioning of the Anthropocene are responsible for the COVID-19 outbreak. We tested hypotheses that the number of COVID-19 cases, number of deaths and growth rate of recorded infections: (1) are positively associated with population density as well as (2) proportion of the human population living in urban areas as proxies of interpersonal contact rate, (3) age of the population in a given country as an indication of that population's susceptibility to COVID-19, (4) net migration rate and (5) number of tourists as proxies of infection pressure, and negatively associated with gross domestic product which is a proxy of health care quality . . . This study demonstrates that the characteristics of the human population and high mobility, but not population density, may help explain the global spread of

> the virus. In addition, geography, possibly via climate, may play a role in the pandemic. The unexpected positive and strong association between gross domestic product and number of cases, deaths, and growth rate suggests that COVID-19 may be a new civilisation disease affecting rich economies.

Other studies have come forth to explain pandemics of the past and present as "diseases of the Anthropocene" (Whitehouse 2015; De Pascale and Dattilo 2016; Clark 2017; O'Callaghan-Gordo and Antó 2020). These correlate human activities with pandemics and other existential dangers, and thus would fall under the expanded range of nuclear semiotic analysis (Gare 2007; Kenner 2012; Culloty et al. 2018; Tateo 2020; Leone 2021). This broader paradigm would also fill a few gaps left by the early work. One is the role of humor in folkloric traditions, which surfaces as a coping strategy in times of anxiety (Dundes 1987), as well as a means of self-analysis and self-reflection (Propp 2009; Bouissac 2015; Sover 2020). This can be seen in Internet reactions to the COVID-19 crisis, which witnessed a proliferation of online videos that made fun of various aspects of the pandemic, as a coping mechanism. As Torres et al. (2020) have remarked:

> Humor is no cure for COVID-19, does [not] feed the hungry, nor can pay the bills of the jobless. Many do not approve of humor out of crisis, yet millions of people have come up with COVID-19-related humor scripts on social medial platforms if only to soften grief, lighten mood, and distract people from the struggle in accepting the new normal. Humor is also used as a coping mechanism for the bad scenario experienced by many. Everybody tends to laugh at those they love and hate, and many times they joke about the good and bad fortunes of people.

The researchers looked at 214 Tagalog and English humor scripts that were created and circulated via social media platforms during the COVID-19 pandemic. The scripts were coded according to humor type (aggressive, ethnic, positive, self-deprecating, sexual) and style (conversational, narrative, one-liner, question and answer). They found a commonality in both languages, suggesting a need to share common experiences with respect to the pandemic. The same pattern has been documented with previous pandemics (Groves 2011). On the other hand, humor could induce a form of passive acceptance of pandemics and other existential dangers, as a study by Fraustino and Ma (2015) emphasized, showing how "participants who received the humorous risk message reported significantly weaker intentions to take protective actions in comparison to those who received the traditional, non-humorous risk message."

Epilogue

Today the Paris-based Nuclear Energy Agency (NEA) carries on with the work of the task forces of the past such as the HITF, establishing a Preservation of Records, Knowledge and Memory Across Generations initiative, starting in 2011. The NEA is an intergovernmental agency which encourages cooperation among countries that possess an advanced nuclear technology infrastructure. It has put forth suggestions to help future humans make informed decisions, such as time capsules and physical markers. Clearly, Sebeok's report has left a legacy, even if it is rarely acknowledged as such. Given the threat to human survival posed by current existential dangers, nuclear semiotics is even more important today than it was in the 1980s; as argued in this book, it is powerful as a tool for investigating how people react to dangers via the representational artifacts that they use commonly, verbal and nonverbal.

As discussed and illustrated in the previous two chapters, the starting point for nuclear semiotics is the past, as Sebeok also implied with his folkloric recommendation. Consider, as a case in point, the Egyptian tombstone from Sheikh Abd el-Qurna, Egypt, *c.* 1295–1069 BCE, written in hieratic (Figure 3.4).

The curator of National Museums Scotland, Dan Potter (2017), has translated it as follows:

> It is to you that I speak; all people who will find this tomb passage! Watch out not to take (even) a pebble from within it outside. If you find this stone you shall [not] transgress against it. Look for a place worthy of yourselves and rest in it, and do not constrict gods in their own houses, as every man is happy in his place and every man is glad in his house. As for he who will be sound, beware of forcefully removing this stone from its place. As for he who covers it in its place, great lords of the west will reproach him very much.

At a denotative level, this warning is an appeal for good behavior to protect the tomb and honor the memory of the deceased. But its coded message is a more expansive one—if we do not leave sacred things alone, we will suffer the "reproach" of the "great lords." That message is a metaphorical one and hence can be interpreted as a powerful warning: Do not try to over-control Nature because, as many myths have warned us, it will only lead to disaster. It is in deconstructing such messages from the past that the approach to current existential dangers can be envisioned as based on history; the semiotic deconstruction can also provide insights into how to devise representational strategies that have always turned the danger sense on at various levels.

As mentioned, the Shoshone peoples see the Yucca Mountain site that was the subject of Sebeok's report as a sacred one that has been defiled by nuclear wastes. They perceive this as a transgression that will bring

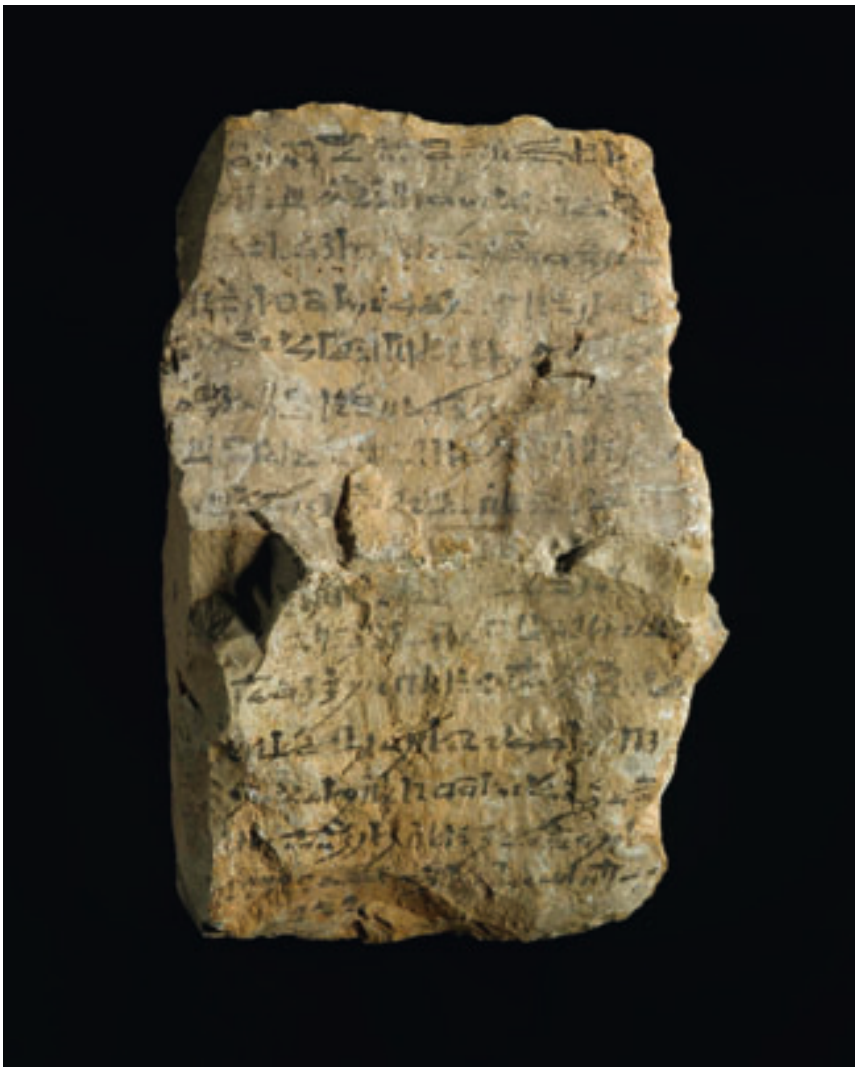

FIGURE 3.4 *Tombstone warning, Sheikh Abd el-Qurna, Egypt,* c. *1295–1069* BCE *(Wikimedia Commons).*

consequences that echo the same warnings in the Egyptian tombstone—Shoshone ancestors are buried in the mountain and many of the inscriptions on their tombs are remarkably similar in content and tone to the hieratic one above. In 2010, the Yucca Mountain project was finally abandoned as a dump site. The controversy is rarely acknowledged today as one about Native sovereignty and the need of Native peoples to preserve the meanings of the land and to determine their own destiny.

4

Verbal Warnings

Prologue

The fact that languages undergo change systematically over time, rather than randomly, was established scientifically in the nineteenth century after philologists started comparing different evolutionary stages of specific languages to their current forms (via phonological, lexical, and grammatical analysis). This approach also made it possible to reconstruct the structure and meanings of words from the past, as well as to identify the cultural-historical events, factors, and contexts that brought about the linguistic changes, and how these affected comprehensibility in the present. For example, the English word *bead* originally signified "prayer." Its modern meaning emerged from the practice of reciting prayers by using beads (such as rosary beads). If one were to use the word *bead* with its original meaning today, it would be incomprehensible, because the historical context in which it emerged has been forgotten.

Incomprehensibility of this kind is what Sebeok aimed to attenuate in designing warning signage in terms of a relay system to be projected thousands of years in the future. As he pointed out at the start of his report, linguists had developed theoretical tools to analyze change from the past to the present (known as diachronic analysis), but they had never considered analyzing how meaning will evolve in the future with the same tools, because they obviously have believed, traditionally, that the contextual factors that would influence future change in structure are unknown: How can we know what *bead* will mean in the distant future, say, in the year 2300, if it even will exist as a word? Because of this, Sebeok decided to look beyond linguistics, which, as he pointed out, had rarely considered studying the evolution of language *forward* in time. He put it as follows (Sebeok 1984: 1–2):

> It is thus focally relevant to the problems of human interference and message exchanges involving long periods of time, over which spoken and written languages are sure to decay to the point of incomprehensibility,

> making it necessary to utilize a perspective that goes well beyond linguistics (the formal study of verbal messages), which, traditionally (mainly in the 19th century), has dealt with the relatively brief diachronic past, or (mainly in the 20th century) the synchronic present. Workers in semiotics, or in its narrower branch called linguistics, have very seldom been called upon to make projections into the short-range future, let alone the long-range future, which, in the case at hand, must take into account up to 10,000 years, or (according to current actuarial calculations), the span of 300 generations to come.

Sebeok's implication is that nuclear semiotics would have to tackle the problem of linguistic decay and incomprehensibility head on, identifying the factors that have influenced change in meaning from the past to the present, and then using this as a platform on which to infer how the same factors might influence meaning change, or adaptation, from the present to the future. Sebeok's platform consisted, as we saw, of folkloric artifacts and language from the past as a basis of future projection analysis. Folkloric language and narrativity is implanted in metaphor and myth—hence the importance of studying these two dimensions in an expanded nuclear semiotics. The former will be discussed in this chapter and the latter in the sixth chapter.

Another area of concern for nuclear semiotics is how language affects thinking, feelings, and beliefs, as exemplified in microcosm by the *Empty* gasoline drums anecdote (Chapter 1). An oft-cited accompanying anecdote to the Whorfian one is the story told about the founder of general semantics, Alfred Korzybski (cited in Derks and Hollander 1996: 58). As he was giving a lecture to a group of students one day, at a certain point Korzybski stopped talking and took out a small packet of cookies from his briefcase, telling the class that he just had to eat something due to a sudden attack of hunger. Showing politeness, he offered the cookies to students seated in the front row, some of whom took one, eating it with apparent gusto. As they were digesting the cookies, Korzybski remarked, "Nice cookie, don't you think?" Then he tore off the wrapper around the packet, revealing the original packaging, which showed the picture of a dog's head and the label, *Dog Cookies*. The students became visibly upset—two of them even ran out of the room to a toilet to vomit. Korzybski then turned to the rest of the class and uttered: "You see, I have just demonstrated that people don't just eat food, but also words, and that the taste of the former is often outdone by the taste of the latter." The objective of Korzybski's game was to show that each time we use language, its normal referential context of usage comes instantly to mind; when this is altered, so too are reactions and interpretations. The students showed no adverse effects at first by eating the cookies, thinking

that they were intended for human consumption. These were evoked when they were shown the *Dog Cookies* label, which re-directed their minds to a different referential frame (eating dog food), producing negative physical effects as a consequence.

It is no coincidence that Sebeok became fascinated by Korzybski's ideas, seeing them as intertwined with semiotics, even giving a lecture in the Alfred Korzybski Memorial Lecture Series in 1981 (Read 1983). Korzybski viewed human understanding as being regulated by the interplay between the structure of the human nervous system and the structure of language. For this reason, he claimed that humans do not experience reality directly, but through the language structures that are imprinted in nerve circuitry. Neuroscience has provided some substance to Korzybski's perspective (for example, Damasio 1994). The effects produced by language on thought and the emotions, such as those illustrated by Korzybski's anecdote, can be classified under the rubric of linguistic emotivity, which is a correlate of linguistic relativity (Chapter 2). Studying the general mechanisms of emotivity built into words and entire discourses, and how these have shaped language comprehensibility from the past to the present, may provide insights into how the danger sense is turned on or off, and thus how language can be harnessed to help solve the problems posed by differing perceptions of current existential dangers.

Emotivity

The Korzybskian game is anecdotal evidence of the notion that language, thinking, and the emotions are intertwined—a notion that goes back to antiquity, but discussed formally in the eighteenth century by Johann Herder (1770) and in the subsequent nineteenth century by Wilhelm von Humboldt (1836); it was given a scientific-anthropological formulation by early twentieth-century linguists, such as Franz Boas and Edward Sapir, culminating in the research of Benjamin Lee Whorf (1956), whose *Empty* gasoline drums example has been discussed several times as exemplifying this theory in a nutshell. Overall, linguistic relativity theory posits that the lexical, grammatical, and pragmatic (discourse) categories of a language affect the perception of things, not just encode them, producing emotive reactions (such as the negative ones produced by the *Dog Cookies* incident).

Let us alter Korzybski's experiment—hypothetically—in the following way. Suppose that after unwrapping the white paper around the same packet, a picture of a sumptuous cookie appeared with the tagline: *Gourmet Cookies*. This label certainly would not induce the nausea reaction evoked by the *Dog Cookies* label; it would likely affect gustation positively and might even stimulate desire

for more cookies. As such mind experiments show, words do not simply refer to things; they modulate cognitive and emotional responses, and may even help construct them—a view that is receiving corroboration from neuroimaging studies, which have shown that "labeling one's emotional experiences and perceptions alters those states" (Brooks et al. 2017). In effect, language can raise or lower the emotivity level. It is this capacity that is of particular interest here, since one of the goals of nuclear semiotics is to understand how language can be used to create warnings with a high level of emotivity.

The term *emotivity* surfaces frequently in semiotics, anthropology, and linguistics. It was used by Roman Jakobson (1960) in reference to the intents of the addresser in a communication act; Jakobson employed the term *conative* to refer to the effects that this was intended to produce in an addressee. In the present framework, the term *emotivity* is used to describe the emotional (experiential) effects produced by language forms on people, whether or not these were intended by an addresser. Emotivity is built into entire discourses, not just words, wherein it becomes a powerful factor in shaping beliefs (Bateson 1971). For instance, during the COVID-19 pandemic in 2020–1, various discourses emerged online that produced and reinforced non-scientific beliefs about the disease. One of these portrayed the pandemic as part of a spiritual war, with the virus created as a weapon by a political-scientific cabal behind the social scenes. As a result, those who subscribed to this discourse believed that the pandemic could only be defeated by spiritual, not medical, actions. Another type of discourse portrayed the coronavirus as a hoax, perpetrated by political elites, inducing the belief that the media reports of its mortal effects were fake. Those who were influenced by either of these two discourses reacted by not wearing masks, by not keeping safe social distances, and by not taking the vaccines that emerged in late 2020, because they believed that such activities were useless or unnecessary, and even counterproductive. The emotivity level of such discourses was at a maximum, as evidenced by the fact that counter-discourses for offsetting the false beliefs were largely ineffectual (Wicke and Bolognesi 2020).

An analogous set of emotively-based discourses have always related to climate change. One of these portrays scientists as elitist, condescending, inducing distrust and even rejection of the science behind climate change, as Ialenti (2020) has cogently argued (Chapter 3). This distrust was eloquently described by the social critic Herbert Marcuse (1964: 192), long before the current controversy, as follows:

> The intellectual is called on the carpet . . . Don't you conceal something? You talk a language which is suspect. You don't talk like the rest of us, like the man in the street, but rather like a foreigner who does not belong here. We have to cut you down to size, expose your tricks, purge you.

The question now becomes: Can the same kind of negative emotivity be harnessed in reverse—that is, to instill trust in science and combat false beliefs? One possible strategy is to change labels, as discussed with regard to the gasoline drums incident—by changing the label from *Empty* to, say, *Explosive*, the workers might have perceived the situation correctly as a dangerous one. This has actually been carried out with the name change from *climate change* to *climate crisis*—*change* implies something gradual and natural; *crisis* something calamitous that requires immediate attention. This name change is traced to politician and climate activist Al Gore, in the first decade of the 2000s. It has become a widespread moniker in the discourses of climate activists who are alarmed by the dangers posed by global warming. Other terms that have attempted to amplify the emotivity factor include *climate emergency, climate catastrophe*, *climate chaos, climate breakdown*, and *climate disaster*. However, as it has turned out, these have had little effect on changing hardened beliefs, perhaps because of the emotive force of the original false discourses, which envision crises as manufactured by elite groups for self-serving purposes. Also, there is the problem of "crisis fatigue," whereby the urgency to respond to an existential danger loses its strength over time because the warnings built into scientifically shaped discourses gradually decay in emotive force through repetitive usage.

A relevant neuroscientific study (Spark Neuro 2019) has shed some important light on this situation. It looked at the responses of Republicans, Democrats, and independents in the US to the terms *climate crisis, environmental destruction, environmental collapse, weather destabilization, global warming* and *climate change* using electroencephalography and galvanic skin-response measurements. The researchers found that the term *climate crisis* elicited stronger emotional responses than the other terms among all subjects, regardless of their political views. However, they also found that these were not strong enough among those who denied climate change as to preclude them from generating counter-arguments. Moreover, the study designers noted that emotive intensity could backfire, finding that a highly charged term such as *environmental destruction* was seen as unnecessarily alarmist. Perhaps, as this study suggests, one cannot fight language with language, so to speak—nonverbal warning systems may be more effective, as Sebeok understood (and as will be discussed subsequently).

Consider the effects of discursive emotivity on attitudes and behaviors vis-à-vis the COVID-19 pandemic. Without a vaccine, the primary way of keeping the spread of the virus at bay was through the wearing of masks and the maintenance of a safe physical distance from another person. As it turned out, this public health recommendation was not maintained among various groups because of their beliefs that the pandemic was a politically motivated hoax, leading to spikes in the disease (Peeples 2020). Such groups also

tended to filter out contradictory information against their beliefs, or else reshape it in optimistic, rather than negative, ways (Sharot 2011; O'Sullivan 2015; Beattie and McGuire 2018)..

The question now becomes: If changing labels, as for example from "climate change" to "climate crisis," has proven to be ineffectual, are there any other kinds of linguistic techniques that can be used instead to raise the emotivity level? One potentially effective technique is the use of so-called *phonemic iconicity* (also known as "sound symbolism") in the construction of the warnings (Westley and Folke 2018). In a review of relevant research studies, Schmidtke, Conrad, and Jacobs (2014) found that such iconicity does indeed have the ability to raise the emotivity level, evoking sensory experiences (see also Nikolić 2009). Adelman, Estes, and Cossu (2018: 122) trace this pattern of reaction to evolutionary mechanisms:

> Rapidly communicating the emotional valence of stimuli (i.e., negativity or positivity) is vital for averting dangers and acquiring rewards. We therefore hypothesized that human languages signal emotions via individual phonemes (emotional sound symbolism), and more specifically that the phonemes at the beginning of the word signal its valence, as this would maximize the receiver's time to respond adaptively. Analyzing approximately 37,000 words across five different languages (English, Spanish, Dutch, German, and Polish), we found emotional sound symbolism in all five languages, and within each language the first phoneme of a word predicted its valence better than subsequent phonemes. Moreover, given that averting danger is more urgent than acquiring rewards, we further hypothesized and demonstrated that phonemes that are uttered most rapidly tend to convey negativity rather than positivity. Thus, emotional sound symbolism is an adaptation providing an early warning system in human languages, analogous to other species' alarm calls.

This perspective has been adopted by Derek Bickerton (2009), who sees iconicity as crucial in the origin of language itself. He speculates that our human ancestors used iconic signs as recruitment signals in the scavenging of animals, and from this full-blown language gradually emerged. While there may be some debate about Bickerton's overall approach (which need not concern us here), the idea that iconicity is a formative force in language is a widely accepted one in semiotics. This can be called the iconicity principle. In a relevant study, Roberts, Lewandowski, and Galantucci (2015) found that while novel human communication systems emerge with and without iconicity, the iconic systems aid the comprehensibility and efficacy of messages greatly. The implication is that iconicity will be of particular utility in creating effective warning signs and texts. But what does this mean concretely? Semiotically, it implies using

metaphor and poetic style in the creation of warning messages—topics that are explored in the remainder of this chapter.

The Metaphoricity Principle

Metaphor is an iconic representational strategy in the sense that it relates words and referents to each other via resemblance at different levels, from the concrete to the abstract, as semioticians such as Peirce, Jakobson, and others have cogently argued (see, for example, Waugh 1976). So, a corollary to the iconicity principle above can be called, simply, the *metaphoricity principle*, which posits that the higher the metaphorical content of a warning system the higher its emotivity.

What makes metaphor powerful is that it is largely unconscious, and thus more likely to permanently affect how we perceive something, shaping the stream of consciousness that unfolds in people during conversations and speeches. As an example, consider the speech delivered on September 30, 1847 to the Agricultural Society of Rutland County by a congressman from Vermont, named George Perkins Marsh. The speech was a catalytic one, leading to the foundation of a movement to conserve natural resources in the state, decrying the human capacity for destruction of the environment and advocating a better management of resources. Below is a brief (but relevant) excerpt (Marsh 1848: 11):

> But though man cannot at his pleasure command the rain and the sunshine, the wind and frost and snow, yet it is certain that climate itself has in many instances been gradually changed and ameliorated or deteriorated by human action.

Marsh realized that the result of exploiting natural resources recklessly was a gradual increase in temperature every year. The idea that humans could negatively alter the climate of an entire planet by usurping its natural resources was not common knowledge at the time. But Marsh likely implanted a seed of warning in his audience by using a metaphorical image to emphasize his point—namely, that the unbridled *command* of Nature by humans implies a forceful intrusion by humans into Nature's domain—to their own detriment. This image of self-destructive control shaped his overall argument, making it highly emotive, entering the stream of consciousness of his audience and, subsequently, of his readers, corroborated indirectly by the emergence of Nature-preserving societies in Vermont. As discussed in previous chapters, the metaphorical image of humans controlling Nature, like a master and a slave, is an ancient one, which Marsh had likely absorbed by exposure to such language and then used to describe a new situation (Eglash 2007).

Warning messages discovered on walls, stones, and other artifacts across time reveal how the same kind of metaphoricity framing has been employed to record the detrimental effects that ensue from controlling Nature in a destructive way. Consider, as a case in point, the so-called *hunger stones* (referring to famine), discovered in various parts of Central Europe. One of these, found on the banks of the Elbe River in Děčín, Czech Republic, dates from 1616. The message inscribed into it is *Wenn du mich siehst, dann weine* ("If you see me, then cry") (Figure 4.1).

The image of crying is itself associated with the symbolism of tears as standing for the plight that comes from famine, linking the Elbe River as a source of water iconically to tears themselves. As in Marsh's speech, the metaphorical subtext is that by commanding Nature, the results are invariably detrimental—hence the tears; that is, the slave-master (humanity) ends up crying from its own destructive activities. The same type of metaphorical crying image manifests itself in the current discourses on the climate crisis, but it is often reversed, whereby it is Nature that is portrayed as "crying" or "in tears" as a result of humans' reckless "control."

A common metaphor in the discourse on climate change, past and present, is that of *war.* Consider the 12,000-year-old Viking stone called the Rök runestone, discovered in 1832 near the town of Ödeshög, in Östergötland, Sweden (Holmberg et al. 2020) (Figure 4.2).

The stone's message, written with the runic alphabet, is dedicated by a father called Varin to his son, Odin, who had fallen in battle. It contains nine

FIGURE 4.1 *Hunger stone, Děčín, Czech Republic, 1616 (Wikimedia Commons).*

FIGURE 4.2 *Part of the Rök runestone, Ödeshög in Östergötland, Sweden (Wikimedia Commons).*

riddles about a terrible conflict to come "between light and darkness, warmth and cold, life and death." Below is one of the riddles:

> Let us say this as a memory for Odin, which spoils of war there were two, which twelve times were taken as spoils of war, both from one to another?

The answer is: "The sun and moon." The riddle is a warning about the dangers to the environment (the sun and the moon) that result from the *war* that humans are waging on it *twelve times* (the twelve months of the year). Varin had apparently witnessed three events that were harbingers of doom: a powerful solar storm that had colored the sky in dramatic shades of red; crop yields that had suffered from an unusually bitter cold summer; and a solar eclipse that occurred just after sunrise (Holmberg et al. 2020). The metaphoricity of the riddle is consistent with how eclipses and extreme winters were portrayed in ancient Norse mythology, namely with the war image—an example is the tale of Ragnarök, which centered on a cataclysmic battle of the gods prophesying the end of the world, during which the sky turned blood-red and sunlight black. In Varin's riddle, the father linked his son's death to the apocalyptic signs of doom

he saw in the sky in an identical way to this mythological tradition. Overall, the nine riddles constitute miniature tales of coming disasters based on the same kinds of metaphorical themes of Norse mythology.

Similar metaphorical messages are found throughout ancient mythologies. Two classic examples are the *Epic of Gilgamesh,* written in the late second millennium BCE in the Akkadian language, and the Greek myth of Cassandra. The following excerpt from Tablet IV of the *Epic* is an ominous warning couched in the same kind of language of the Rök runestone:

> The skies roared with thunder and the earth heaved,
> Then came darkness and a stillness like death.
> Lightening smashed the ground and fires blazed out;
> Death flooded from the skies.
> When the heat died and the fires went out,
> The plains had turned to ash.

This passage contains apocalyptic images—*darkness, death, fire*—which describe how Nature will take its revenge on humans by bringing about disasters that leave the Earth in ashes. The whole scenario is an overarching metaphor designed to arouse intense feelings about the dangers that the unbridled human control of Nature inevitably brings about.

Cassandra was a daughter of Priam, the king of Troy. Taken by her beauty, the god of love, Apollo, gave her the gift of prophecy in return for her love. However, because Cassandra refused Apollo's romantic advances, he put a curse on her, ensuring that nobody would believe her warnings. As a result, even though she had knowledge of future dangers, Cassandra could not convince others of the truth of her predictions. This situation is now called the *Cassandra metaphor*, and it has been applied to explain the enduring power of anti-climate-change discourses, which elicit in some "a refusal to believe what at the same time they know to be true, [showing] a universal tendency toward denial, a potent defense against persecutory anxiety and guilt" (Klein 1963: 295). Environmentalist Alan Atkisson (1999) has used the Cassandra metaphor as a basis to argue that humanity is on a collision course with Nature—a situation that he calls the *Cassandra dilemma,* defined as a situation whereby someone who can see the most likely outcome of a trend, such as massive pollution of the environment, warning people about its inherent dangers, will be disbelieved or marginalized by others who, later, if catastrophe occurs, may even blame the person's prediction as having actually set the disaster in motion. As Atkisson (1999: 32) puts it: "too often we watch helplessly, as Cassandra did, while the soldiers emerge from the Trojan horse just as foreseen and wreak their predicted havoc. Worse, Cassandra's dilemma has seemed to grow more inescapable even as the chorus of Cassandras has grown larger."

In contemporary linguistics, the images evoked by metaphorical vehicles, such as the *war* one, are called, *image schemas*, a term introduced by George Lakoff and Mark Johnson (1980; Lakoff 1987; Johnson 1987). These are mental images that convert concrete referents, such as fires, ashes, etc. into metaphors (Dodge and Lakoff 2005). Consider the *war* image schema, which the author of the Rök runestone converted into a metaphor to link his son's death in battle to the war being waged on the environment by humans. The same image schema is found throughout the popular discourse on climate change today (Flusberg, Matlock, and Thibodeau 2017), as the following few phrases mined randomly from the Internet show:

1 *war* on Nature

2 *fighting* climate change

3 our common *enemy* is pollution

4 we must *attack* the problem together

5 we must *win* the war

6 global warming is a powerful *enemy*

7 we cannot afford to *lose* this *war*

8 we need powerful *tactics* to *defeat* climate change

9 join our *fight* for climate justice

It is an ancient image schema, portraying danger as an *enemy* that must be *defeated*—a metaphor adopted by an advocacy group called Climate Mobilization, formed in 2014 in the US, which seeks large-scale political action against global warming on the same scale of mobilization used during a war. Its founder, Margaret Klein Salamon, has explicitly adopted the war metaphor to confront climate change denial. However, her approach appears to work well only with people who are already deeply concerned about climate change, but not with those who deny it—for reasons similar to the ones discussed above. War rhetoric may be actually counterproductive in bringing opposite sides together, escalating the conflicts between them (to extend the metaphor). As Charles Eisenstein (2018) has argued, framing the problem of climate change as a war stokes partisanship and obscures any common ground of agreement that might be otherwise established—warriors need enemies. A study by Deignan, Semino, and Paul (2019) found, in fact, that the kinds of metaphors to describe climate change used typically in science, education, and society generally may actually lead to misconceptions about the problem. The researchers describe the outcome of their study as follows (Deignan, Semino, and Paul 2019: 379):

> Experts are generally in agreement that anthropogenic climate change is happening and will increase in severity, but this view is not clearly reflected in more non-specialist texts. Research has shown that school students have a limited and sometimes faulty understanding of climate change. Metaphors are used by scientists in developing thought and communicating with non-scientists; they are also used by educators. This research investigates students' understandings of climate change by comparing metaphor use in three corpora, of research articles, student educational materials, and of transcribed interviews with school students aged 11–16 from the north of England. We find that some metaphors are shared by the three corpora; where this happens, the researchers' use tends to be highly conventionalized and technical, while educational materials extend and explore metaphors, and the students' use is still more creative, sometimes resulting in inaccurate descriptions of the science. Students also develop some of their own distinctive metaphors based on their immediate concrete experience, and possibly on visual educational materials; these metaphors convey highly simplified and often inaccurate understandings of climate science.

So, what is the solution, if any? As an ancient image schema, the war metaphor still resonates with people, since it is found throughout discourses of all kinds, and can thus be recycled as a persuasive strategy today in the climate change debate (Lakoff (2012: 163–4). As Paul Ricœur (1991: 85) has observed: "Metaphor shatters not only the previous structures of our language, but also the previous structures of what we call reality." As studies have been showing since at least the mid-1980s, metaphor can indeed be used strategically to influence minds, shaping perception and beliefs (Fauconnier and Turner 2002; Gibbs 2017; Holyoak and Stamenković 2018; Kövecses 2020). Research on so-called *conceptual blending* (Fauconnier and Turner 2002; Cánovas and Manzanares 2014) has provided corroborative support to the metaphoricity principle, maintaining that metaphor is "a fundamental instrument of the everyday mind, used in our basic construal of all our realities, from the social to the scientific" (Turner 1997: 93). Nonetheless, problems of interpretation persist even in metaphorical discourses, as discussed: "One person's or culture's metaphor may be another person's or culture's metonymy, or indeed another person's or culture's literal truth" (Sandor 1986: 101). In a review of the relevant literature, Boeynaems et al. (2017) came to a similar conclusion. Perhaps a distinction between common discourse metaphors and mythic ones can be made, since the latter are likely to be more effective in shaping beliefs, because they may be embedded in the collective unconscious—as will be discussed in Chapter 6.

Discourse Framing

Metaphoricity undergirds the framing of entire discourses and arguments (Spitzer 1928; Foucault 1969; Goffman 1974; Bakhtin 1981). As Gordon Allport (1954: 334) has put it: "When one frame of reference is invoked, one set of subsidiary attitudes and habits comes into play; when a contrary frame is invoked, a quite opposite set of dispositions is activated." The power of discourse framing became evident in the contrasting climate change discourses that started spreading in the 1990s (Gelbspan 1997; Norgaard 2011; Klintman 2019). As Lakoff (2010: 72) has observed, the different ways in which something is portrayed discursively activates "frame-circuits" in the brain which affect people emotionally—hence the high emotivity of climate change discourses:

> Many frame-circuits have direct connections to the emotional regions of the brain. Emotions are an inescapable part of normal thought. Indeed, you cannot be rational without emotions. Without emotion, you would not know what to want, since like and not-like would be meaningless to you. When there is neither like or not-like, nor any judgment of the emotional reactions of others, you cannot make rational decisions.

An example of a highly emotive discourse frame intended to raise awareness of the dangers posed by climate change is provided by Oreskes and Conway (2012); it is based on a banquet analogy that utilizes the image schema of paying for the meal—an analogy that is a particularly apt one, since famine may be the result of climate change:

> Imagine a gigantic banquet. Hundreds of millions of people come to eat. They eat and drink to their hearts' content—eating food that is better and more abundant than at the finest tables in ancient Athens or Rome, or even in the palaces of medieval Europe. Then, one day, a man arrives, wearing a white dinner jacket. He says he is holding the bill. Not surprisingly, the diners are in shock. Some begin to deny that this is their bill. Others deny that there even is a bill. Still others deny that they partook of the meal. One diner suggests that the man is not really a waiter, but is only trying to get attention for himself or to raise money for his own projects. Finally, the group concludes that if they simply ignore the waiter, he will go away. This is where we stand today on the subject of global warming. For the past 150 years, industrial civilization has been dining on the energy stored in fossil fuels, and the bill has come due. Yet, we have sat around the dinner table denying that it is our bill, and doubting the credibility of the man who delivered it.

The analogy connects the two domains—eating and global warming. This linkage suggests that we have been "dining on the energy stored in fossil fuels" nonchalantly, regardless of what price (consequences) this entails. The reality that there are significant consequences comes with the appearance of the bill-holder, asking for payment. The analogy ends with a moral warning—we are still "denying that it is our bill." As Kuypers (2009: 81) has observed: "Framing is a process whereby communicators, consciously or unconsciously, act to construct a point of view that encourages the facts of a given situation to be interpreted by others in a particular manner."

Effective discourse framing has always been an intrinsic part of climate activist movements, such as the one initiated by Marsh in Vermont (above) and others in the same century, including Henry David Thoreau in his novel, *On Walden Pond* (1854), which set the stage for modern environmental discourses, calling persuasively for the preservation of Nature. A common framing technique is the one intended to instill fear. But even this does not guarantee that it will be effective, as a study by Kleres and Wettergren (2017) demonstrated. The researchers exposed disbelieving subjects to dire warning messages that were intended to raise awareness of the threat of climate change and to get them to commit to action. They found that while the subjects processed the messages as persuasive, they did not spur them on to activism. As the study authors concluded, the danger-alerting capacity of fear-based discourse is embraced "internally," but is rejected as a motivational impetus. As a relevant study by Hazboun et al. (2019) found, a little later, a major reason why many fear-based discourses may not work is because they are too negative, being narrowly focused on the climate change dangers themselves, rather than on framing the advantages of using renewable energy technologies: "non-climate-based frames for renewable energy are likely to garner broader public support" if they are presented in a positive way.

Overall, the studies on discourse framing have shown, directly or indirectly, that emotivity levels correlate with metaphoricity content—that is, the higher the metaphoricity of a warning, the higher its emotional impact is likely to be. This principle leads to a consideration of a type of language that has always been high in metaphorical content—namely, poetic discourse.

Poetic Warnings

In a 2015 essay, the Canadian writer Margaret Atwood expressed the following relevant thought in the debate over climate change: "It's not climate change, it's everything change." Her statement spread broadly through cyberspace at the time, becoming an online meme for a while. Atwood's main argument in her essay was that poets should become involved actively in warning about

the dangers of climate change, framing it with their poetic art so as to raise consciousness about these dangers, recalling Percy Bysshe Shelley's remark (1821): "poets are the unacknowledged legislators of the world." This remark was, incidentally, the inspiration for a contemporary collection of poems, compiled by John Felstiner, *Can Poetry Save the Earth?* (2010), which aimed to show that, from antiquity to the present, poets have always been influential in shaping attitudes towards Nature and in warning people of the dangers that ensue from assailing it.

Poetry was the language of ancient prophets and seers, who used it to warn people about the dire consequences certain actions would bring about—a divinatory function that has persisted in poetic art to this day. Consider Robert Penn Warren's *Evening Hawk* (published in 1923), which warns people of the calamities that will ensue when there is no more wind—a metaphor of the disasters that will come about with the destruction of Nature. He imparts the sense of doom not by explication but by the tone, feeling, and mood that his words evoke. He starts by describing how a hawk needs the wind to survive, ending its day by scything "down another day." The sounds the hawk makes with its wings in the wind are perceived as "crashless," and thus part of the silence of time and Nature. But the hawk's natural motion, which is part of the natural order of things, will come to an end without the wind, as will human life, which has been thrust by modernity into a noisy, cacophonous world. The images of the Earth "grinding," "dripping in darkness," "like a leaking pipe" have a synesthetic effect, combining sound and visual imagery into a dissonant admixture. This dissonance is the result of an iconic-metaphoric representational modality that raises the emotive level considerably—as discussed previously and which is intrinsic to poetry.

As Mark Turner (1997) has aptly remarked, poetry projects the mind into the experience of something via this representational modality. When a poem uses the imagery of a *snake* in reference to a person, we will likely start to imagine the person turning into a snake in our imagination, experiencing the metamorphosis vicariously. Franz Kafka played on this power of poetic metaphor in his 1915 novella *Die Verwandlung* ("The Metamorphosis"), which starts with a salesman waking one morning to find himself transformed into a monstrous vermin. Kafka's tale, like most of his others, reads like a narrative poem, constituting a disorienting assault on literal meaning, but in so doing it impels us to search for a deeper meaning, as a study by Proulx and Heine (2009) actually showed. The two researchers asked subjects to read a modified version of another of Kafka's seemingly meaningless stories, *A Country Doctor* (1918), illustrating it with a series of equally nonsensical pictures. A control group of subjects was given a story similar in plot, but more conventional in form. All subjects then took a test that required them to identify patterns in random strings of letters. Those who read the original

Kafka story were more inclined to search for the patterns and more successful in spotting them; the control group was not.

Atwood's comment above came at a time when a poetic movement, called *ecopoetry,* dealing with the existential dangers posed by climate change, was gaining momentum through the Internet. Parini and Pack (2000: iv) explained the motivation for the movement when it first came onto the scene in the latter part of the twentieth century: "Nature is no longer the rustic retreat of the Wordsworthian poet. [It] is now a pressing political question, a question of survival." But the goal of ecopoetry is actually an ancient one in contemporary guise, as discussed throughout this book. It is an updated poetic reframing of ancient folkloric warnings related to floods and other disasters. Many of the original proverbs were also forged as poetic warning messages, serving "as advice, reproach, warning, encouragement and further explanation of some facts" (Adamo 2015), as the following illustrative examples, taken from different cultures, indicate:

1. One should be just as careful in choosing one's pleasures as in avoiding calamities (Chinese proverb).
2. The Earth lies polluted under its inhabitants; for they have transgressed laws, violated the statutes, broken the everlasting covenant. Therefore a curse devours the Earth, and its inhabitants suffer for their guilt (Bible).
3. If the moon is with you, you need not care about the stars (African proverb).
4. Care now, be cared for later (Arab proverb).

The retrieval of a folkloric-poetic language to articulate climate change dangers today is also evident in the ways certain aphoristic statements about these dangers are being framed by cultural personalities and public figures. A few that are exemplary of this implied proverbial style, found online, are listed below:

1. Humankind has suddenly entered into a brand new relationship with our planet. Unless we quickly and profoundly change the course of our civilization, we face an immediate and grave danger of destroying the worldwide ecological system that sustains life as we know it (Al Gore).
2. The planet will continue to cook (Paul Krugman).
3. The facts are there that we have created, man has, a self-inflicted wound that man has created through global warming (Arnold Schwarzenegger).
4. Climate change is responsible for conflicts that can only deepen in the future if we don't act as soon as possible (José Manuel Barroso).

In his ground-breaking 1936 book, *The Philosophy of Rhetoric*, the literary scholar I. A. Richards argued that the metaphorical-poetic mode of speaking and representing reality reveals how human understanding occurs—as neuroscientific studies have actually corroborated (for example, Hawkins 2004). The suggestion is that this mode is a "natural" one for gaining understanding—hence its origin in antiquity as a universal mode for issuing warnings about existential dangers. Ecopoetry is a current-day manifestation of this very same mode. A few illustrative examples will suffice (from https://www.familyfriendpoems.com/collection/climate-change/). The poem *Mother Earth* (2019) by Sophia E. Valdez is a contemporary evocation of the Gaia myth, portraying the Earth metaphorically as the mother of humanity, who we have betrayed with our "carelessness and fears." Sylvia Stults' poem *Warned* (2015) recalls the same metaphorical images found in texts such as the Rök runestone, including the loss of "blue skies" and the brightness of "stars." Another poem named *Mother Earth*, this time by Dave Mottram (2019), is also based on the Gaia myth, with the Earth portrayed as shedding its tears along with human tears—recalling the image schema of crying in the hunger stone discussed above. The poem *Awareness About Our Environment* (2011), also by Sylvia Stults encapsulates the destruction of Nature with the image of people "tearing out trees," an image that goes back truly to the origins of poetic traditions that revolved around the significance of trees to human survival.

The question of whether this type of poetic language truly constitutes an effective warning system today, spurring people on to do something about it, clearly requires further research within nuclear semiotics in collaboration with cognate disciplines such as psychology and anthropology. As Ralph Waldo Emerson (1836: 23) observed so insightfully, the poet literally opens our inner eye to the truth of things, etching it into the mind:

> There is a property in the horizon which no man has but he whose eye can integrate all the parts, that is, the poet . . . To speak truly, few adult persons can see nature. Most persons do not see the sun. At least they have a very superficial seeing. The sun illuminates only the eye of the man, but shines into the eye and the heart of the child. The lover of nature is he whose inward and outward senses are still truly adjusted to each other; who has retained the spirit of infancy even into the era of manhood. His intercourse with heaven and earth, becomes part of his daily food.

Epilogue

The aim of this chapter has been to examine the kinds of verbal warning strategies that have been devised and applied to existential dangers throughout

history. The underlying theme has been that the urgent predicaments that we face today require the involvement not only of scientists, but also of orators and poets who understand the power of discourse framing and metaphoricity in shaping perceptions and beliefs. Past verbal warnings show that ancient peoples were unconsciously guided by the metaphoricity principle, as artifacts such as the hunger stones, the Rök runestone, and flood myths bring out.

A computer modeling study by Pasquale Raia et al. (2020) has suggested that the greatest threat to our long-term survival today is climate change. The research team combined climate modeling and fossil records in search of clues as to the probable factors behind the extinctions of earlier species of *homo.* Their model found that the main reason was the inability of early humans to adapt to changing climactic conditions. They conclude that, despite technological innovations in hominid and early human groups, such as fire and stone tools, as well as the formation of complex social networks, fitted clothes, and significant cultural and genetic exchanges, early humans were incapable of surviving intense climate change. Even though they sought out different locations in order to survive, nothing they did ensured their survival. The fossil database used, which included almost 3,000 archaeological records, revealed that the climatic conditions were too extreme just before extinction. The relevant point here is that the eras from which the archeological records that the researchers consulted coincide with the early flood myths, dating as far back as 5000 BCE. These were, in effect, the earliest records of how humans perceived existential dangers, representing their fears with poetic language that is comprehensible to this day. In the Noah's Ark story in Genesis, phrases such as "a flood that flows over the tops of the highest mountains in the world," are as understandable today as they were in biblical times. The same image of floods rising above mountains, incidentally, is found across ancient cultures (Peschel 1971). Such language not only makes sense now, but is likely to resist decay in the future.

Along its coastline, Japan has experienced centuries of danger due to water levels and the ever-present peril of tsunamis. The main strategy of the Japanese inhabitants living along the coast has been to construct buildings as high up as possible. Through trial and error, they have learned where the tsunamis tend to hit and how high up the waves reach. From this knowledge, they have constructed ten-feet-high stone slabs, some of which are 600 years old. These slabs have powerful poetic warnings etched into them that alert future generations not to build below them. The stone below was erected a century ago near the village of Aneyoshi (Figure 4.3).

The inscription reads as follows: "High dwellings are the peace and harmony of our descendants. Remember the calamity of the great tsunamis. Do not build any homes below this point." The residents of Aneyoshi have heeded this warning, building their homes higher up. As a result, they survived

FIGURE 4.3 *Japanese tsunami stone, Aneyoshi (Wikimedia Commons).*

the 2011 Tohoku tsunami intact. The relevant point here is that the Japanese text is replete with metaphorical images that resonate emotively with the Japanese people, images of "peace," "harmony," and "ancestors." There is little doubt that these are effective motivators for action because they are understandable in emotive ways.

Notwithstanding the arguments put forward in this chapter, the caveat expressed by Sebeok with regard to the use of language as highly susceptible to decay and resistant to cross-cultural comprehension, is still a valid one. Sebeok (1984: 16) put it as follows:

> A symbolic message is one whose relationship to the "state of affairs" that it purports to represent is arbitrary, that is, understandable because of a preexisting social convention which specifies that the message will, to all who concur, stand for thus-and-so. For instance, the spoken word "dig" will be understood by all who are privy to the code known as "modern spoken English" as, roughly, equivalent to "excavate" (and associated notions), given the right context; (in other contexts, the same morpheme might mean "thrust", "reside", "poke", "apprehend", "enjoy", and so forth—derivative extensions commonly called "metaphoric meanings"). Symbols, of course, can be encoded in various other modalities. The American flag is also a symbol triggering deep emotional responses—say, in the context of a burial at Arlington National Cemetery.

Stabilizing the range of interpretations of words is a thorny problem, as discussed throughout this book. One of Sebeok's own solutions was to suggest the use of visual emblems in lieu of verbal messages: "The technical word used for highly formalized symbols in the visual mode is 'emblem'; examples of emblems are the international symbol used to inform of the presence of radiation hazard in the vicinity, the trefoil; or the abstract wheelchair design making it known that there is a facility nearby suitable for the use of handicapped persons" (Sebeok 1984: 16).

On the other hand, it could be argued that the unconscious emotive force of metaphor, poetry, myth, and certain discourse frames, such as those based on analogy (as illustrated in this chapter) can be harnessed to help communicate present dangers effectively and to project their meanings into the future, given that these have shown themselves to be effective since antiquity, having resonance to this day. The *war* metaphor, for example, was used by the president of China, Xi Jinping, who called for a "people's war" against the coronavirus in February 2020. Shortly thereafter, the French president, Emmanuel Macron, told his people that "We are at war" against the virus. The relevant point here is that this metaphor translates into virtually any language without any loss of meaning. Linguist Elena Semino of Lancaster University has set up a crowdsourced project called *Metaphor Menu*, to investigate the ways in which people with cancer talk about their condition, finding that the same metaphor comes up in this case as well. However, she also found that such people prefer a *journey* metaphor instead. The conclusion to be deduced is that if a metaphor proves ineffectual, then one must find other ways to frame a problem. This is perhaps the key to solving Sebeok's problem linguistically, rather than just emblematically. Some metaphorical images seem so deeply embedded in human cognition that they might be archetypal, and this is why they are easily translatable across languages. Examining ancient poetic and metaphorical warnings might reveal which images are truly archetypal—which has been a subtext throughout this chapter. The *war* and *journey* metaphors seem to fall into this category.

As Umberto Eco (2010: 58) has remarked, "a homeopathic purification (according to the Greek medical tradition and to its connections with the Dionysian rites) depends on a discursive strategy through which language and other semiotic systems can produce propositional attitudes and make people believe or act in a certain way." This citation encapsulates the *raison d'être* for studying the verbal warnings from antiquity to the present, which should be a goal of nuclear semiotics.

5

Pictorial Warnings

Prologue

Images communicating a sense of danger inscribed on cave walls, painted on vessels, or sculpted in figurines reach back to antiquity (as discussed several times). The pictorial medium, as Sebeok (1984) emphasized, has always constituted an emotively powerful nonverbal relay system for conveying danger, given that visual signs and texts are more likely to retain comprehensibility across time, resonating with a common ground of iconic meaning cross-culturally. As Hans Belting (2016: 235) remarks, pictures enfold an "iconic presence":

> Iconic presence is presence in and as a picture. The physical presence of a picture in our world refers to the symbolic presence which it depicts. Similar to body and voice—and different from writing—the picture involves a representation which produces an impression of presence.

This may explain why we comprehend pictorial representations of the past as if they were "present"; and it suggests that they might be understandable in the future as well. Consider the "Hopi Prophecy Rock" as a case in point. The Hopi are a Native American society, living chiefly in northeastern Arizona, and the subject of considerable interest on the part of anthropologists and linguists (Whorf 1956; Geertz 1983; Kaiser 1990, 1991; West and Rubin 2015). The Prophecy Rock is a sandstone structure located on the Hopi Reservation near Oraibi; it has a prophecy etched into it that recounts how the Great Spirit will save those who are faithful to the traditional Hopi goal of preserving the Earth, while those who pursue destructive aspects of modernity will not survive (Figure 5.1).

The sequential order of the images mirrors a chain of events, as foretold by the prophecy. Below is the etching reproduced in adapted form for convenience (from Waters 1963) (Figure 5.2).

FIGURE 5.1 *Hopi prophecy rock, Oraibi, Arizona (Wikimedia Commons).*

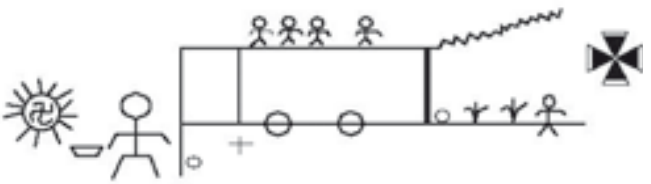

FIGURE 5.2 *Hopi prophecy etching (Waters 1963).*

The large human stick figure on the left represents the Great Spirit. The ceremonial bowl in its hand is a symbolic one that contains the warning from the Great Spirit to lay down weapons and end all conflicts before it is too late. The perpendicular line next to the Great Spirit represents a time scale that the Hopi use to measure chronological periods in thousands of years. The point where the Great Spirit touches the line is the moment of its return. The horizontal lines touching the vertical one (forming a rectangle with it) represent the "life paths" established by the Great Spirit, with the lower line (path) standing for continuous life in harmony with Nature and the upper one for the scientific achievements of the "white man." The perpendicular bar on the left joining the two paths stands for the coming of the white man; and the cross just below represents the Christian religion that the white man brought to the Hopi. The two circles on the lower path represent the consequences of following the

wrong path, standing for a great shaking of the Earth. The perpendicular bar at the end of the scene represents a last chance for the people to turn back to Nature before everything disintegrates—represented by a jagged line reaching up into nowhere. Below it are symbols for corn, which will grow again in abundance when the Great Spirit returns, after a dire famine. The cross-like symbol in the sun to the left represents the two helpers of Pahana, who is the figure of the True White Brother. It also stands for the wandering Hopi clan.

Understanding the meaning of certain figures in the scene involves straightforward semiotic analysis. The bowl and the greater size of the stick figure holding it stand symbolically for divine messages and the Great Spirit—an interpretation that is consistent with Hopi symbolism in general. The human stick figures, the corn images, and the circular Earth figures are iconic forms, as discussed. A key visual iconic form is the jagged line, reflecting a Hopi proverb which states that the wrong path is a "zig-zag" one leading to disaster, and the result of a lifestyle that the Hopi call *koyaanisqatsi*, which means "world out of balance."

Like the Hopi, other Native American societies pass warnings on from generation to generation through similar pictorial representations. These show how danger has been visualized by these societies in the past and how they remain meaningful in the present, given their iconic presence, which seems resistant to meaning decay. These constitute primary sources of insight into the nature of warnings for nuclear semiotics.

Semasiographic Warnings

Sebeok (1984: 21) classified pictorial representations into three general categories:

1. *Semasiographic*: representations such as drawings on cave walls, markings on objects (such as figurines), visual artworks, etc.
2. *Phonographic:* forms of writing that transform pictographic signs into phonemic ones.
3. *Para-graphic*: markings used within or in addition to writing proper that correlate loosely with language, such as cartoons and comic strips.

The main category of interest here is the semasiographic one. The Hopi Prophecy Rock above is an example of this kind of pictorial text. It encodes a warning by producing an iconic presence that is expressed in other Hopi pictorial representations and in their verbal prophecies as well—the world is in danger of destruction when people became greedy, worship material things

as they would a god, and forget the teachings of elders to honor the Earth as the source of life and sustenance. As such, the etching above is a visual counterpart to the prophecy of *koyaanisqatsi*—translating its words into images (to be discussed further in Chapter 6).

Many examples of ancient art have a similar semasiographic warning function. In these early representations there are recurring images, which suggest an archetypal understanding of danger across cultures. One of these is the hands, often depicted as detached from the rest of the body. As a case in point, consider the *Cueva de las Manos* ("Cave of Hands"), discovered in Santa Cruz Province, Argentina, showing a group of separated hands reaching out for something or someone in a seemingly desperate way (Figure 5.3).

The painting has been carbon-dated to around 7300 BCE. It is not known for certain who the original artists were. Since it has been established that the site where the cave was found was last inhabited around 700 CE by the Tehuelche people of Patagonia, however, the best guess is that the creators were the ancestors of these people. Interpreting this scene in any definitive way is problematic, because it could have a broad range of meanings that cannot be easily pinned down in a retrospective way. Some have suggested that the hands were a symbolic part of a broader ritual connected with hunting, an interpretation

FIGURE 5.3 Cueva de las Manos, *Santa Cruz Province, Argentina (Wikimedia Commons).*

that is supported by the fact that other cave paintings in the area show the separated hands and animals together, and by the fact that the inhabitants of the region were hunter-gatherers. Another possibility is that the scene was painted by the young members of the tribe, as part of an initiation or passage rite, perhaps because hands are critical in hunting or any other kind of survival-based activity that adults must carry out (Gradin, Aschero, and Aguerre 1976). Whatever the intent of the painting, the depiction of a multitude of severed hands evokes an iconic presence of danger, with the hands pointing in all directions and open in a way that today we would interpret as a warning signal to stop someone from doing something (Birdwhistell 1952).

Perhaps stretching the interpretive range somewhat, this type of painting might suggest a fascination with hands themselves, as prehensile appendages distinguishing humans from other non-primate animals. Therefore, it could well be that paintings such as the one above are reflective of an early awareness that hands play a crucial role in human survival, allowing for the making of tools and gestural communication, but also constituting natural weapons that can be used against animals and other humans. This suggests that the depiction of severed hands might be an early (prehistoric) archetype, whose manifestations have continued throughout history, as can be seen in all kinds of artworks, from Michelangelo's *Creation of Adam* (*c.* 1508), part of the Sistine Chapel's ceiling fresco, showing the near-touching hands of God and Adam symbolizing the beginning of human life, to the 1948 lithograph, *Drawing Hands*, by the Dutch artist M. C. Escher, among many others. The latter is particularly interesting, showing a sheet of paper, out of which two hands arise, drawing one another into existence. However it is interpreted, this drawing resonates archetypally with the *Cuevas* painting, portraying human hands as distinctive anatomical structures in the human species, constituting creative "tools" themselves. As Aristotle put it, the hand is the "tool of tools" (Aristotle, *De Anima, c.* 350 BCE), symbolizing strength and protection.

In addition to hands, a common theme of ancient semasiographic art is that of animals shown in both fear-inspiring and fearful poses. This can be seen, for example, in the art of one of the many caves discovered at Lascaux, France, from the Upper Paleolithic era, which represent animals and fauna that correspond to the fossil records of that era. In the painting below, found in the Hall of the Bulls, we can see two aurochs (an extinct species of large cattle) who stand in obvious confrontation to each other, suggesting battle and violence, as other animals in the background stand by (Figure 5.4).

Some art historians maintain that it was a pictorial record of hunting success. But, again, this type of interpretation does not take its iconic presence into account, which conveys the danger emanating from the combat that is about to take place between the aurochs. As Julien d'Huy and Jean-Loïc Le Quellec (2010) have similarly argued, many of the Lascaux paintings suggest conflict and injury—an interpretation bolstered by the fact that many

FIGURE 5.4 *Cave painting, Lascaux, France (Wikimedia Commons).*

prehistoric paintings across the world also show animals either in combat with each other or humans, or else hurt and suffering from the violence perpetrated on them by other animals, including humans. Cumulatively, these paintings constitute what can be called a pictography of danger based on archetypal themes, from the symbolism of hands to the emergence of combat as a means of survival.

In the *Cueva de la Pileta*, in the Spanish province of Málaga, with its many prehistoric paintings, one stands out in particular—that of a large angry-looking fish, surrounded by various jagged shapes, evoking an iconic presence associated with fear and alarm (Figure 5.5).

The painting is found at the end of the longest gallery in the deepest part of the cave, called the Fish Chamber. The large fish is about 1.5 meters in length; inside the fish there appears to be the outline of a seal or some other animal that it has likely devoured. Its surroundings are discordant, as the many random jagged scratches suggest. A particularly danger-warning cue is the fish swimming aimlessly, searching for more prey. In sum, the fear that this painting encodes is truly powerful, remaining terrifying to this day.

Portraying danger visually may have a neural source, given that evidence from neuroscience indicates that by *seeing* danger (rather than, say, hearing it) various neural mechanisms are activated in tandem (Liu et al. 2014). So, it could well be that ancient semasiographic art reflects how the brain encodes

FIGURE 5.5 Cueva de la Pileta, *Málaga, Spain (Wikimedia Commons).*

fear, seeing it in the occurrence of specific events (for example, large fish eating and seeking prey), and then leading to an impulse to draw the events. The fact that most of this art was found in caves, which were safe havens from dangers associated with inclement weather and wild animals on the prowl, indicates that early art was a form of understanding the dangers that existed outside. In dangerous situations, all sensory modalities are activated, but the visual one becomes especially important for humans because it allows for the location of the prey in the line of sight. This ability is represented in pictorial forms that symbolize it iconically and symbolically. As Hoffman et al. (2018: 912) aptly put it: "Cave and rock art constitutes particularly impressive and important evidence for symbolic behavior."

Disaster Art

The painting below is found in a book on the Aztecs, *The History of the Indies of New Spain* (1581), written by the Dominican friar Diego Durán. It depicts an Aztec ritual designed to appease the angry gods who had unleashed a flood on their capital city of Tenochtitlan (Figure 5.6).

The figure of a serpent-shaped boat carrying survivors was, as Durán himself noted, a visual symbol of the dangers that natural disasters held for

FIGURE 5.6 *Aztec ritual for flooding, Diego Durán, 1581 (Wikimedia Commons).*

the Aztecs. As such, it reflects two archetypes that are found in ancient folkloric stories—the snake as connected to the birth of a people and the ark as a means to save humanity from extinction. In Aztec mythology, snakes are symbolic of divinely guided rebirth and renewal, hence the serpentine shape of the boat. Many of the most important Aztec gods were, in fact, snakes—Xiuhcoatl (the fire serpent), Mixcoatl (the cloud serpent), Quetzalcoatl (the feathered serpent who acts as chief of the gods), and so on. The boat itself fits in with the ark archetype, which will not only take the Aztecs away from danger, but also move them towards a more spiritual understanding of things.

The Aztec painting is an example of disaster art, defined as a visual art genre that depicts calamities such as floods with an implied warning that humans will continue to face them, either because of unstoppable natural processes in the world or because they have intervened destructively in the world to their detriment. Before the Renaissance, the common belief was that disasters were punishment from the divinities for human wickedness. The art genre thus emerged as a visual type of cautionary tale. This focus on apocalyptic scenarios continued into the Middle Ages, when most of the art was created for manuscript illumination by medieval scribes. An example is the 975 CE depiction of the flood scene in the Noah's Ark story held in the *Gerona Beatus* (Girona Cathedral, Catalonia) (Figure 5.7).

The painting is a pictorial representation of the Ark story, showing the naked bodies of wicked humans drowning beneath the sea-going vessel. At the top of the Ark, we see Noah and saintly people (identified by their halos) in a triangular enclosure; animals are sheltered in different enclosures below them. According to the biblical story, the flood is punishment from God designed to wash away human wickedness; the painting captures the agony that human wickedness can bring about. But this biblical account is not

FIGURE 5.7 *Noah's Ark*, Gerona Beatus, *975 CE (Wikimedia Commons).*

unique—in fact, it is a common one based on older Mesopotamian models. In its oldest version, inscribed in a tablet in the Sumerian city of Nippur (*c.* 1600 BCE), the hero is King Ziusudra, who builds an ark to conserve life after the gods decided to destroy it.

Famine is a common theme in disaster art. The medieval era saw the spread of famines, including the Great Famine of 1315–17, which was depicted in various illuminated manuscripts including the well-known *Biblia Pauperum* one at Erfurt, Germany, entitled the *Apocalypse,* which shows an apocalyptic scene with Death standing astride the mythical manticore, whose long tail ends in a flaming figure; below is a forlorn humanoid figure pointing to its hungry mouth, as it stands itself in the mouth of the hellish figure which is devouring him with flames (Figure 5.8).

During the Renaissance, disasters became the subject matter of famous artists, including Leonardo da Vinci who, in his *Disastro naturale* ("Natural Disaster"), shows chaotic swirls of water during a deluge, producing an iconic presence that evokes a sense of terror, drawing the viewer into the whirlpool (Figure 5.9).

In his notebooks, da Vinci wrote about the causes of inundations, against which human protections are hopeless. One of the causes which da Vinci hinted at was what we call climate change today. So, his painting marks a

FIGURE 5.8 Apocalypse, *Biblia Pauperum*, c. *1315–17 (Wikimedia Commons)*.

definitive break from the mythological and religious themes undergirding ancient and medieval disaster art (Crease 2019). As Passannante (2019) has suggested, da Vinci's depictions of catastrophes show that they are the result of impersonal Nature, not of divine intervention. In the sketch below (Figure 5.9): "We watch Leonardo turning the idea of disaster around in his mind as much as he did human anatomy" (Passannante 2019: 23).

Da Vinci's century saw the birth and rise of humanism; but biblical themes did not disappear from the arts. Rather, they were revisited with new humanistic eyes. A famous example is Michelangelo's *Alluvione* ("Deluge") (*c.* 1508), painted inside the Sistine Chapel, which is his version of the Noah's Ark story (Figure 5.10).

On the left, we see a group of desperate naked people seeking protection on a mountain top, away from the increasing water levels. On the right, another group is looking for shelter from the rain. And in the middle, there is a small boat that is about to capsize with Noah's Ark just behind it. The naked figures in the scene suggest vulnerability and helplessness in the face of disasters. Their

FIGURE 5.9 Disastro naturale, *Leonardo da Vinci*, c. *1517 (Wikimedia Commons)*.

FIGURE 5.10 Alluvione, *Michelangelo Buonarroti*, c. *1508 (Wikimedia Commons)*.

contorted bodies convey the sense of doom in a powerful iconic way. The only ones sheltered from the deluge are those on the Ark. But this begs an existential question: Why is there such divine vengeance on humanity, save for a chosen few? So, while treating a biblical theme, the painting does so from a different perspective, away from a literal interpretation of the Ark story as punishment from God (Rodríguez, Quarantelli, and Dynes 2007; Cregan-Read 2010). It does so by begging the above rhetorical question in visual form.

Since the Renaissance, the disaster art genre has covered other existential dangers, including war, which became topical in the nineteenth century, after Napoleon led the French army into the Peninsular War against Spain in 1807–14, affecting artists such as Francisco Goya intensely. Goya did not express his thoughts publicly, but these can be inferred from his foreboding set of lithographic prints called *Disasters of War*, published three decades after his death. They remain a visual testament to the horrors of war and of art's power to confront the horror directly, depicting executions, torture, and corpses dumped in mass graves. The last print, titled *Esto es lo verdadero* ("This Is the Truth"), shows a change in tone from desperation to hope, depicting a gleaming, resplendent woman, who gives off a luminous glow while hugging a worried, hunched, gaunt worker (Figure 5.11).

Her finger is directing the worker's attention to the beauty of the world of Nature around them—which is the only truth in the midst of suffering. It constitutes a cathartic resolution to the "disasters of war" Goya had painted previously, offering an aesthetic redemption—a theme developed further over a century later by Pablo Picasso in his *Guernica* (1937) painting. This is Picasso's artistic response to the World War II bombing of Guernica in northern Spain, visually emphasizing the suffering provoked by the resulting chaos. The scene shows a gored horse falling in agony, a dead dismembered soldier, and a screaming woman holding a dead child. The severed arm of the soldier continues to grasp a shattered sword in a rigor mortis fashion, and his left hand shows a stigma, a symbol of Christian martyrdom. A horrified woman is seen floating into the room to bear witness to the scene, carrying a lamp, which she holds near a light bulb. Below her, we see another frightened woman staring blankly at the light bulb. A bull is seen goring the horse, as its tail forms the figure of a flame with smoke rising from it. Painted in black and white, the absence of color makes the scene even more horrific in the imagination. Overall, the painting portrays the fragmentation of life that war brings about—life torn into pieces that can never be put together again, physically and psychologically.

Today's disaster art has turned to the theme of existential dangers with images taken directly from everyday life. An example is the work of American artist Donald Sultan, who produced a series of so-called *Disaster Paintings* in the 1980s. Using images of actual events, his paintings highlight the imminent

FIGURE 5.11 Esto es lo verdadero, *Francisco Goya, 1820 (Wikimedia Commons)*.

danger posed by the polluting activities of industrial plants, which he depicts as fragile structures that can collapse at any moment from catastrophic events, exposing the vulnerability of the entire industrial-technological culture. His work explores, overall, the changing environment of the planet and the deleterious effects of pollution on it. It is an example of what is now called *ecoart*, an offshoot of the disaster art genre. Ecoartists use not only traditional canvas painting, but also landscape installments—sculptures and architectural structures built directly into the environment—to convey the iconic presence of the repercussions of global warming and pollution, with images of submerging ice, contaminated water, crumbling buildings, decrepit zones of habitation, and the like. A few illustrative examples of this kind of art are the following:

1. *Signs for Changing Climate* (2009), by Finnish artist Otto Karvonen, consists of common traffic signs as warnings about rising sea levels and carbon emissions.
2. *Winter* (2008) is an installation by another Finnish artist, Nestori Syrjälä, consisting of five truckloads of artificial snow piled in front of the Museum of Contemporary Art in Helsinki, constituting a memento of how the climate is reacting to human-made pollution.

3 *Cement Eclipses* is a set of art projects by Spanish artist Isaac Cordal, consisting of small cement sculptures on top of bus shelters, walls, cornices, etc. In one project, called *Waiting for Climate Change* (2013), Cordal created a series of miniature sculptures of individuals that he installed on the top of poles; the individuals are wearing lifebuoys, seemingly "waiting" for the final apocalyptic chapter of climate change.

4 The various water-color works by American artist-scientist Jill Pelto incorporate scientific data on climate change, blending science and representational art. Her art impels us to visualize the climate data, and thus to grasp it both rationally and aesthetically at once.

5 *Red Polar Bear* by Icelandic painter Bjargey Ólafsdóttir shows a giant red polar bear painted on a glacier that is rising up, suggesting the threat that climate change poses to polar bears and, by extension, to all species on the planet.

6 The famous anonymous street artist, Banksy, created a mural near Hyde Park in central London in 2019, which depicts a young girl with a seedling bearing the symbol of Extinction Rebellion, a group using civil disobedience to draw attention to government inaction on climate change. The spray-painted words on the wall say "From this moment despair ends and tactics begin."

7 *The Anthropocene Project,* started in 2018 by Canadian photographer and artist Edward Burtynsky, is a project combining photography, film, virtual reality, augmented reality, and scientific research to investigate and depict the negative influence of humans on the ecological system of Earth. Together with other collaborators, Burtynsky embarked on a journey around the world to record in images the most disturbing evidence of human influence. The project has produced: (a) a traveling museum exhibition that started simultaneously at the Art Gallery of Ontario and the National Gallery of Canada; (b) environmental photography; (c) documentary videos; (d) immersive interactive experiences in augmented and virtual reality; (e) art books; and (f) a comprehensive educational program.

Like the verbal warnings discussed in the previous chapter, ecoart aims to engender awareness of the destructiveness of modern-day activities, and the need to change human behavior towards Nature and the other species with which we coexist. As Aviva Rahmani (2013: 23) defines it, such art is "a practice, often in collaboration with scientists, city planners, architects and others, that results in direct intervention in environmental degradation. Often,

the artist is the lead agent in that practice." However, as in the case of the language of danger discussed in the previous chapter, there is always the possibility that the art itself could be counterproductive in desensitizing people to the perils posed by human-influenced existential dangers. This risk was already articulated by the writer Susan Sontag in her last book, *Regarding the Pain of Others* (2003), which she wrote to answer Virginia Woolf's question: How are we to prevent war? Sontag's response was a pessimistic one—despite the images of pain, horror, and the overall violence of war that are captured by artists and photographers, the influence of such art on humanity is minimal, since people tend to interpret the images in subjective ways, rather than communally. Only those who have actually suffered from war can truly understand the images, whereas those who have not lived through it cannot understand the experiences that the images represent.

That said, it is still true that images are more effective than words in affecting people, raising the danger sense considerably. As research shows (Orians 2014; LeDoux and Pine 2016), pictorial representations of disaster activate the same regions of the brain which process actual disasters, losing very little (if any) impact on the viewer. This is true of traditional art as it is of ecoart, which uses the material objects of the world as part of its representational code. A forerunner of the pop art movement, Marcel Duchamp, understood that objects may themselves be interpreted as art forms. Steven Hicks (2004: 196) recounts an incident that brings this out:

> Asked to submit something for display by the Society of Independent Artists in New York [in 1917], Duchamp sent a urinal. Duchamp of course knew the history of art. He knew what had been achieved—how over the centuries art had been a powerful vehicle that called upon the highest development of the human creative vision and demanded exacting technical skill; and he knew that art had an awesome power to exalt the senses, the intellects, and the passions of those who experience it. Duchamp reflected on the history of art and decided to make a statement. The artist is a not great creator—Duchamp went shopping at a plumbing store. The artwork is not a special object—it was mass-produced in a factory. The experience of art is not exciting and ennobling—at best it is puzzling and mostly leaves one with a sense of distaste. But over and above that, Duchamp did not select just any ready-made object to display. In selecting the urinal, his message was clear: Art is something you piss on.

But there is a subsidiary message in the Duchamp anecdote. Whatever material the artist uses, the end product is something people really do descend upon, to extend Duchamp's analogy. It gets us to see, touch, and hear the danger, not just contemplate it in an abstract way.

Warning Pictograms

On a much smaller scale of representation than disaster art are the warning pictograms, discussed in previous chapters, which should remain of interest to nuclear semiotics, because questions of their design offer insights on how imminent physical dangers can be communicated effectively, and these can then be transported to the representations of existential dangers. Consider again here the trefoil hazard pictograms developed for alerting people to the presence of radiation. As discussed, these were intended to be immune to cultural coding and thus free from misinterpretation; but, as it has turned out, this was not the case, even though they are still used universally. Simply put, someone unfamiliar with the meanings of the features of the pictograms, may not read the meaning of "danger" in them, but rather something totally different (as we saw). The reason why they are still used universally, across cultural systems, is that they have evolved into a conventional pictorial language, much like the conventional codes of scientific discourse, whereby the world has agreed on certain symbols to serve as a shorthand system for recording and recalling information.

Recall the use of the skull and crossbones symbol, used not only in the trefoil sign (Chapter 2), but separately as a marker of dangerous materials, placed on bottles containing some poisonous or toxic substance (Figure 5.12).

This is the standard symbol adopted by the GHS to indicate the presence or location of some lethal substance. The decision for using this symbol has been, traditionally, that it is more readily recognized than a written warning and more commonly understood, independently of the viewer's cultural-linguistic background. But, as discussed, this is hardly the case. To decipher it as a warning, one has to have access to the cultural code behind it, which is much broader than enfolding the meaning of danger. For example, it was the symbol on flags (called the Jolly Roger) that identified English pirate ships during the eighteenth century. While this usage was not a widespread one, the symbol nonetheless fell into the realm of pirate legend in narratives of adventure, where it took on the

FIGURE 5.12 *Skull and crossbones symbol (Wikimedia Commons).*

connotations of danger and death that spread into society generally. It is this specific meaning that was assumed by the IAEA in 2007 (United Nations News 2007). To ensure that the pictogram had cross-cultural comprehensibility, a group of UN researchers conducted a five-year project in eleven countries with different population groups (of mixed ages, educational backgrounds, gender, etc.) to test this assumption. It was also tested by the Gallup Institute on over 1,600 people in countries such as Brazil, Saudi Arabia, China, and the United States. From such surveys, the conclusion was reached that it did indeed embed a sense of danger for most people. Perhaps the reason for this is that it had become conventionalized at the time, as any other scientific or mathematical symbol, accepted with this specific meaning at a denotative level.

But the symbol has migrated to other domains of culture, where its ability to turn on our danger sense has been diminished considerably. It is used in pirate fiction, as a logo for branded products, as a fashion emblem, and so on. It is also used as a symbol by "political pirate parties," such as the one in Sweden, to promote civil rights, alternative participations in government, free sharing of knowledge, freedom of information, and net neutrality. In effect, the meaning of danger in the skull and crossbones symbol is being rendered progressively ineffectual, as it spreads throughout the world, accumulating new connotations and uses. Of course, if used in a specific way as a warning pictogram, such as a label on a container of poison, then this particular usage will narrow down the range of meanings to that of danger specifically. But, the other connotations that the symbol has acquired will nonetheless likely interfere (subconsciously) in the interpretive process, likely diminishing the sense of danger in this case, even if the overall meaning of danger remains. The context is the limiting frame for connotative variability; but it cannot completely eliminate the connotations that a sign bears.

Aware of the variability of interpretation of standardized warning pictograms, already in the mid-1960s, a group of engineers and designers at Dow Chemical suggested six criteria to create the optimal pictogram for biohazardous materials (Baldwin and Runkle 1967):

1. It should be striking in form so as to draw immediate attention.
2. It must be unique and unambiguous to avoid confusion with other symbols.
3. It should be instantly recognizable and easily recalled, but designed in such a way that non-warning meanings cannot be [easily] assigned to it.
4. It should be easy to draw.

5. It should be symmetrical, in order to appear identical from all angles.
6. It should be acceptable to, and understandable by, groups of varying ethnic backgrounds.

One of the symbols that Dow created according to these principles, and which now has become a standard one for biohazards, is the one below, created in 1966 (described in Baldwin and Runkle 1967) (Figure 5.13).

The outline of three overlapping circles correlates with the image of the standard trefoil pictogram. There is also a circle behind the overlapping ones, and a smaller one in front. Whether the designers were aware of it or not, this imagery actually has cross-cultural resonance as a version of the ancient *triskelion*—a motif consisting of a triple spiral exhibiting rotational symmetry, found in artifacts that go as far back as the Neolithic and Bronze Ages (Judge 2018). Below is a generalized outline version of the triskelion figure (Figure 5.14).

In the Hellenistic period, the symbol was revised as consisting of three legs. Versions of this archetypal symbol are ubiquitous—they are found on coins, church windows, flags, etc. It is also used as a religious symbol in various traditions, including Buddhism and Christianity, where it represents the Holy Trinity.

FIGURE 5.13 *Biohazard pictogram, Dow Chemical, 1966 (Wikimedia Commons).*

FIGURE 5.14 *Neolithic triskelion (Wikimedia Commons).*

The assumption by the Dow team was that its pictogram of intertwining circular figures would be: (1) striking in form; (2) unique among symbols; (3) easily recalled and "meaningless"; (4) easily drawn; (5) symmetrical; and (6) ethnically neutral. They likely were not aware of its archetypal value, which may be the unconscious reason why it remains meaningful to this day. To ensure that the pictogram met all the criteria and was highly comprehensible, a research project by Baldwin and Runkle (1967) was designed and carried out to determine if it was indeed memorable. The researchers showed their pictogram and others that might be familiar to the subjects (for instance, Mr. Peanut, the Texaco star, Shell Oil symbol, the Red Cross, and the swastika) to a large sample. Participants were asked to guess the meaning of each symbol, recording it down. A week later, the same subjects were shown more symbols, including the original ones, and asked to identify the ones they had seen in the original round. The symbol that stood out, achieving the top memorability score, was their own pictogram. After further testing by government agencies, corroborating the Dow research findings, it was adopted by the Centers for Disease Control (CDC) and the Occupational Safety and Hazard Administration. However, as "connotation-proof" as this symbol seemed to be, it has been compromised semiotically because it has been adopted as an emblem on T-shirts, mugs, and stickers. As in the case of the skull and crossbones, the more popular a warning sign becomes outside of its intended uses, the less effective it will arguably be at alerting people to danger.

The GHS and other agencies have produced a vast array of warning pictograms adopting similar criteria as those above, while adding others, such as humor and age-based adaptations, so that a pictogram can be comprehensible even to children. An example is the *Mr. Ouch* sign, depicting the danger of electricity by showing a child electrocuted by sparks. It was devised in 1981 by the National Electrical Manufacturers Association (NEMA). This design is the result of various studies that a task force established by NEMA had conducted to explore warning signs that would be effective in preventing young children from being electrocuted. The test groups chosen consisted of an equal number of English and non-English-speaking children, from 2.5 to 6 years of age. From a set of sixteen illustrations, the one that children most strongly associated with danger was the *Mr. Ouch* one. This was confirmed by a follow-up 1995 study (Silver et al. 1995).

To help control the range of connotations in pictograms, the GHS has come up with a set of its own principles. One of these involves establishing the most likely meanings of colors:

- *Red:* used in prohibition and hazard signs, fire extinguishers, representing the red color of heat and fire.

- *Yellow:* used in biohazard signs to indicate nuclear wastes or toxic chemicals, associated with the glow emanating from radioactive substances.
- *Blue:* used to designate the importance of safety measures, since blue is perceived in many cultures as a sign of security.
- *Green:* used for emergency escape signs (on doors, exits, and routes) and first aid signs (showing location of first aid equipment and facilities), since this color is also associated with safety, contrasting with red as indicating danger.

One semiotic problem with such color codes is that they apply in cultures where such colors exist as distinct lexical categories. Where they do not, variability will surface. Take, for example, the color blue. Russian and Italian do not have a single color term for *blue*, but rather separate lexical items for *light blue* and *dark blue* as distinct focal colors—respectively *celeste* and *azzurro* in Italian and *goluboy* and *siniy* in Russian. As Winawer et al. (2007) found, this difference has relativity effects on cognition. In an experiment, the researchers found that Russian-speakers performed more quickly on a matching task when the *blue* hues belonged to different linguistic categories, whereas English subjects were much slower, since the color stimuli belonged to the same category. Now, the anticipated meaning of blue by the GHS would hardly apply in Russian or Italian culture, at least in the same way. Because of culture-specific color coding, various countries have, in fact, devised their own color codes of danger.

There are several other fundamental semiotic principles that should apply to the design of pictograms, whether or not they are recognized as such. These include the following (see also Skaggs 2017):

1. *Contrast*: selecting a sign vehicle that stands out in the image, such as a crossing-out line placed on the image of a cigarette in *No Smoking* signs or the electricity sparks in the *Mr. Ouch* sign.
2. *Organization*: the arrangement of the sign vehicles should convey a holistic meaning, much like syntax allows for words to cohere into holistic meanings.
3. *Alignment*: the image must be aligned in such a way that it reaches the eye of the viewer effectively.
4. *Proximity*: the space in the background of the sign should produce a maximum foregrounding effect on the relevant sign vehicles.

Overall, the results of efforts to standardize the meanings of hazard pictograms has had mixed results, as a relevant study by Boelhouwer and Davis (2010) has confirmed. The researchers used both word labels and visual pictograms in their

project, finding that the latter were not more effectual as danger signs than the word labels. They describe their project and results as follows:

> This preliminary investigation evaluates the impact of pictograms and signal words that would be present on chemical product labels following the modification of the Hazard Communication Standard by OSHA to incorporate the United Nation's Globally Harmonized System of Classification and Labelling of Chemicals (GHS). The GHS classification for a given hazard determines the hazard classification category (Category 1 or Category 2), if a pictogram and/or a signal word will be present on the label, and the hazard and precautionary statements that would appear on the label. Participants were able to refer to samples of chemical product labels to assist them in completing an on-line questionnaire. The hazard classification category and the presence of a signal word ("Danger" or "Warning") were significant with regard to the level of perceived risk by individuals, but there was no significant effect for pictograms on the sample chemical product labels.

The reason for this outcome does not lie in the visual nature of pictograms, but rather in the interpretive variability that they enfold. This problem merits further attention by nuclear semiotics today, since it suggests that humans process meaning in multimodal ways, that is, in terms of verbal and nonverbal blended systems, not in any monolithic way.

Visual Iconicity

The sense of fear and alarm that humans experience in the face of existential dangers, from floods to wars, has been a constant theme in pictorial art from prehistory to today. Its ability to induce an iconic presence in viewers that imparts the sense of danger holistically might reflect an innate tendency in humans. Research on children's drawings (for example, Krampen 1991; Goodman 2018) shows that children start representing their environment pictorially at about the same time that they utter their first words. If a drawing instrument is put into the child's hand, that child will almost instinctively use it to scribble—a skill that no one has imparted or transmitted to the child. As time passes, the scribbling becomes more and more controlled; geometrical shapes such as crude circles, crosses, and rectangles, at first produced accidentally, are repeated and gradually perfected. With parental prompting, the child may then label the shapes as "suns," "faces," etc.

The importance of visual iconicity as a primary mode of representing the world became a central topic within and outside semiotics in the mid-1960s, after the publication of Roland Barthes' article "Rhetoric of the Image" (1964),

which showed how images are coded at different levels of meaning. Shortly after, Rudolf Arnheim (1969) claimed that visuality was more important than verbality for grasping the meaning of our experiences of reality. However, despite the apparent primacy of visual iconicity, it is still subject to interpretive mechanisms and contextual factors. Psychological studies have constantly shown that the interpretation of images varies along cultural lines; and even within a specific culture the image itself is subject to various interpretations. When asked to visualize a triangle, for example, people living in cultures where classical Euclidean geometry is part of the school curriculum will come up with the equilateral triangle as the primary form, seeing other kinds of triangles—obtuse, acute, right-angled—as subtypes, that is, as deviations from the equilateral prototype (Rosch 1981). This has not been found in cultures that do not have historical traditions based on Euclidean geometry.

In the current digital age, simulated representational systems such as virtual reality (VR) environments have turned visual iconicity into a simulacrum modality. The term *virtual reality* was coined by artist and computer scientist Jaron Lanier in the late 1980s, referring to a computer-simulated, three-dimensional environment designed to activate the perception of being immersed in some real environment (vicariously). This is accomplished through special interface devices that transmit the sights, sounds, and sensations of the simulated world to the user, such as the head-mounted display (HMD). These also record and send the speech and movements of the participant to the simulation program, which provides appropriate realistic-seeming responses. In this way, subjects are projected into a virtual space where they can interact with simulated representations as if they occurred in actual physical space. This type of representational modality has many implications for nuclear semiotics. Lanier (2017), for instance, has suggested that VR has the capacity to engage and inspire more than any other kind of visual technology (such as video games), because it impels the user to focus on reality, rather than escape from it.

In actual fact, climate change scientists, activists, and digital artists have used VR to help inspire people to become aware of the climate crisis. For example, a research project by Stanford University's Virtual Human Interaction Lab found that if someone is immersed in a VR world and observes a tree being cut down, feeling the vibration and hearing the chainsaw and tree crashing to the ground, that person is more likely to conserve paper subsequently (Gorlick 2011). If this experiment is indeed generalizable, then it has enormous implications for changing minds. What separates VR from other visual iconic modes of representation are three factors: immersion, interactivity, and a heightened sense of presence. The former is the projecting of the viewer into an environment of danger, allowing the person to experience the danger as if it were real; interactivity implies that users can interact with the environment, given that they can smell, walk, touch, and feel the simulated

world; and presence is the actual sense that the experience is real, rather than simulated—it is a powerful form of iconic presence.

Because people may not have a concrete understanding of what climate change is, as do climate scientists, and thus what its tangible negative impacts might be, VR has the ability of immersing individuals in an environment where they can actually see and experience the impacts, reacting to them on a deeper emotional level. As mentioned, Stanford University emerged as a leader in this field of research, showing how VR might be effective at changing attitudes in its 2011 experiment. In a follow-up study, Ahn, Bailenson, and Park (2014) compared the effects on a group experiencing the cutting down of a tree via VR, against control groups exposed to either a verbal description of the same event or to a video presentation. Unknown to the participants, the researchers tested how many paper napkins each would use when a researcher "accidentally" spilled some water after the experiment. Those in the VR group picked up 20 percent fewer paper napkins to clean up the spill than those in the control groups—a finding that provided indirect support for the view that VR can actually influence real-world behaviors, since the VR group apparently had realized that the use of paper products adds to the crisis.

Another relevant project (Ahn et al. 2016) has suggested that immersive digital environments can stimulate a positive sense of connection with Nature, raising awareness that could potentially make humans more sensitive to the dangers of climate change. Specifically, the different experiments in the project aimed to determine if VR would get users to empathize with the experiences of animals in Nature. In one, the researchers used VR to get subjects to "enter the body" of a cow, crawling on hands and knees and stooping in a bovine way to eat and to drink water, just before they were prodded into a vehicle and transported to a slaughterhouse. Another experiment used VR to simulate coral dying in an acidifying ocean, with participants feeling the vibrations and hearing the cracking sounds as the coral's branches broke off. The researchers showed the same two scenarios on video to a control group. They found that the VR participants empathized with the scenarios more than the control group. Although the results were not as significant as the previous studies, they were nevertheless revelatory. The researchers explain their results as follows (Ahn et al. 2016: 399):

> Immersive virtual environments (IVEs) produce simulations that mimic unmediated sensory experiences. 3 experiments (N = 228) tested how different modalities increase environmental involvement by allowing users to inhabit the body of animals in IVEs or watch the experience on video. Embodying sensory-rich experiences of animals in IVEs led to greater feeling of embodiment, perception of being present in the virtual world, and interconnection between the self and nature compared to video. Heightened interconnection with nature elicited greater perceptions of

imminence of the environmental risk and involvement with nature, which persisted for 1 week. Although the effect sizes were small to moderate, findings suggest that embodied experiences in IVEs may be an effective tool to promote involvement with environmental issues.

Influenced and inspired by such results, there are now organizations and agencies that are using VR to help change attitudes with respect to climate change, producing VR simulations that allow people to take virtual journeys across the globe where climate change has impacted the environment negatively, including deforestation, wildfires, and famine. Projects have also been designed by NASA, public media outlets such as PBS, and various university laboratories such as the Stanford one above. As VR continues to advance, and costs of producing simulations decreases, this medium offers a powerful tool for engendering behavioral change. On the other hand, there are limits to VR technologies, since these risk turning the sense of danger into little more than a simulacrum itself. Whatever the ultimate outcome, the point here is that VR is something that is of relevance to the semiotic study of danger representation, since it has extended visual iconicity considerably as a mode of grasping dangers.

To support the use of VR to help solve climate change, a task force of the United Nations Environment Programme (UNEP) has identified four main reasons why it is potentially more effective than other modes of warning representation:

1. *Simulated Sense of Reality.* VR can show things in a realistic way that other representational systems cannot. For example, our carbon footprint is huge—six tons on average and up to around thirty in a developed country. But seeing numbers in themselves does not make us feel how significant they are. However, by being projected into a simulated environment where the effects of this footprint from pollution activities can be experienced via a simulacrum, the meaning of the numbers becomes more tangible.
2. *Captive Audience.* The immersion aspect of VR makes people experience the simulated environment as real, which may captivate audiences in ways that are more effective than other modes of representation.
3. *Sound.* The use of sound in VR heightens the simulacrum effect. A wildfire that is heard roaring is more effective than just a viewing of the wildfire on a video.
4. *Magic.* VR can convey to the user the sense of self-empowerment, which comes from influencing the course of events, as if by magic.

Interestingly, the United Nations Environment Programme (UNEP) is also recommending role-playing video games for raising awareness to the dangers posed by the climate crisis (Kwok 2019). These are designed to get players to engage in role-playing activities revolving around the protection of endangered species due to climate change. In a 2019 report, *Playing for the Planet*, UNEP claimed that video games are particularly useful because they could engage billions of people across the world; and even changing the attitudes of a small portion of that population could have a massive beneficial impact. UNEP has since formed an alliance with various game developers to harness the emotive power of gaming to encourage action on solving the climate change problem. An example of a game designed with this goal in mind is *Transformers: Earth Wars*, which actually came out a few years before the UNEP initiative. The game contains environmental themes in its storyline, including the search for new technologies to make Earth's energy resources sustainable. However, as in the case of VR, this overall approach raises several questions, as Kwok (2019: 7602) observes:

> Can such games, however well-intentioned, actually help people learn about climate change? Could they change the public's attitude toward the science and help illuminate the impact on people and ecosystems?

As in the domain of VR research, evidence exists that gaming can indeed stimulate awareness of existential dangers. Rooney-Varga et al. (2018) collated and analyzed responses to a survey they sent to over 2,000 gamers around the world, ranging from high-school students to business graduate students. The researchers found that, after playing an environmentally themed game, most of the participants reported increased feelings of urgency to do something about the danger of environmental changes caused by pollution, gaining a better grasp of how carbon dioxide builds up in the atmosphere via human activity. The researchers did not, however, follow up to determine if the participants had taken concrete action afterward. The question of whether climate change games can actually change behavior is still an open one.

Epilogue

In discussing the role of visual iconicity in his relay system, Sebeok (1984: 15) offers the following insight, which can be used to summarize the theme of this chapter:

> Images, such as drawings or photographs, are commonly utilized icons in our culture: there is an assumed isomorphism between the pictorial

> representation and the thing represented. An example is our Star Spangled Banner: what is iconic about the United States flag is the fact that each of the fifty white stars in a single blue canton "stands for" one of the fifty states in the present Union, whereas each of the fifty stripes "stands for" one of the Colonies that originally formed the Union. The important point here is that their iconic relations can be grasped only by those already informed of the code, or convention (viz., American history) being used. There are other aspects of our flag which are indexical and symbolic; the aspect that predominates is always a function of the context.

Despite built-in interpretive variability, Sebeok still opts for the use of visual iconic strategies for solving his problem, along with folkloric ones (as discussed in Chapter 3). Pictorial representations are certainly more meaning-retentive across time, attenuating the sclerotic decay of verbal communication over generations. This is why we can look at an example of ancient cave art and extract meaning from it with our modern eyes. We do not need a Rosetta Stone for achieving this. Visual portrayals of floods, disasters, and human suffering from the past are as understandable today as they were in the era in which they were realized.

The potency of visual art was discussed insightfully by the American philosopher Susanne Langer (1948, 1957). We do not experience art, she emphasized, as individual bits and pieces (sounds, shapes, words, etc.), but as a total emotional experience. It is only when we attempt to understand why the artwork had such a powerful aesthetic effect on us that the holistic experience can be taken apart discursively. But, no matter how many times we try to understand the experience logically, by talking about it, the feeling we get from the picture remains larger than the sum of the verbal structures used to describe it. As she put it (Langer 1953: 40): "Art is the creation of forms symbolic of feeling."

When faced with disasters and catastrophes, since antiquity artists (known and unknown) have provided concrete ways to warn us about them. Images of disaster, tragedy, and suffering are arguably more powerful than words. They are immediate, no matter how desensitized we might have become. Images of disaster and danger remain part of a universal iconic code of representation that is more culture-independent than language. While interpreting art may be somewhat variable, as Sebeok suspected, the variability is not as broad as it would be with language. The only verbal form that approaches the iconic power of visual art is poetry, as discussed in the previous chapter. The interconnection of the two is explicated eloquently by da Vinci (1651) as follows: "Painting is poetry which is seen and not heard, and poetry is a painting which is heard but not seen. These two arts, you may call them both either poetry or painting, have here interchanged the senses by which they penetrate to the intellect."

6

Narrative Warnings

Prologue

Sebeok's (1984) recommendation to employ folklore as a primary strategy for communicating danger to future generations was based on the premise that folkloric artifacts are more resistant to meaning decay than other semiotic elements. The proof he offered, which has been discussed in previous chapters, is the fact that ancient folkloric rituals, symbols, and myths are grasped to this day as having the same meanings and functions as they did in the era in which they were created, to varying degrees of interpretation. The ancient myths in particular still resonate with us today because they are likely implanted in the collective unconscious, which Jung (1972: 153) saw as accessible through mythology:

> The whole of mythology could be taken as a sort of projection of the collective unconscious. We can therefore study the collective unconscious in two ways, either in mythology or in the analysis of the individual.

Jung's observation is supported by the fact that the first myths of humanity emerged as the foundational historical narratives of cultures across the world—explaining their origins, encoding systems of ethics, portraying human character, etc. (Tylor 1871; Malinowski 1926). These remain understandable and meaningful to this day because they deal with the same problems we face today. Decoding them implies updating them. As Roland Barthes suggested, myth is in all our systems, constantly adapting and updating itself (Barthes 1957: 148):

> Statistically, myth is on the right. There, it is essential, well-fed, sleek, expensive, garrulous, it invents itself ceaselessly. It takes hold of everything, all aspects of the law, of morality, of aesthetics, of diplomacy, of household equipment, of literature, of entertainment.

The functions of the ancient geomyths (Chapter 2), for instance, migrated to the realm of prose fiction starting in the medieval era, when the same warnings about existential dangers were expressed in a different way by writers of fiction and delivered through writing. Today, the delivery channels involve all kinds of media (print, film, digital, etc.). But the danger themes remain implanted in the same mythological thought patterns, as Barthes suggested. Consider, as a case in point, the first scene of the science fiction movie *Mad Max: Fury Road* (2015), which shows the protagonist, Max, crushing a gecko lizard with his boot and then eating it. The image becomes even more horrendous as we see the gecko squirming and dangling from Max's mouth while he looks menacingly and darkly into the camera. The scene presages a hellish future world spinning into chaos and dystopia because of a growing scarcity of food and the prospect of a universal famine—a theme that is found throughout ancient mythologies. So, while the imagery used in the movie may be a contemporary one, its theme is virtually identical to that of the ancient myths, which also describe chaos, fear, and famine. The main difference lies in the fact that in antiquity famines were typically perceived as punishments from the gods meted out to warn humans of their iniquities and to teach them to be more judicious about their actions; in science fiction narratives, famines result from the exploitation of the Earth's resources and the "punishment" is a self-induced one. So, while the reasons for a famine may be different, the narrative treatment is identical in myth and science fiction.

The science fiction genre as an extension of myth is classified under the rubric of *mythopoetic*, a term introduced by J. R. R. Tolkien with his poem, *Mythopoeia*, defined as myth-making irrespective of era or narrative format. Apparently, Tolkien composed his poem in reaction to a dispute with the writer C. S. Lewis in 1931, who had claimed that myths were nothing more than lies. In his poem, Tolkien defended myths as products of a creative poetic art, which, like visual art, is designed to explain "fundamental things" holistically. Tolkien put it subsequently as follows (Tolkein 1936):

> The significance of a myth is not easily to be pinned on paper by analytical reasoning. It is at its best when it is presented by a poet who feels rather than makes explicit what his theme portends; who presents it incarnate in the world of history and geography, as our poet has done. Its defender is thus at a disadvantage: unless he is careful, and speaks in parables, he will kill what he is studying by vivisection, and he will be left with a formal or mechanical allegory, and what is more, probably with one that will not work. For myth is alive at once and in all its parts, and dies before it can be dissected.

An example of a mythopoetic theme which updates an ancient mythic one is that of the culture hero, who emerges in stories of survival to save humanity

from itself. In Native American mythologies, the culture hero is an animal, rather than a human. Some tell of a coyote spirit who stole fire from the gods, constituting a version of the Greek myth of Prometheus, who similarly stole fire from the gods. In science fiction, the culture hero trope is typically embodied by a valiant astronaut, who, either intentionally or by necessity, leads the way in building a new world in space, seeking strategies to ensure biological survival in inhospitable environments. In the movie *The Martian* (2015), for example, Watney, an astronaut stranded on Mars, must ensure three main elements for his survival—oxygen, water, and food. As a botanist, Watney improvises a makeshift greenhouse farm utilizing Martian soil fertilized with human waste and he produces water by extracting hydrogen from rocket fuel. Watney does indeed survive (until rescue comes) by using the powers of his intellect to cultivate food resourcefully—the hallmark of the culture hero.

Mythic Warnings

Interpreting ancient myths retrospectively is susceptible to the subjectivity of the interpreter. One way to make the interpretation more objective is to map the myths against other historical artifacts (symbols, rituals, etc.) and recorded events, extrapolating from this comparative analysis any relevant patterns by determining which characteristics of each are similar and which are different, and to what degree. This is the main method used in geomythology, as discussed, but it is also used more broadly in semiotics.

Examining how the oral myths were eventually written down comparatively, as for example the Homeric poems and those of Hesiod around the eight century BCE, provides potential insights into how the original myths were interpreted in antiquity and what cultural functions they had. Homer's *Iliad* and *The Odyssey*, for example, recount events that corresponded to historical events in the late Bronze Age, many of which were connected with wars and human destructiveness; Hesiod's *Theogony* provides a genealogy of the gods for the first time in Greek history as a means to also explicate human actions that are comparable to those described in the Homeric narratives, including those that brought about dangerous predicaments. This simple comparison furnishes relevant insights into how the different mythical narratives documented the same things in similar narrative ways. The mythic accounts were also represented in art, as can be seen in public buildings such as the Parthenon at Athens, the Temple of Zeus at Olympia, and the Temple of Apollo at Delphi, which were adorned with sculptures representing scenes from mythology. In the fifth century BCE, the same mythological system came to be represented in the new format of theatre, as can be seen in the plays of Aeschylus, Sophocles, and Euripides.

Most of the mythic stories were essentially cautionary warnings, as discussed. Some of these focused on the dangers of human vices, such as greed and vanity. For instance, the story of King Midas tells of a ruler who was granted his wish that everything he touched be turned to gold. When he discovered that this included food and drink, his vanity almost resulted in bringing about his death from starvation. The myth of Narcissus also dealt with the dangers of vanity, recounting the story of a handsome youth who fell in love with his own reflection, losing the will to live in the process. The myth of King Croesus, who lost his kingdom to Persia, warned that vast riches cannot ensure happiness or even constancy in one's life. The repertoire of cautionary tales is extensive. The point here is that such tales reveal similar patterns of narrative representation that have been continued through the mythopoetic channel of today. Jung claimed that these were present in the brain before consciousness developed, remaining an inherited trait that motivates behavior and thinking. The link between myths and archetypes is elaborated by Jung (1934: 42–3) as follows:

> The concept of the archetype, which is an indispensable correlate of the idea of the collective unconscious, indicates the existence of definite forms in the psyche which seem to be present always and everywhere. Mythological research calls them "motifs;" in the psychology of primitives they correspond to Levy-Bruhl's concept of "representations collectives," and in the field of comparative religion they have been defined by Hubert and Mauss as "categories of the imagination." My thesis, then, is as follows: In addition to our immediate consciousness, which is of a thoroughly personal nature and which we believe to be the only empirical psyche (even if we tack on the personal unconscious as an appendix), there exists a second psychic system of a collective, universal, and impersonal nature which is identical in all individuals.

A common archetypal theme of the ancient myths is that of the culture hero, as mentioned. One of the most famous manifestations of this motif is in the legend of a Great Flood in the *Epic of Gilgamesh,* told via a series of narrative poems written in the ancient Akkadian language in the second millennium BCE. The protagonist, Gilgamesh, was the likely eponym of the historical ruler of the Sumerian city of Uruk. There are five surviving poems. One of these is a flood myth, which may have been added to the *Epic* from a much older Sumerian tale (Tigay 1982). It recounts Gilgamesh's journey to meet the culture hero, Utnapishtim, after the god Enlil decides to destroy the world with a flood because humans had become too careless and wasteful. The god Ea, who had created humans out of clay, had secretly warned Utnapishtim of the impending flood, giving him detailed instructions for

building a boat so that many may survive. The parallels between this tale and others, such as the Noah's Ark story and the flood tale recounted by Plato in the *Timaeus* (*c.* 360 BCE), suggest that humans have always grasped the dangers of the same natural disasters in similar ways, etching them into mythical accounts that paralleled the pictorial warnings that they also created (Chapter 5). In Plato's story, humans had so angered Zeus with their constant wars and conflicts that the god decided to punish them with a great flood. In the story of Prometheus' son, Deucalion was the culture hero, advised by Zeus to build an ark in order to save himself and his wife Pyrrha, who at the same time threw stones over their shoulders, which turned into humans to repopulate the world. In a Zoroastrian myth, the evil spirit Ahriman attempts to destroy the world with a drought, which the hero Mithra—the god of light and goodness—thwarts by shooting an arrow into a rock, from which a flood springs, allowing one man and his family to survive in an ark with his cattle, thus continuing humanity.

There are five common thematic elements that can be extrapolated by examining and comparing the ancient flood myths across the world:

1. There is a great flood, caused by some divinity as a warning.
2. It is perceived by people as an act of divine punishment for humanity's reckless actions or wicked behaviors.
3. Complete destruction is thwarted by a culture hero or some other heroic figure.
4. Survival is ensured (in many of the myths) by building an ark—a vessel that serves as protection against extinction.
5. The flood itself is portrayed as a metaphor of cleansing, and the ark a vessel of rebirth.

As discussed, the approach called geomythology sees these myths as stories of real flood events expressed in mythic-poetic language. As Piccardi and Masse (2007: vii) remark:

> Geomythology indicates every case in which the origin of myths and legends can be shown to contain references to geological phenomena and aspects, in a broad sense including astronomical ones (comets, eclipses, meteor impacts, etc.). As indicated by Vitaliano (1973) "primarily, there are two kinds of geologic folklore, that in which some geologic feature or the occurrence of some geologic phenomenon has inspired a folklore explanation, and that which is the garbled explanation of some actual geologic event, usually a natural catastrophe."

Research conducted by Australian geologist Patrick Nunn (2004) among traditional tribal cultures on several Fijian islands is an example of how the geomythical approach can produce tangible results. Nunn interpreted the story of Tanovo, the ancient chief of the island of Ono, as a tale explaining how a volcanic eruption created the Fijian archipelago. One day Tanovo came across his main rival, the volcano god Nabukelevu. To intimidate him, the chief made Nabukelevu erupt and belch lava and rock into the air. Tanovo had brought massive baskets with him to catch the debris, allowing him to throw it into the ocean. From this, the islands were formed. Nunn realized that this story coincided with the geological account of an ancient eruption in time and in location. Pressure from magma can make a volcano expand in size before the release of gas and ash. It was always suspected by geologists that the small islands around Fiji were created by volcanic rubble, and Nunn was the first to show this as verifiable, by reading between the lines of the Tanovo myth.

Studying the ancient myths has even revealed many previously unknown geohazards. For instance, according to several legends of the Duwamish people, a Native American society in Washington State, large boulders along the shores of the Puget Sound, the Strait of Juan de Fuca, and areas around the city of Seattle are haunted by A'yahos—dangerous spirits with the body of a snake and the head and forelegs of a deer. Young hunters had always been warned by tribal elders not to enter an A'yahos' dwelling place, since this would shake the earth and sea, generating large waves and throwing large boulders around. Had people actually paid attention to the stories, the real earthquake dangers that have plagued the region might have been known earlier. Geological evidence and archaeological site-dating have provided compelling evidence that strong earthquakes and tsunamis in the region do indeed go back to the period in which the A'yahos story emerged.

Overall, the ancient warning myths constitute a Sebeokian relay system. Sebeok (1984: 22–3) offered a relevant observation on Pandora's Box that is worth repeating here:

> The opening sentence of Harrison's classic survey of *Pandora's Box* on the changing aspects of this celebrated mythical symbol, begins: "There is a strange fascination about a mythological character that has retained its vitality up to our own day." This familiar myth—which occurs in endless verbal and pictorial variants since Hesiod's famous account of the Pandora story in his *Works and Days* (Panofsky 1962)—deals with the first woman, the beautiful mischief, who opens a forbidden box, out of which comes every evil the flesh is heir to. Pandora and her proverbial box (or jar, or cask, or vase) appears as an emblem of misery and destruction.

In a common version of the tale, Pandora was sent to Earth by Zeus after Prometheus had stolen fire from the gods to give to humankind. Pandora was given a box (or a vase in some versions) to take to Earth, which contained all the evils that have come to characterize the human condition (war, disease, poverty, etc.), but was told not to open it. But curiosity overtook her, and she opened it, releasing innumerable plagues and sorrows into the world. Only Hope, the one good thing the box had contained, remained to comfort humanity in its misfortunes.

Mythic thinking, as Barthes maintained, has hardly disappeared. It is often revived or reimagined to explain current existential dangers, as the COVID-19 pandemic made saliently obvious. Almost from its first appearance in late 2019, it became mythologized as a plague. And perhaps like the ancient myths, the new ones may have been nothing more than coping mechanisms at the level of what the late literary critic Northrop Frye called "individualized myth" (Frye 2002: 716), that is, myth that serves subjective needs.

Fictional Warnings

As discussed in Chapter 2, prose fiction emerged during the bubonic plague, called the Black Death, in the medieval era, with Giovanni Boccaccio's *Decameron* constituting a literary response to it. Literary historians see this work as the first one that can be labeled as fiction, in the modern-day sense of the term, rather than a mythic, poetic, or theatrical example of writing. It is a collection of 100 novellas from which one can glean concrete insights into life during the Black Death, and how people reacted to it, psychologically and socially. Boccaccio actually started his book with a graphic depiction of the effects of the plague, from which some of Boccaccio's own family members died, descrying how the rich were able to seclude themselves at home, enjoying quality wines, music, and other forms of entertainment, while the poor lived in dire conditions. The wealthiest of the wealthy, which he depicted as "ruthless," deserted their city homes in Florence altogether, retreating to comfortable estates in the countryside, "as though the plague was meant to harry only those remaining within their city walls, while the poor were forced to stay at home, dying in droves every day." After this gloomy preface, Boccaccio presents 100 stories, narrated by ten fictional nobles who had fled Florence to their amply stocked country mansions. The stories reveal characters who are indifferent to the pain of others, blinded by their own ambition and quest to survive at any cost.

Boccaccio's book was the start of what can be called "plague fiction." A subsequent example of this genre is Daniel Defoe's 1722 book, *Journal of the Plague Year*, designed as a fictional "eyewitness" account of a man's

observations of the devastations caused by the bubonic plague when it hit the city of London in the year 1665, known there as the Great Plague of London. The book was published under the initials H. F., since Defoe likely based his own narrative on the actual journals of his uncle, Henry Foe, who lived in London during the plague. The style of Defoe's account is verisimilar to that of an actual diary or journal, depicting neighborhoods and houses in which the events connected to the plague actually took place. Defoe also included statistical tables of casualty figures, purported oral witness testimony, mortality bills, mayoral proclamations, and excerpts from the medical literature of the era to make his work even more realistic, drawing special attention to the dangers of crowded living conditions and how the plague spread so easily under such conditions.

Defoe also described the panic that people experienced, as they tried to come to grips with the disease and how it came into their lives, as well as satirizing the many fake cures and quack practitioners who cropped up during the plague for financial self-interest. Defoe's book is a narrative portrait of the plague and its emotional and social effects on those living in London. At one point H. F. describes a lockdown ordered by the mayor of London, who put guards outside house doors to ensure that people remained inside, as well as running errands for the residents (getting food, medicines, etc.). But the guardsmen were often bribed and even murdered. H. F. became appalled by this kind of dangerous behavior and the inanity of people who simply went on with their lives, ignoring the danger, drinking, and mocking anyone who objected to their careless and heedless behavior. In one incident, H. F. confronted a group of rowdies, who reviled him abusively, which led him to excoriate them with: "Why are some people so wicked that they deliberately infect others?"

Defoe's book contributed significantly to debates about public health at the time. But it also had a negative side to it, since it assigned indirect blame for the plague to another nation, France, claiming that it reached England via the French port at Marseilles. It is truly remarkable to observe similar echoes of blame in stories, newscasts, and headlines related to subsequent pandemics. Defoe's recounting of the sham cures, such as the "antipestilential pills" and "incomparable drinks," which were being recommended against the plague, is also a prophetic observation. Also striking are the fringe therapeutic theories that H. F. describes as being bandied about , which made it much more difficult for the physicians to enact real therapeutic measures. For all his uncertainties, H. F. is convinced of one thing, as was Boccaccio before him—the plague affected the poor disproportionately, because they lived in crowded, unsanitary conditions, and were more susceptible to taking bad advice. At the start of the outbreak in 1665, those with money fled London in droves, also recalling Boccaccio's account.

A modern-day example of plague fiction is Albert Camus' *The Plague* (1947), which tells the story of Dr. Bernard Rieux and his efforts to help people survive in the city of Oran, Algeria, where several cases of the plague had been recorded. At first, the government wanted to hide the disease from the population, but the news nevertheless got out to the citizens. Oran is thus put into quarantine for months, with the army surrounding the entire city, blocking anyone from entering or leaving it. Rieux reflects on the quiet bravery of medical workers, who put their own lives at risk to help others, constituting ipso facto culture heroes. Camus' novel suggests that the same empathy should be shown by everyone, thus conquering ignorance (Camus 1947: 119):

> The evil that is in the world always comes of ignorance, and good intentions may do as much harm as malevolence, if they lack understanding. On the whole men are more good than bad; that, however, isn't the real point. But they are more or less ignorant, and it is this that we call vice or virtue; the most incorrigible vice being that of an ignorance which fancies it knows everything and therefore claims for itself the right to kill. There can be no true goodness, nor true love, without the utmost clear-sightedness.

The Spanish Flu pandemic of 1918 was the inspiration of a host of important narrative works. One is the novella *Pale Horse, Pale Rider* (1939), by Katherine Anne Porter, which centers around the relationship of a journalist, Miranda, and Adam, a soldier during the Spanish Flu pandemic. In the story, Miranda becomes sick and delirious, but eventually recovers, only to discover that Adam had died of the disease, as a result of tending to her. The title of the novella has apocalyptic overtones, taken from an African-American spiritual, which begins "Pale horse, pale rider, done took my lover away," itself based on Revelation 6:1–8, which tells of the Four Horsemen of the Apocalypse with the Conqueror on a white horse, War on a red horse, Famine on a black horse, and Death on a pale horse. When Miranda awakens after weeks of fever and medicines, not only does she find that her lover is gone, taken away by Death, but that a new world had come into existence, re-shaped by the flu and World War I. Porter's trilogy is a cautionary warning tale in contemporary garb—with the moral subtext that people must stop hating each other, otherwise calamities will ensue.

Margaret Atwood's *The Year of the Flood* (2009) is another example of modern plague literature, depicting a post-apocalyptic world in which humanity has been almost wiped out by a "waterless flood," that "travelled through the air as if on wings, [burning] through cities like fire." Toby, one of the few survivors, lives on a rooftop garden, scraping by every day to stay alive as best she can. The apocalypse came about from the dangerous use of bio-engineering sponsored by mega-corporations. What makes this novel

somewhat different from previous plague novels is that it lacks recognizable (culture) heroes and villains. Each character has an equal chance to be heroic. If there is a villain, it is technology itself that is used for self-serving avaricious objectives.

Environmental Cinema

The disaster narrative migrated to the screen early in the history of cinema (Keane 2006), starting with the silent film *Fire!* (1901) directed by James Williamson, which depicts the horror associated with a burning house and the bravery of the firefighters who rescue the inhabitants. Disaster movies became popular throughout the golden era of movies, including films such as *Atlantis* (1913), about the sinking of the Titanic, *Noah's Ark* (1928), whose title is self explanatory, *Deluge* (1933), about a massive earthquake that strikes the United States, unleashing a massive flood that threatens to destroy many parts of the country, and *The Hurricane* (1937), about a tropical cyclone devastating a fictional South Pacific island. Films of the 1950s and 1960s started focusing on the fears that had emerged in the Atomic Age, as the era is sometimes called, with movies such as *When Worlds Collide* (1951), *The Day the Earth Caught Fire* (1961), and *Crack in the World* (1965). By the 1970s, films began dealing more and more with the theme of environmental disasters and existential dangers caused by deleterious human impacts on the environment, leading to a rise of genre that can be called environmental cinema.

The number of films in this genre spiraled in subsequent decades. Two examples of particular relevance are the 1982 film *Koyaanisqatsi*, directed by Godfrey Reggio, and the 2019 movie *Dark Waters*, directed by Todd Haynes. The former has no distinctive characters, plot, dialogue, or commentary—it is not recognizable as a traditional filmic narrative. It presents dissonant, incongruous images of cars on freeways, atomic blasts, litter on urban streets, people shopping aimlessly in malls, deteriorating housing complexes, buildings being demolished, and long lines of countless automobiles on freeways speeding everywhere and nowhere. To reinforce the insanity of this urban landscape, Reggio incorporates the minimalist music of Philip Glass, which acts as an interpretive guide to the images. The slow rhythms are heavy and tiresome, while the fast tempi—which accompany a demented chorus of singers chanting in the background—turn an unconscious sense of danger on.

The whole film can be conceived as a musical sonata with an opening exposition, a middle developmental section, and a final recapitulation, ending with a coda. The exposition presents a picture of a vastly different world—the world of the Hopi, whose lifestyle is firmly implanted in a holistic view of existence, a view that does not separate humans from Nature (Chapter 5). The

music here is sacred in texture, reflecting the Hopi worldview; it is sung by a choir as if it were in a resounding cathedral. It stands in dark contrast to the development of the filmic sonata—a mélange of dissonant images of a decaying, senseless, industrialized, urban world, accompanied by melodies and rhythms that reflect the chaos on screen. Then we are taken back, at the recapitulation, to the opening haunting strains of the choir followed by a warning in the coda, which is projected onto the screen—the only time that written text is used:

Koyaanisqatsi (from the Hopi language):

1. Crazy life
2. Life in turmoil
3. Life out of balance
4. Life disintegrating
5. A state of life that calls for another way of living

Reggio explained the lack of dialogue as motivated by his belief that contemporary language itself was in a similar chaotic state, reflecting the chaos of the world. The Hopi-language word, *koyaanisqatsi*, is the only one that has the ability to describe the world in which we live. In Glass' score, the word is chanted at the beginning and end of the film by a dark, foreboding basso profondo over a solemn organ passacaglia bassline. Three Hopi prophecies sung by a choral ensemble during the recapitulation are translated prior to the end credits:

1 "If we dig precious things from the land, we will invite disaster."

2 "Near the day of Purification, there will be cobwebs spun back and forth in the sky."

3 "A container of ashes might one day be thrown from the sky, which could burn the land and boil the oceans."

The film is the first in a trilogy: It was followed by *Powaqqatsi* (1988) and *Naqoyqatsi* (2002), each depicting different perspectives of the relationship between humans, Nature, and technology, with *powaqqatsi* meaning "parasitic life," and *naqoyqatsi* "civilized violence, life as war." The former focused on the destruction of traditional ways of life brought about by industrial modernity. *Naqoyqatsi* reprises the theme and style of *Koyaanisqatsi*, updating its imagery. With Glass' music, this last entry of the *qatsi* trilogy itself completes the overall musical structure of the films, based on sonata form, with *Koyaanisqatsi* forming the overall exposition, *Powaqqatsi* the development, and *Naqoyqatsi* the recapitulation.

The trilogy warns us about the dangers that the natural ecology faces because of rampant industrialization and technologization; this is in contrast to the sacred world of the Hopi, which continues to be respectful of Nature. A written treatise or a video documentary on this theme would hardly be as effective in emphasizing how much modernity has grown dangerously apart from Nature. *Koyaanisqatsi* reached large audiences when it first came out, tapping into a growing sense of a need to change course in the progress of modernity. The film was selected in 2000 for preservation in the US National Film Registry by the Library of Congress for being "culturally, aesthetically, or historically significant." Films emulating the original movie followed, including *Baraka* (1992), but have not been as successful or impactful.

The environmental cinema genre, like the mythic tales, often revolves around the exploits of a culture hero, who is portrayed as fighting against some chemical or energy company that is involved in contaminating the environment and causing harm to citizens. One of the classic films in this category is *Erin Brockovich* (2000)—a biographical legal drama film directed by Steven Soderbergh, which dramatizes the true story of Erin Brockovich, who became famous as an environmental activist, after fighting the Pacific Gas and Electric Company over a real groundwater contamination incident. Brockovich was a low-paid legal assistant in a California law firm, who was examining some paperwork related to real estate cases, when she noticed disturbing medical records. After investigating the cases, she discovered that the sick people lived on land filled with chromium contamination dumped there by Pacific Gas and Electric. She succeeds in making her boss take on a legal case with her against the company, even if it entails having to make great sacrifices in their lives. In the end, her bond with the victims and the legal case she effected laid the groundwork for the victims being reimbursed financially by the company, which had to admit culpability.

A later film in the same category is *Dark Waters* (2019), also based on a true event and revolving around the efforts of a culture-hero lawyer, Robert Bilott, and his justice campaign against the DuPont chemical company, which had contaminated a small town in West Virginia by dumping unregulated perfluorooctanoic acid (PFOA) into its water supply. After uncovering the pollution, Bilott takes the corporation to court, arguing that the amount of PFOA in the water was higher than was deemed safe by DuPont's own internal documents. In court, DuPont claims that the West Virginia Department of Environmental Protection had determined that the level of PFOA was safe. As a result, a scientific panel is set up to study the effects of PFOA, based on blood samples of those exposed to it. Bilott urges the local residents to donate their blood for the study, which they do willingly. Seven years pass with no results. Bilott becomes destitute, suffering a stress-induced ischemia. When the scientific panel finally concludes its findings, it contacts Bilott informing

him that PFOA was indeed linked to cancers and other diseases. The lawyer bravely decides to take each case to court, eventually winning major financial settlements for the victims against DuPont. The result was the breakup of the original DuPont company organization; but the film also raised viewers' awareness level of chemical pollution and the dangers it poses to everyone.

Perhaps the movie that started the environmental cinema genre in the early 1970s is *Soylent Green* (1973), which is scripted as a mystery story. In a densely overpopulated, famished New York City of the future, the culture hero in this case is detective Robert Thorn, who investigates the murder of Solomon Roth, an executive at a rations manufacturer owned by the Soylent Corporation. Roth had been killed in a mysterious fashion, after he gave an oceanographic report to the authorities, in which he claimed that the oceans no longer produced the plankton needed to manufacture "Soylent Green," the wafer advertised by the company as containing high-energy plankton from the oceans, a wafer that was nutritious and palatable, but in short supply. The report disclosed that the wafer was made from human remains, the only possible supply of protein available, given the vanishing of plankton from the oceans due to pollution. The film puts forth a worrying vision of an overpopulated and increasingly polluted world struggling to cope with emerging problems such as the hunger of the masses. It is a profoundly upsetting cautionary tale depicting a plight that is as emotively putrid as the green color of the Soylent product.

The large number of environmental movies that have been produced since 2000 reveal the extent to which environmental crises now trouble people's conscience. A few are listed below as illustrative cases in point:

1. *Beasts of the Southern Wild* (2012), directed by Benh Zeitlin, highlights the plight of children who have to cope with environmental disasters beyond their control. In a Louisiana bayou community called "the Bathtub," we see a six-year-old girl, called Hushpuppy, who, after a class at school one day, cannot get the image out of her mind of the prehistoric aurochs that her teacher tells her will be released from melting ice caps. The Bathtub was fashioned on the model of real fishing villages in the Terrebonne Parish of Southern Louisiana—isolated wetland communities that are threatened by extreme weather and rising sea levels. At the end, Hushpuppy and her friends confront the aurochs. As the aurochs leave, she says her last goodbyes to her dying father, listening to his last heartbeat. She then lights his funeral pyre, standing together with the remaining residents of the Bathtub, in an image of desperation and solitude, as the promethean fire burns away.

2 *Snowpiercer* (2013), directed by Bong Joon-ho, is about a failed geoengineering experiment to combat climate change, which ended up killing life, except for a few surviving humans who boarded a so-called snowpiercer train, a perpetual motion machine that circles the Earth on a constant loop. As the train goes round and round, a tyrannical class system has evolved onboard. The scene is reminiscent of the brutal social order in the *Lord of the Flies*, where a few of the inhabitants take over, threatening the others to obey their desires. This leads to the formation of a clique of rebels, who find out that the protein jelly-like slices they were fed were made of ground-up cockroaches—a rather fitting metaphor of desperation and survival, given that cockroaches may well be the oldest living species on Earth and able to survive in any environment. At the end, an explosion causes an avalanche that derails the train. Shortly after, two protagonists escape the wreckage, and see a polar bear in the distance, informing them that life exists outside the train—a symbol of hope, especially given that it is one of the most threatened species of Earth because of climate change.

3 *Interstellar* (2014), directed by Christopher Nolan, presents a frightening vision of the future, after the impacts of climate change have brought about global food shortages. A brilliant NASA physicist works on plans to transport Earth's population to a new planet via a wormhole. But first, a NASA pilot is tasked with leading a mission to find a habitable planet in another galaxy. The result is catastrophic for the astronaut hero, as the movie ends with his ejecting into a wormhole where he disappears—an image suggesting that the same will happen to everyone.

As was the case with VR and video games (Chapter 5), the question becomes whether such movies, as interesting and aesthetically effective as they seem to be, actually lead to modified behaviors in viewers, impelling them to actively seek changes that will curtail the effects of climate change. Does a movie like *The Day After Tomorrow* (2004), for instance, which shows a catastrophic transformation of the Earth's climate into a new ice age, actually motivate viewers to change their wasteful habits or to engage in some form of climate activism? A study by Lowe et al. (2006) showed that this particular film actually had such an impact on filmgoers in the UK, at least in the short term: "Following the film, many viewers expressed strong motivation to act on climate change;" but this apparent resolve evanesced quickly thereafter because "the public does not have information on what action they can take to mitigate climate change" (Lowe et al. 2004: 435). It also may be the case that the barrage of environmental movies may be desensitizing people to the

actual dangers of climate change (Griffin 2017). Whatever the truth, the point here is that in modernity, the cinema has become a major source for creating and delivering warning messages to contemporary audiences.

False Myths

Even though we live in an age of science, myth as a mode of understanding has hardly disappeared (as discussed throughout this book). As Roland Barthes cogently argued (1957), it is an unconscious factor in the creation of contemporary narratives, such as those appearing in science fiction. The major function of myth is to "naturalize" a mode of thought or belief. It is thus important to differentiate modern myths from the original myths, which emerged as a means to understand real events (before the advent of science), as the work in geomythology has revealed. The modern ones fall into two categories: (a) those that recycle ancient mythologies, such as science fiction narratives (which are mythopoetic), and (b) narratives that surface to provide false interpretations of existential dangers for particular reasons. Defoe's description of the phony cures for the plague (above) is an example prefiguring the latter type of mythology. For the present purposes, therefore, a false myth can be characterized as a contrary-to-science narrative. The main manifestation of this type of mythology today is the conspiracy theory—a narrative that ascribes some existential danger, such as climate change, to the machinations of covert but influential groups (including scientists) behind the social scenes.

An example of an early conspiracy theory about COVID-19 was that it was a hoax perpetrated by some purported behind-the-scenes cabal. As a result, those who subscribed to the theory reacted by ignoring the public health recommendations to wear masks, which were recommended as prophylactic devices against the spread of the disease. Another example involves the rejection of food aid in Zambia during a famine, because of the spread of a conspiracy theory that convinced the country's government that the food had been genetically modified on purpose for nefarious ends.

A major goal of nuclear semiotics would be to confront these false narratives by demystifying them with the tools of semiotic analysis, exposing them as "pathological social myths," as Northrop Frye characterized them (2002). This would imply identifying the subconscious mechanisms that undergird conspiratorial narratives (Leone, Madisson, and Ventsel 2020; Madisson and Ventsel 2021), comparing them to, and differentiating them from, the original warning myths. This includes the following:

1. Deconstructing the metaphors used in the construction of conspiracy theories (CTs) will normally reveal underlying ideological, subjective, or

sociological motives. So, when a CT explains a pandemic as a *weapon*, this metaphor provides the key to exposing the CT as a politically motivated mythology. This analytical approach is based on the metaphoricity principle (Chapter 4).

2 CTs do not portray pandemics as random, but as orchestrated, doing so by misrepresenting scientific discourses as self-serving to the scientists themselves. The goal here is to show how the misrepresentation is built on fallacious discourse (Chapter 4).

3 CTs play on the good-versus-evil dichotomy in human understanding. Grasping how this type of binary logic operates to shape beliefs is of primary importance in any semiotic demystification of CTs.

4 CTs claim to uncover how dangerous events are linked, involving secret, shadowy cabals (the linkages are construed as more believable if they are not obvious). The deconstruction process involves identifying the emotivity effects of specific word labels and discourse structures (as discussed previously).

5 CTs tend to interpret any contrary evidence as confirming it (known as confirmation bias). When a disagreement vis-à-vis the same evidence between those who believe a CT and those who do not becomes extreme, the false belief is actually reinforced in the minds of the believers. Using discourse and metaphorical analysis will, again, allow for an understanding of the contrasting viewpoints.

6 The links that CTs create are the threads that hold the narrative together conceptually; if any of these is disconnected the whole narrative will fall apart.

The last point was the target of a relevant study by Tangherini et al. (2020), which looked at how CTs emerge online, using a combination of artificial intelligence and folklore analysis to investigate how unrelated facts and false information can be linked cohesively into a narrative framework that would, however, fall apart if some of its inner elements are taken out. The researchers examined the spread of news about the 2013 "Bridgegate" scandal in New Jersey and the spread of a CT in 2016, known as "Pizzagate," about a Washington, D. C., pizza eatery—called the Comet Ping Pong Pizzeria—that was claimed to be the hub of a child sex-trafficking ring involving prominent Democratic Party officials. The researchers used machine learning software to analyze the CT that spread online, which allowed them to identify the people, places, events, organizations, themes, etc. in the CT. The researchers found that the CT itself emerged from the connections that are forged conceptually among thematic elements embedded in key words and phrases, which act as

the threads holding the misinformation together. The researchers claimed that a CT is easily debunked if any of these threads within it are disconnected. The Pizzagate CT arose from a manipulative interpretation of hacked emails released in 2016 by Wikileaks. Analyzing nearly 18,000 posts from April 2016 through February 2018 from social media sites, Tangherini et al. were able to unravel layers of false threads that would come untangled if the Wikileaks component were removed from the narrative.

The urgency of unraveling the layers of CTs, using basic semiotic techniques as discussed above, is of primary relevance today, given the threat that such CTs pose in fostering aberrant behaviors. A citizen actually went to the Washington pizzeria with a revolver and a rifle looking for supposed enclaves hiding victims of sex trafficking. In courtroom testimony, the gunman claimed that he had read about the CT online, watching videos about it, which spurred him to go and investigate the matter himself, with the intent of rescuing the children from harm. Incredibly, this was not the only abnormal response that the Pizzagate CT triggered. In January 2017, a man from Shreveport, Louisiana, pleaded guilty to making a threatening phone call to Besta Pizza, another pizzeria on the same block as Comet Ping Pong, three days after the previous attack. He had threatened to "save the kids" and "finish what the other guy didn't." In January 2019, Comet Ping Pong suffered an arson attack that was also described as "finishing the job." In 2020, posts on social media platforms with the #PizzaGate hashtag were viewed more than 82 million times according to various media reports, and Google searches for the CT increased in that same period of time. So, while CTs might be exposed as false, it seems that once they have become part of belief systems, it is almost impossible to eradicate them from people's minds (as already discussed), creating a "conspiracy effect."

A research study by Van der Linden (2015) has lent substance to the validity of the conspiracy effect notion. The 316 participants in the study were randomly assigned to one of three groups: (a) those who were shown a brief conspiracy video about global warming; (b) those shown an inspirational pro-climate video; and (c) a control group. The results indicated that those participants who were exposed to the conspiracy video were "significantly less likely to think that there is widespread scientific agreement on human-caused climate change, less likely to sign a petition to help reduce global warming, and less likely to donate or volunteer for a charity in the next six months" (Linden 2015: 171). The overall implication of the study is that "exposure to popular conspiracy theories can have negative and undesirable societal consequences."

As Silvestri (2018) has argued, false myths may be reshaping memory as a "connective" process rather than a "collective" one. He (2018: 3997) goes on to claim that memes, such as those that reinforce CTs, have the ability to

influence "not only the content of public memory but also the attitudes with which we remember that content." In effect, social media systems facilitate affective-emotive communication allowing people to share immediate feelings and reactions—a situation which has led to a "culture of instantaneity" that has put pressure on people to participate in ongoing Internet memetics because they allow people to be participants in a kind of ersatz secret mission to understand the world.

Epilogue

As Sebeok understood, the effective communication of danger involves folkloric ideas harnessed to make sense in the present. Echoing Herder (1770), Tylor (1871), and Frazer (1894), Sebeok realized that the power of folk myths lies in the ways in which they speak a common (archetypal) language that resonates unconsciously to this day (Liszka 1989; Graf 1996). As Vladimir Propp (1928) argued, the power of myth comes in fact from its archetypal structure, with recurring characters (such as culture heroes) and plots that are based on metaphorical image schemas (journeys, war, and so on).

One of the first warning myths is the story of Pandora's Box, as Sebeok (1984) perceptively realized. The myth is linked to the story of Prometheus as recounted by Hesiod. It is worth reiterating here in schematic form by way of conclusion to this chapter, since it illustrates how narrative warnings emerged in the mythic imagination. Prometheus and his brother, Epimetheus, were given the task of creating humans and animals, providing them with the endowments they would need to survive. Epimetheus gave the gifts of courage, strength, swiftness, and feathers, fur, and other protective coverings to the animals. Prometheus fashioned humans as different from all other animals, enabling them to walk upright. After he went to Olympus and stole fire from the gods to give to his newly created beings, he incurred the wrath of Zeus, who then had Prometheus chained to a rock, where he was constantly preyed upon by an eagle. Zeus then sent Pandora to Earth with a box (or jar), warning her to keep it locked. But she opened it nonetheless, unleashing sickness, death, and other evils into the world. But the box also contained Hope, which was how humans could cope with the evils.

This same mythic Hope resurfaced in the context of the COVID-19 pandemic—concretely as the hope of finding a vaccine to "vanquish" the evil predator. Vaccines were announced towards the end of 2020, and the sense of a "new day" emerged from the danger that the coronavirus had instilled throughout the world. In effect, during the pandemic Hope helped people navigate emotionally towards that new day, defeating yet another apocalypse.

On the other hand, the Hope in Pandora's jar may itself be a curse—an angle on the story taken by Friedrich Nietzsche (1878: 498), who characterized Hope as the most evil of all Pandora's evils, because it prolongs humanity's senseless search for meaning:

> Hope. Pandora brought the jar with the evils and opened it. It was the gods' gift to man, on the outside a beautiful, enticing gift, called the "lucky jar." Then all the evils, those lively, winged beings, flew out of it. Since that time, they roam around and do harm to men by day and night. One single evil had not yet slipped out of the jar. As Zeus had wished, Pandora slammed the top down and it remained inside. So now man has the lucky jar in his house forever and thinks the world of the treasure. It is at his service; he reaches for it when he fancies it. For he does not know that the jar which Pandora brought was the jar of evils, and he takes the remaining evil for the greatest worldly good—it is hope, for Zeus did not want man to throw his life away, no matter how much the other evils might torment him, but rather to go on letting himself be tormented anew. To that end, he gives man hope. In truth, it is the most evil of evils because it prolongs man's torment.

The mythic-folkloric modes of expressing Hope in the face of existential dangers have been largely transferred to narrative fiction, as discussed in this chapter. Along with visual art and poetry, narrative artifacts have provided, and continue to provide, a means to understand and deal with these dangers. Without them, we would hardly grasp them in "hopeful" ways.

7

Understanding Danger

Prologue

In the course of a cleanup operation in 2004 at the Hanford nuclear site in Washington State, workers digging through a trench discovered a safe containing a glass bottle, inside of which was white sludge. Tests identified the sludge as plutonium; further investigations conducted in 2009 revealed that the bottle was a 1944 time capsule from the nuclear program of the era, constituting the oldest known sample of plutonium from a nuclear reactor, with a half-life of 24,110 years. The sludge was not dangerous to touch, since its particles were too large to penetrate the skin, but it was poisonous if swallowed, and would remain toxic for centuries to come. Despite the danger, it was placed in a simple unmarked container, creating a potentially dangerous situation—if somehow the unlabeled container got into someone's hands inadvertently, it would pose obvious harm to the person, because that person would not know what was inside it. This situation emphasizes in a nutshell the importance of warning signage as a means to help people obvert danger. It also encapsulates the essential nature of Sebeok's problem.

The semiotic approach to devising an appropriate label for the container entails two main questions: (a) What type of label would be effective (verbal, nonverbal, a mixture of the two)? (b) How can it be made to resist meaning decay? Such questions were surely in the mind of the US government when it decided to contact Sebeok in 1981, as discussed (Chapter 3). Sebeok described the task he was assigned, and the general semiotic principles he aimed to adopt, in the opening statement in his report, which is worth repeating here (Sebeok 1984: i):

> The Department of Energy created the Human Interference Task Force (HITF) in 1980 to investigate the problems connected with the postclosure, final marking of a filled nuclear waste repository. The task of the HITF is to devise a method of warning future generations not to mine or drill at that site unless they are aware of the consequences of their actions. Since the

> likelihood of human interference should be minimized for 10,000 years, an effective and long-lasting warning system must be designed. This report is a semiotic analysis of the problem, examining it in terms of the science or theory of messages and symbols. Because of the long period of time involved, the report recommends that a relay system of recoding messages be initiated; that the messages contain a mixture of iconic, indexical, and symbolic elements; and that a high degree of redundancy of messages be employed.

The goal of this book has been to extend this purview of nuclear semiotics beyond Sebeok's specific problem, augmenting its analytical paradigm to investigate warning representations in general, so as to glean from them any implications for understanding how existential dangers have been perceived across the world and across time, and then apply these to help solve problems of making warnings about these dangers emotively powerful. The main aspects that this type of approach entails include:

1. examining the ways in which danger has been represented throughout history in different forms and media, from cave art and poetry to hazard pictography and cinematic environmental narratives;
2. gleaning from this examination common principles of representation that might reveal how people have perceived and interpreted danger throughout history (and even prehistory);
3. using this analysis as a means to understand the sense of danger itself;
4. suggesting ways to help solve problems of effective communication with regard to current existential dangers, such as those posed by climate change and the rise of infectious diseases;
5. putting forth concrete strategies for counteracting denial discourses.

These have been discussed in separate chapters. So, in this final chapter, the objective is to summarize them in terms of a set of the semiotic principles that these entail. These can be designated as follows:

1. Representationality
2. Emotivity
3. Relativity
4. Metaphoricity
5. Iconicity

6 Folkloricity

7 Narrativity

Overall, nuclear semiotics can be envisaged as providing a particular approach to understanding the psychological-emotional processes underlying human responses to danger, using people's own expressive records of these responses—linguistic, pictorial, narrative, folkloric. This understanding can then be directed to the development of constructive frameworks for devising effective warning systems related to existential dangers, present and future.

Representationality

This principle affirms that semiotic access to the sense of danger is via an examination of the different representations that humans have created to encode and communicate it. Representations constitute the "semiotic database" for investigating this sense as it has manifested itself across time, from ancient cave art and warning stones to current movies and memes on the Internet. To reiterate here (from Chapter 2), representation is the use of signs and sign vehicles to relate, record, depict, portray, or reproduce something perceived, sensed, imagined, or felt to be dangerous. The form and complexity of the representation varies in range from a simple word label to pictorial and narrative texts that relate the danger to broader cultural frames. Figuring out the meaning of any representation is not, however, a simple task, as discussed throughout. The intent of the representation-maker, the historical and social contexts in which it was made, the purpose for which it was devised, the physical medium used, the relativity and emotive effects of the particular codes used, will shape its interpretation.

The different components of the representationality principle can be summarized as follows:

1 A representation allows people to reflect on dangers beyond instinctive responses, thus permitting them to identify the consequences that a danger enfolds by thinking about them reflectively rather than just reacting instinctively.

2 It allows people to contemplate what the danger is about, before taking action, and how it came about in the first place.

3 It projects the danger onto a broader cognitive-cultural system, connecting it to human and natural processes in tandem.

4 It constitutes a type of "self-contained theory" of the particular danger it textualizes.

5. It provides a framework for organizing information about a danger so that inferences about its source can be cogitated.
6. It reveals a particular perspective on the source and nature of the danger itself.
7. As a consequence, it suggests solutions to dangerous situations, allowing inferences to be drawn from specific cases-in-point.

The other side of representation is interpretation (Chapter 2)—that is to say, the representationality principle subsumes an analysis of how interpretations of specific representations vary across cultures and time while retaining common patterns of understanding. Some types of representation are more resistant to interpretation or meaning decay. For example, the flood myths of the past can be interpreted today as ancient warnings about climate change phenomena, rather than apocalyptic punishments for evil-doing from the divinities, as the geomythology approach has shown. However, the subtext of human accountability remains intact; it is just expressed or interpreted differently. Moreover, apocalyptic representations have not disappeared from modernity; they have often been reframed to make sense to contemporary people. As an example, Salvador and Norton (2011) portray the 2004 movie, *The Day After Tomorrow,* as depicting catastrophic climatic effects that are perceived as ushering in a new ice age with a style that iterates the ancient flood myths almost verbatim, which, they suggest, may be counterproductive to inspiring activism (Salvador and Norton 2011: 45):

> *The Day After Tomorrow* . . . articulates a variation of apocalyptic discourse identified as a flood myth, [which] largely undermines contemporary environmental discourse that attempts to generate public activism in addressing ecological problems, by replacing an emphasis on human efficacy with symbolic vindication and exchanging collective effort for individual survivalism. The film thus serves as a cautionary tale about the potential consequences of contemporary mythic discourse presented as supporting environmental activism.

But what these critics may have sidestepped is that images such as those in the movie evoke archetypal-folkloric understanding, which may be the only effective way of inspiring activism broadly, whether or not this particular movie does so in and of itself. Today, science provides us with factual ways to grasp the sources of environmental disaster; but while relevant scientific discourse does not affect people emotively, mythic language and its continuance in narrative-filmic language does. The latter carries forth the original apocalyptic warnings below the level of consciousness, making them likely more potent emotively, as Sebeok certainly understood.

Emotivity

This principle can be expressed simply as follows—the more emotively powerful a representation, the more it is likely to raise the awareness of danger in people. This begs specific types of semiotic questions: Which type of representation is emotively powerful in a particular case? Is a painting such as Munch's *Scream* more emotively powerful than, say, a narrative about some natural disaster? If so, then why so? As discussed and illustrated in previous chapters, and as Sebeok himself clearly understood, a general answer to these questions is that the more iconic a representation, the more emotively powerful it tends to be. So, the emotivity principle is a corollary of the iconicity principle (to be discussed below).

Emotivity and connotation are intertwined—raising one entails raising the other. Now, the question becomes: How does one determine the relation between the two and the strength of the correlation in any empirical way? One useful technique that has been proposed to attempt an answer to this question is called the *semantic differential*, by Osgood, Suci, and Tannenbaum, who introduced it in 1957, arguing that connotative meanings could be measured by using specific semantic oppositions laid out on seven-point scales, on which subjects are asked to rate a topic. This would purportedly measure the emotivity factor in the connotations, since it involves subjective emotive reactions to the topic at hand. To describe the technique in highly condensed form, suppose hypothetically that subjects are asked to rate the concept *climate change* in terms of emotive oppositions such as *real*-versus-*false, urgent*-versus-*irrelevant,* etc. on a scale from 1 to 7. The first term in each opposition (the one at the left end of the scale) reflects the view of climate change as a veritable crisis, while the second one (on the right end) reflects the opposite view. A subject who feels that the *climate change* problem is *real* would place a mark towards the *real* end of the scale; one who feels instead that it is *false*, would place a mark on the *false* end of the same scale; and so on. The ratings range from "1," indicating high belief in climate change, to "7," indicating low belief in climate change. If we were to ask a large number of subjects to rate the problem in this way, we would get a connotative profile in terms of the statistically significant emotive variations in sense that it evokes. The number 7 was chosen as a limit because psychologist George Miller had shown, in a 1956 study, that the ability to process meaning cues or bits of information was limited to between 5 and 9 equally weighted errorless choices—hence 7 as a mid-point between the two.

Now, suppose we choose a group of 100 subjects, selected in advance as "neutral," that is, as neither climate activists nor climate change deniers, and then ask them to rate the topic of climate change on the scales below (Figure 7.1).

real	_	_	_	_	_	_	_	*false*
	1	2	3	4	5	6	7	
urgent	_	_	_	_	_	_	_	*irrelevant*
	1	2	3	4	5	6	7	
imperative	_	_	_	_	_	_	_	*ignorable*
	1	2	3	4	5	6	7	
human	_	_	_	_	_	_	_	*natural*
	1	2	3	4	5	6	7	
dangerous	_	_	_	_	_	_	_	*harmless*
	1	2	3	4	5	6	7	

FIGURE 7.1 *Hypothetical semantic differential for "climate change."*

The outcome of our hypothetical study would yield a tentative profile of the emotivity range of the connotations associated with the term *climate change* by neutral people. Results near the end of the scales (say, 1.4 or 6.4) would indicate high emotive content (one way or the other); results near the middle of the scales would indicate neutrality and, thus, equipollence in emotivity. Now, because this evaluation of the term correlates with views and attitudes towards the climate change phenomenon, it could be used to broach related questions such as: Do people perceive terms such as *climate change* and *global warming* differentially at an emotional level? Do these terms reflect varied reactions based on the political orientation of people and the connotations that these entail? A research thesis by Nadia Seeteram (2012), at Fordham University, used the semantic differential to examine these very questions. She distributed a survey to fifty-three respondents containing thirteen oppositions on a semantic differential scale.

Half the respondents were asked to rate their perceptions of the term *global warming* and the other half of the term *global climate change*. The overall results indicated that the respondents perceived the latter to be more serious on various scales than the former, regardless of political affiliation. It tentatively confirmed the power of the connotative relativity of words and terms in a specific domain.

A few other studies using the semantic differential in this area have come forth to shed further light on the relation between attitudes and the culturally coded meanings of climate change. For example, Fang et al. (2019) examined the social impacts of climate change in China over 2000 years. The authors used the semantic differential to help them interpret impact-response processes to climate change, leading them to formulate the following conclusion:

> The overall impacts of climate were negative in the cold periods and positive in the warm periods, at decadal to centennial scales during Chinese history. However, the impacts seemed a mixed blessing both in the cold or warm periods. The social-economic development and population growth in warm periods would intensify the natural resource shortage and disequilibria in the human-environment system, especially when encountering abrupt climate changes.

The oppositions used in the scales were designed to focus on famine as the most important fear factor in the history of China: "Adaptation to adverse climate change could not only help people to avoid hardship [famine] whilst maximizing profits, but also expanded the capabilities for the continual development of Chinese civilization" (Fang et al. 2019: 231).

The same technique has been applied to assess the effects of the coronavirus pandemic on mental health. A study by Chandu, Marella, and Panga (2020), for instance, used subjects from an electronic database compiled by using key search terms on the Internet. Fifteen scales measuring COVID-19-associated mental health problems allowed the authors to connect attitudes towards the pandemic and their effects on mental health. The results indicated that the technique did indeed constitute a helpful organizational tool, but that there was a "need for future research to develop and validate comprehensive psychometric tools to assess COVID-19-associated mental health problems." The semantic differential essentially pointed out a gap in knowledge that required filling.

Research utilizing this tool has shown, overall, that the range of connotative variations is not a matter of pure subjectivity, but forms a pattern, varying according to social variables (age, class, etc.) and cultural coding. A common critique of the technique, however, is that the choice of terms such as

dangerous-versus-*harmless* are themselves inducive of relativity effects, unconsciously guiding subject choices along a certain interpretive path. Nevertheless, as Hollis and Westbury (2016) have cogently argued, in general the technique does indeed seem to account for the variance in affective (emotive) distinctions that are used to organize meaning via lexical access. Osgood, Suci, and Tannenbaum had actually reported that a small number of emotive factors regularly accounted for most of the variance in the ratings, including pleasantness of the concept (evaluation), its energetic potential (activity), and the degree to which it could affect change (potency). The researchers also found that these factors consistently arose among subjects from different populations, regardless of stimulus type, including not only judgments of words, but of paintings, sculptures, and sonar signals.

As studies such as those just described imply, emotivity is a powerful element in meaning extraction. It can even produce physical-behavioral effects, as the anecdotal examples used in previous chapters indicate—such as Whorf's analysis of the *Empty* sign on gasoline drums and Korzybski's story about the effects of the label *Dog Cookies* on students—a fact recognized as well by Sebeok (1984: 12), who recounts a related experiment:

> The verbal context may subtly yet decisively affect memory, as was shown in a remarkable experiment by Loftus (1980) and Palmer. These two psychologists showed a movie of an automobile accident, and questioned two different groups of "witnesses" about it in two slightly different ways. One group was asked, "How fast were the cars going when they smashed into each other?" The other group was asked, "How fast were the cars going when they hit each other?" A week passed. Then all "witnesses" were asked: "Did you see any broken glass in the accident?" Although there was no broken glass, those who were cued with the verb "smash" were more than twice as likely to erroneously report the presence of broken glass than those originally cued with the verb "hit."

Studying emotivity structures will be of great significance in the battle to change resistant attitudes towards the dangers posed by existential dangers such as climate change. As the Korzybski story implies, signals that precede food intake can become conditioned stimuli for a set of bodily responses, preparing the body for food and digestion. If the signals are mixed or changed, then the responses are altered. Arguably, the same pattern would hold when different labels related to existential dangers are used. This would constitute a form of "emotive conditioning" that might help as a strategy in changing denial attitudes or beliefs.

Relativity

The last comment implies another principle discussed in this book—namely, the principle of semiotic relativity, or the idea that words, images, and other expressive structures shape meaning perception. The gist of this principle is that, while representations are created initially to interpret some aspect of reality, the instant they come into usage they mediate the reality on their own terms, influencing how it is subsequently perceived or "calibrated." This is encapsulated succinctly by Whorf (1940: 229) as follows: "We are thus introduced to a new principle of relativity, which holds that all observers are not led by the same physical evidence to the same picture of the universe, unless their linguistic backgrounds are similar, or can in some way be calibrated."

The upshot of this principle in terms of Sebeok's problem is that the danger sense can be turned on or off, up or down (calibrated) by the type of representation used. As discussed several times, the *Empty* label on the gasoline drums actually turned the danger sense completely off; to turn it back on the label would need to be changed in some appropriate way (for example, *Danger! Explosive!* etc.). If we do not have the apt label to define a risk, it will be difficult, if not impossible, for us to perceive it.

The makers of hazard signs have tried to avoid the relativity effects associated with word labels by turning to images, on the belief that these are less subject to misinterpretation than words. As it has turned out, however, this is hardly the case (see Chapter 2). Nonetheless, hazard-sign creating agencies have attempted to come up with a visual lingua franca that assumes broad comprehensibility. But, as we saw with the trefoil and other pictograms, this has been an impracticable solution, as users from different backgrounds have ended up interpreting them in terms of culture-specific meanings. And, even among those who are from the same linguistic-cultural background, the interpretation of the visual elements is subject to connotative variation. In effect, images, like words, produce relativity effects, albeit arguably to lesser degrees. Even the smiley emoji figure, which was meant to be as culturally neutral as possible, designed as a simple facial circle colored in yellow as an obvious attempt to remove recognizable facial features associated with race or ethnicity, has produced relativity effects. Almost right after it spread into universal usage, it became subject to culturally shaped meanings, leading to new designs. The result has been an attenuation of the desired universality of the emoji code and, consequently, of the universality of the purported universal principles of communication it was meant to subserve.

The principle of relativity can be extended to entire texts, such as narratives. For example, the ways in which natural disasters are recounted in myths will produce a different perception than how they are recounted in, say,

environmental movies. Moreover, by changing elements in each type of text it is possible to calibrate its interpretation. This is actually an inherent principle of historiography—namely, that how history is recounted shapes how it is perceived, because it is recorded with a particular language by a particular user of that language. As Dana Arnold (2002: 5) has aptly observed:

> Historical reality is then a 'referential illusion', in which we try to grasp the reality (the referent of language) that we believe lies beyond the barrier of the linguistic construction of its narratives. In this way history becomes a Myth or an ideology as it purports to be reality. Indeed, storytelling is often seen as one of the most important functions of writing histories and fundamental to the nature of the discipline . . . History is about the past. Yet it exists only in the present—the moment of its creation as history provides us with a narrative constructed after the events with which it is concerned. The narrative must then relate to the moment of its creation as much as its historical subject. History presents an historian with the task of producing a dialogue between the past and the present. But as these temporal co-ordinates cannot be fixed, history becomes a continuous interaction between the historian and the past. As such, history can be seen as a process of evaluation whereby the past is always coloured by the intellectual fashions and philosophical concerns of the present. This shifting perspective on the past is matched by the fluid status of the past itself.

A goal of nuclear semiotics would be to examine how danger textuality shapes the perception of danger, in the same way that word labels and images do, gleaning from this any relevant insights for creating effective cross-cultural texts to both signal danger and to create discourses that can combat the conspiratorial discourses of danger deniers.

Metaphoricity

This principle is a corollary to the previous one—it implies that metaphorical (figurative) language is a powerful source of emotivity and relativity, shaping beliefs about dangers in specific ways. As Susan Sontag argued in her 1978 book, *Illness as Metaphor*, metaphoricity is at the core of how we evaluate diseases, predisposing us to think about them in non-physical ways, that is, in terms of how they are perceived culturally. She claimed that the metaphors used in talking about cancer reveal moral judgments built into the perceptions of the disease, affecting how it is experienced by sufferers. These are thus potential psychosomatic triggers that affect how people with cancer might react to it physically, and thus might be as deleterious to a patient's health as

the malignancy itself: "As long as a particular disease is treated as an evil, invincible predator, not just a disease, most people with cancer will indeed be demoralized by learning what disease they have" (Sontag 1978: 7).

Interestingly, some of the same conceptual metaphors related to cancer, such as *cancer is an enemy* to be *defeated*, are the same ones used to portray pollution as an *enemy* (Chapter 4), suggesting that there might be a common conceptual ground which connects dangers, from the biological to the meteorological, as the following commonly-used expressions indicate:

1. Pollution is a *killer*.
2. Pollution is a *predator*.
3. It's an uphill *battle* to beat the climate crisis.
4. Global warming is a *scourge*.
5. We must *fight* climate change.
6. *Defend* yourself against pollution.
7. We must *defeat* global warming.

The exact same conceptual metaphor emerged during the coronavirus pandemic, (Heffernan 2020) with the virus being portrayed as an *enemy* and its *victims* as casualties of *warfare*—thus supporting the likely presence of a common ground of understanding. However, as Craig (2020: 1025) has cogently argued, and in accordance with Sontag's thesis, while metaphors allow for the effective portrayal of the dangers of COVID-19, they might also inflict emotional damage:

> As the COVID-19 crisis spreads around the globe, the rhetoric about the pandemic evoked by journalists and politicians harks back to that of prior diseases and epidemics . . . Alongside the damage wrought by the virus itself, these discourses can inflict greater, even lethal damage, while thrusting into relief ongoing critical concerns around socio-cultural power, injustice, and inequality.

Actually, it is relevant to note that the same kind of metaphoricity has cropped up across time to describe pandemics (Angeli 2012). In Boccaccio's *Decameron,* for instance, the plague is described as a *predator* that sends humans to *slaughter*. This exact same image schema can be seen in media coverage of recent pandemics, such as Ebola and COVID-19, portraying *victims* as *slaughtered* by *predator* viruses. Now, the question becomes: Why is there such a conceptual continuity via metaphor? As Fauconnier and Turner

(2002) have argued, the reason may well be that metaphor involves the "blending" of common experiences formed in different areas of the brain—physical, affective, cognitive, mnemonic, etc. As K. C. Cole (1984: 156) puts it, metaphors: "are models fashioned from familiar ingredients and nurtured with the help of fertile imaginations." The common semantic ground of many metaphors suggests (as mentioned previously) that they may be archetypal, transcending time and place, finding repeated expression in different media, verbal and nonverbal, as well as in different styles and forms. This may retroactively explain why prophetic warnings were expressed as riddles, which are essentially extended archetypal metaphorical texts (Köngas Maranda 1976). One of the best-known examples is the Riddle of the Sphinx, which is associated with the legend of Oedipus, the mythical King of Thebes. As an infant, Oedipus was left to die on a mountain by Laius, his father, who had been told by the oracle that he would be killed by his own son. Laius and Jocasta, his wife and Oedipus's mother, then went to live in Thebes to make sure that they would escape the prophecy. However, the infant Oedipus was saved and reared by a shepherd. Upon reaching maturity, he became aware of the ominous prophecy and decided to go to Thebes to investigate it for himself. On the road he got into a confrontation with a man, whom he ends up killing. When Oedipus reached the city, he encountered a gigantic sphinx guarding entrance to the city. The menacing beast stopped Oedipus, posing the following riddle to him, and warning him that if he failed to answer it correctly he would die instantly at its hands:

> What creature moves around on four limbs at dawn, on two at midday, and three at twilight?

Oedipus answered: "Humans, who crawl on all fours as babies, then walk on two legs as grown-ups, and finally need a cane in old age to get around." Upon hearing the correct answer, the astonished sphinx killed itself, and Oedipus entered Thebes as a hero for having dispensed with the terrible monster that had kept the city in captivity for so long. Left without their king, who had been murdered, the Thebans made Oedipus their new king, who then married the previous king's widow—Jocasta. Several years later, a plague struck the city. An oracle announced that the scourge would come to an end only after the murderer of the previous king had been driven from Thebes. Oedipus investigated the murder and soon realized, to his horror, that the man he had killed on the road was not only the previous king, Laius, but also his father. Jocasta was his mother. Grief-stricken and desperate, Oedipus blinded himself. Similarly woeful and disconsolate, Jocasta hanged herself. Oedipus was banished from Thebes. He died in a state of unendurable woe at Colonus.

The sphinx's riddle is a metaphor connecting the three life phases of infancy, adulthood, and old age to the three temporal phases of dawn, noon, and twilight. Now, while various interpretations of the Oedipus myth and its relation to the riddle have been put forth, the one that is relevant to the present discussion is that it is a warning against disrupting the normal scheme of things. It is also a warning that sometimes it is better not to know the truth, which may literally kill someone. Overall, it shows that truth will eventually come out, becoming a self-fulfilling prophecy.

The ancient riddles were metaphorical warnings, as can be seen also in the fact that admonitions were commonly phrased in riddle form, as is evident in the Rök runestone (Chapter 4). If metaphor has always been a powerful source of warning, then, as Lidström and Garrard (2014) have cogently argued, it must be considered seriously as part of a critical response to counteracting climate change denial, since it has the "ability to heighten individual readers' awareness of their physical surroundings on the one hand, and . . . engage with difficult and complex environmental questions involving scale, justice, and politics on the other" (Lidström and Garrard 2014: 35). Well-chosen metaphors might not save the world from itself; but they will make people better aware of the state of the world with a form of understanding that reaches back to the origins of culture.

Iconicity

This principle implies that iconic representation is a primary mode of understanding and more transferable culturally as a meaning-making strategy—called *iconic presence* in this book. Pictorial representations in particular have a high degree of such presence and thus are, plausibly, more likely to be understood by people, regardless of background. But, as Sebeok (1984: 17) warned, these too may be subject to interpretive variation in various ways:

> At this point, some comments are in order about certain predictable problems involving iconic, specifically, image-based coding. . . . It should be stressed that there is substantial disagreement on the extent to which pictorial perception depends on specific cultural experience, certainly a major source for human individual differences. Obviously, pictures give some humans some information on some occasions; but the "how" and "when" are complicated questions, and the answers are neither obvious nor should be taken for granted in circumstances as delicate as our project demands.

Putting aside variation for the sake of argument, it can be said that iconic images are likely to be more emotively powerful as universal warning

FIGURE 7.2 *Indonesian cave art, Sulawesi (Wikimedia Commons).*

signs than other types of sign structures. The archeological-anthropological analysis of ancient cave art seems to bear this out, at least indirectly (Chapter 5). An example is recently discovered cave art on the Indonesian island of Sulawesi, estimated to be over 40,000 years old. It depicts an anoa (a water buffalo) confronting smaller human and animal figures in a fearsome way (Figure 7.2).

The imminent danger posed by the anoa to living creatures is tangible, as it points its snout towards them menacingly. In another section of the same painting, another anoa is flanked by several figures holding spears and other weapons, suggesting a defensive reaction to the danger the animal is perceived to pose. While other interpretations have been suggested, including the possibility of palimpsest interventions, the image of danger that comes through is nonetheless present iconically.

The capacity of visual iconicity to convey danger powerfully became evident during the COVID-19 pandemic, when the image of a spiked virus head that was commonly shown by the mainstream media spread as a meme throughout the social media universe. It was even used as a pictogram by Covid Watch, founded in February 2020 (Figure 7.3).

This pictogram is an iconic sketch of the virus, constituting an emblem for the pandemic itself. It spread broadly on the Internet, in pictures, cartoons, animated videos, and emojis such as the one below which shows fear imprinted in the virus form itself in a cartoonish way (Figure 7.4).

FIGURE 7.3 *Covid Watch pictogram.*

FIGURE 7.4 *Coronavirus emoji.*

Aware of the emotive power of such images, Graphic Medicine, a health platform, has adopted iconicity as a means to communicate with the general public, devising comics and cartoons to warn people about the effects of a disease (Tuohy 2018). As Sonnevend (2020: 451) has argued, iconicity allowed for a deeper holistic understanding of the danger posed by the coronavirus:

> There are millions of photographs published about the crisis every day, yet we can see the key actor, the virus, only in artistic representations. Most of us also have very restricted access to central sites of the crisis, as intensive care units, nursing homes, meat packing plants and prisons are often not available for photographic representation. At the same time, we are oversupplied by other images that try to capture the "essence" of the moment. [There are] three prevalent visual genres in connection with the ongoing pandemic: abstract representations of the virus and public responses to it, images of heroes and sinners, and photographs of the "stage": the iconic spaces including empty public buildings and busy domestic spaces. All these iconic representations try to grasp the "deep meaning" of the crisis through a particular scene or moment. Their expressive surfaces have

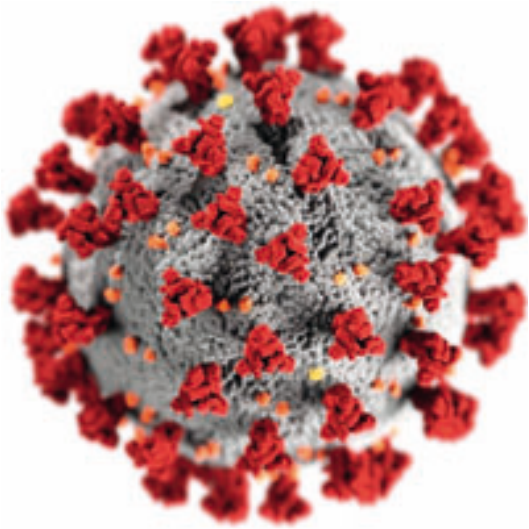

FIGURE 7.5 *Coronavirus illustration, Centers for Disease Control, Alissa Eckert, MSMI; Dan Higgins, MAMS, 2020 (Public Domain).*

become our key sources to imagine the coronavirus crisis, and to socially connect in a time of painful and prolonged physical distance.

Interestingly, the US-based Centers for Disease Control (CDC) hired medical illustrators to create a visible identity for the coronavirus during 2020 that would draw attention to its danger via the power of iconic presence; the result was the image above, which quickly became a worldwide emblem of the coronavirus (Figure 7.5).

What makes this image particularly fearsome are the spikes protruding from it, as well as the amorphous spherical surface of the virus's body, which resembles some spatial alien landscape. It possesses a tactile synesthetic quality, triggering an ersatz desire to explore it via mental touching. Whether it was actually effective or not during the height of the pandemic is a moot point—it became, as Sonnevend (2020: 461) remarks, "our key [source] for imagining the crisis."

Folkloricity

The idea of using folkloric-mythical-ritualistic artifacts in creating effective warning systems was one of Sebeok's (1984: 24) major recommendations, as discussed (Chapter 3), based on a common anthropological-semiotic view that folkloric representation is an unconscious impulse in human meaning-

making, carried forth from the past in the form of archetypal representations that evoke the past latently, thus justifying them in the present. As Barthes (1977: 9) aptly observed, the reason why myth is still powerful, is because it gives ideas a "natural justification":

> Semiology has taught us that myth has the task of giving an historical intention a natural justification, and making contingency appear eternal . . . Myth does not deny things, on the contrary, its function is to talk about them; simply, it purifies them, it makes them innocent, it gives them a natural and eternal justification, it gives them a clarity which is not that of an explanation but that of a statement of fact.

While Sebeok's recommendation was never taken up by the government, it certainly resonated with artists, writers, and others of his day and subsequently. An example is the musical *Hadestown* (2006), which tells a modernized version of the Greek myth of Orpheus and Eurydice (Chapter 6), modifying it to represent a sudden—and catastrophic—change in climate in ancient Greece. In the musical, we witness the world of Hades that Eurydice and Orpheus inhabited as the result of an environment that was climatologically out of balance, either drastically cold or hot, where food became scarcer and social stability increasingly weak. In effect, the musical is an adaptation of a specific folkloric text to fit the present era—which was the main intent of Sebeok's proposal. As Kim and You (2020) have also stressed, many of the ancient myths were folkloric warnings about infectious diseases that can be projected onto the current situation:

> Greek mythology has numerous stories of infectious diseases. At the beginning of the Myrmidon story, the epidemic is well described. Just because Zeus's mistress' name and country name are the same, in the form of plague, the curse of the goddess Hera spread throughout the country, Aegina. Symptoms of the patients suffering from the disease were as follows: "At first the cheek was flushed, and the breath drawn with difficulty. The tongue grew rough and swelled, and the dry mouth stood open with its veins enlarged and gasped for the air. Men could not bear the heat of their clothes or their beds, but preferred to lie on the bare ground, and the ground did not cool them, but on the contrary, they heated the spot where they lay." It reveals the pain of patients suffering from high fever, and this figure overlaps with those of patients currently suffering from COVID-19. The following phrase, inter alia, describes the sacrifice of physicians in the story about plague of Aegina, is mournful and moving: "Nor could the physicians help, for the disease attacked them also, and the contact of the sick gave them infection, so that the most faithful were the

first victims". It also overlaps with front-line doctors who are struggling against COVID-19.

A corollary to the folkloricity principle is that we can learn a lot from antiquity. An analysis of ancient architecture, for instance, reveals that many buildings and city structures were designed to impede invaders from besieging a place, or to inhibit those bringing diseases and pestilence from entering. Now called *hostile architecture*, this concept can be easily carried forth today as a "stay-away" or barrier strategy, as Sebeok (1984: 1) clearly understood:

> Any viable strategy for radioactive (hazardous) waste disposal, in which the repository would be situated in a rock mass beneath a blanket of sedimentary rocks whose physical characteristics are well understood, entails the possibility of human intrusion, which must and can be minimized. For any repository situated in a geological medium, all sorts of natural and engineered barriers can be brought into play to act to prevent migration of the wastes, such as "(i) the waste form and its capsule; (ii) engineered barriers within the repository, such as low-permeability, highly sorptive backfill; and (iii) the migration path back to the biosphere through the ground-water flow system" (Bredehoeft and Maini, 1981: 296); and others (e.g., Winograd, 1981). A "barrier" is commonly defined as a mechanism or medium by which the movement of emplaced radioactive material is stopped or retarded significantly.

The folkloricity principle became a central one in early nuclear semiotics, undergirding proposals such as the ray cat solution by Bastide and Fabbri (1984), which became one of the most fanciful and most discussed to this day. To recapitulate it briefly here, their solution inhered in breeding a new species of domestic cats, whose fur would change color in response to high levels of radioactivity. Countries would then need to devise and promote a new folkloric art and literature in which ray cats are portrayed as symbols of danger to future generations. Leaving aside the impractical and inhumane aspects of this proposal, it actually garnered great interest, leading people to discuss the problem of existential dangers—hence its success as a refashioned "folkloric tale" for the modern age. It can be further refashioned today in the Internet age, by constructing images (such as a humorous drawing of radioactive cats), videos (of cats reacting to nuclear sites), hyperlinks (to sites on the folklore of cats), hashtags (such as #raycatssolution), etc.—all designed to raise awareness to the problems of waste and pollution. But the problem with such digital forms of representation and communication is that of decay, since these tend to have a short lifespan. Nonetheless, in the immediacy of the moment, they capture people's attention effectively.

Similar approaches surfaced during the COVID-19 pandemic, with social networking platforms spreading information about it via memes, viral videos, and the like, which may, however, have been a part of the problem of how rumors, questionable information, and conspiracy theories about the pandemic spread throughout the globe. In response, various social media groups emerged to combat the misinformation, by using memetics as a counter-discourse. One group was called *Zoom Memes for Self Quaranteens*, a term playing on the rise of Zoom in 2020 during the pandemic and the fact that most teenagers were forced into a quarantine. The group used humorous memetic techniques for educating young people, via multimedia videos, including live streams of music and various performances. The same type of humor could be easily incorporated in the case of our hypothetical ray cat memes.

Narrativity

The term *narrativity* has assumed various designations in both literary and semiotic theory (Sturgess 1992). For the present purposes, it can be constrained as referring to the principle that we tend to remember stories about existential dangers more easily and vividly than we do isolated concepts and words about them. Whether the danger narrative is delivered orally (as in myth), in writing (as in print fiction), or in other media (as in film and digital forms), its efficacy lies in the fact that it portrays the danger, not as an isolated phenomenon, but as interconnected to certain events, people, and motivations.

Typically, the narrative starts off by depicting a state of equilibrium or order that is disrupted by human actions, which is restored by some intervention—human or divine. When the equilibrium is not restored, as in some of the films discussed in the previous chapter, then the narrative leaves us in a state of anxiety, without an emotional dénouement. It is no coincidence that narrative fiction emerged and became popular at the time of the medieval bubonic plague, coming forward to chronicle the horrors of the plague (Chapter 6), uniting people in an imaginary *danse macabre* that migrated to pictorial art, inspiring works by Konrad Witz, Bernt Notke, and Hans Holbein the Younger. Running through the *danse* was the view that the Black Death was the apocalyptic harbinger of humanity's demise. The painting below by Michael Wolgemut pictorially summarizes how this *danse* was perceived, with Death bringing about the plague, turning people into skeletons as they danced mindlessly (Figure 7.6).

Interestingly, Dean Koontz's science fiction novel, *Eyes of Darkness* (1981), can be interpreted as a modern-day version of the *danse macabre.* The novel focuses on a mother who wants to find out if her son died a year before, or if

FIGURE 7.6 Danse of Death, *Michael Wolgemut, 1493 (Wikimedia Commons).*

he is still alive. The *danse* begins after she sends her son on a camping trip with a leader who has taken the trip many times before without mishap. Everyone on the trip—campers, leader, and driver—die with no explanation. As the mother starts to accept the fact that her son is dead she begins receiving symbolic messages saying that he is in fact alive, such as writing on chalk boards, words coming out of printers, and other oracular signs. In the end, she finds that the deaths were caused by a virus, created in a laboratory, suggesting that a human-made apocalypse had begun, involving everyone on Earth—the same subtext of the medieval *danse macabre.* Fiction of this type is designed to allow people to grasp the meaning of pandemics, as Doherty and Giordano (2020) insightfully point out:

> Since the global outbreak of COVID-19, internet users' interest in movies about pandemics has increased by 4900%. The timing and the magnitude of this increased interest makes clear that science fiction stories offer more than simply entertainment. Instead, people may be engaging with movies like *Contagion*, *Outbreak*, *The Andromeda Strain*, *Flu*, and *Virus* in ways

> similar to those reasons for which they turn to the news: a desire and search for deeper understanding and some sense of security from things unknown . . . Balancing the two—both the factual and fictitious—is critical to instilling a sense of *ostranenie*: the unfamiliar presentation of a common thing that affords the viewer an enhanced perception of the familiar. Science fiction stitches truths about humanity into the fabric of its unfamiliar worlds: when we imagine ourselves in stories' novel scenarios, it provides good food for thought and the possibility to internalize applicable moral lessons.

Narratives and their pictorial counterparts have always been critical for understanding the meaning of plagues and other disasters. As Max Weber (1922) remarked, science has always been unequal to the task, leaving it up to the writers and artists. Narrativity is a semiotic response to what Korzybski (1921) called *time-binding,* which refers to how the structure of our sense of time is reflected constantly in our narratives, which are "time bound." A "timeless" narrative is an oxymoron. It is relevant to note that Sebeok (1984: 2) adopted Korzybski's notion as part of his relay system:

> It is generally believed that the "social function of communication is the ensuring of continuity in society through access to the experiences and ideas of the past, expressed in [loosely speaking] symbols for transmission across space and through time. This is the 'time-binding' function of social communication (Neelameghan, 1979:103). The time-binding ability of human beings arises from their usage of "language, number, gesture, picture, and other symbolic forms" (loc. cit.) enabling them to transcend the limitations of inherited characteristics and the seemingly insurmountable barrier of "time". It should be noted, in passing, that an era will come when messages vitally important to the race, affecting its survival, will be transmissible by microsurgical intervention with the human molecular blueprint, but the technology required for this form of temporal communication is far from available as yet. Therefore, in what follows, this theoretical possibility will not be further considered.

Solving communicative problems thus lies primarily "on the conviction that all human thinking must be in continuity with the past, but also an ineluctable corollary of this proposition, namely, that information tends to decay over time" (Sebeok 1984: 26). Narrativity can thus help solve the problem of decay indirectly, since it is based on connecting events, people, and situations in ways that seem to transcend time and place.

Epilogue

Sebeok's invitation by the US government to study how to make warnings about nuclear waste effective, understandable cross-culturally, and resistant to meaning decay led to new ways to look at semiotics itself and to examine its inherent principles in a new frame in which they could be tested for practical usefulness and, more generally, for validity. Nuclear semiotics thus held great promise when it materialized to solve Sebeok's problem. However, it never really made any headway within or beyond semiotics. One reason may well be that the problem of danger resulting from human activities extends beyond the production of radioactive wastes—the main focus of Sebeok's problem. It involves all kinds of existential dangers that humans have, in some way or other, brought on or precipitated. The main argument made in this book is that the same methodological and analytical tools that were developed to solve Sebeok's problem can be used more generally to study the efficacy of existential danger representations.

As mentioned several times, Sebeok's recommendations went unheeded by the government, or at least were never acknowledged as useful, even though some of these were taken up by subsequent task forces (Chapter 3), thus indirectly validating their soundness and potential efficacy. A report on the Vatican Archives, commissioned by the *Nordic Nuclear Safety Body* (Pasztor and Hora 1991), a decade after Sebeok's report, came forward to lend support to Sebeok's folkloric recommendation, which he had modeled on the fact that religious systems have shown themselves to be capable of withstanding the test of time. In the same year, 1991, at a conference on the *Transmittal of Information Over Extremely Long Periods of Time*, held at Oslo, Norway, law professor Knut Selmer made the following relevant statement that can be clearly construed as highly supportive of the Sebeokian approach (cited in Garfield 1992):

> It is my suggestion that the only possible way to influence human activity in a very distant future goes through religion. One must approach the leading circles of the great world religions, and persuade them that we are under an obligation to warn our distant descendants of the deadly dangers which we are creating in the environment. The danger symbols must be included in the set of holy symbols of each religion. The obligation to seek information and act upon it must be embodied in the central axioms. If the message could be given a form which was common to the world religions and which formed part of their rites and practices, one might hope that the message would survive and motivate people in a distant future.

Nuclear semiotics receded into obscurity after Sebeok's report, for reasons mentioned in this book. The goal of this book has been to revive it, expanding its purview to the overall study of danger warnings, from antiquity to the present time, extracting from these general principles of representation that may reveal how danger is perceived by the human brain. From the study of ancient cave art to the analysis of hazard pictograms, the nuclear semiotic approach provides a particular angle from which to view human history as a chronicle of danger and how humans have responded to it creatively. From this approach, recurring principles that pertain to the creation of warning signage can be extrapolated and used to construct effective warning systems, including discourses that might be helpful in solving the larger social problem of the denial of existential dangers.

One thing that stands out from even a cursory look at danger representations across time is the fact that humans have always connected existential dangers to broader questions of human life. How this has been realized can be seen in the presence of common themes in the warning texts. Identifying these, therefore, can presumably help combat denials of existential dangers by connecting them to the deterioration of life. Some of the ways in which this can be realized have been discussed in this book. The overall argument is that nuclear semiotics does indeed have a role to play today—an even more important one than when it emerged in the context of Sebeok's problem.

Human history has in fact been based in large part on solving existential dangers. The solutions can be seen from various disciplinary angles, from psychology to geomythology. One of the angles is semiotics, which studies warning signs and their meanings, as well as how they reflect the innate understanding of danger. As poet Ralph Waldo Emerson (1863: 301) so aptly put it: "As soon as there is life there is danger."

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