# Mankind's Future: Using the Past To Protect the Future

## Archaeology and the Disposal of Highly Radioactive Wastes

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**Archaeology is concerned with man-made monuments and information which have survived for long periods of time. The safe disposal of highly radioactive wastes involves the design of disposal systems intended to function for equally long periods of time. In this review it is shown how archaeology can provide a basis for designing a segment of the disposal system – the marking of the site to minimize future human interference.**

The safe disposal of nuclear waste is a subject of much interest to the general public and the scientific community. The topic easily raises heated debates and vastly differing opinions. This review discusses one small aspect of the subject: the use of archaeology to provide a basis for designing long-term marking systems for the disposal sites for highly radioactive commercial wastes. No specific site has been chosen by either the US nor the British government at this time, although three areas have been selected for further study in the USA. The term 'site' is therefore used in a general sense throughout this paper. The method of disposal is presumed to involve the solidification of the wastes into a relatively insoluble form and burial of these wastes several hundred metres below the Earth's surface.[1]

The first section reviews the need to mark the disposal site. Examples of ancient markers are then discussed, with an emphasis on providing guidelines for the marking system. A preliminary design which follows these guidelines is presented. Further work will be necessary to tailor the design to a specific site whenever and wherever one is chosen.

## To Mark or Not To Mark?

The research presented here rests on several presuppositions. First, it is necessary to work toward a practical and safe method of disposing of this dangerous material. This work should draw on all possible resources which can provide constructive suggestions. The contention that this work is inappropriate since no safe disposal method has been demonstrated and that all nuclear waste production must immediately cease[2] begs the question. Several countries have decided that the nuclear option is not for them, yet this does not alleviate the need to dispose properly of the material already generated. Nor does the possibility of a nuclear war absolve us from protecting those who will exist if the war does not occur.[3]

Second, the decision to mark the disposal site reflects a sense of social responsibility. There have been suggestions that the site not be marked, or that the location of the site and its contents be kept secret.[4,5] Archaeological investigations have covered nearly all of the globe, and very few areas bear no traces of human activity. We cannot predict what will be a remote location in the future. The difficulties that we have today with the proliferation of undocumented and unmarked hazardous waste sites, which already contaminate our environment, should indicate the potential folly of leaving the sites unmarked.

Safety analyses for the disposal of highly radioactive wastes[6] have resulted in the realization that an otherwise effective disposal system can be circumvented by human interference, such as drilling. With a properly chosen site and a properly designed system, it is human interference that leads to the highest credible exposure to an individual. In light of this, the regulatory agencies of the United States have required, in their draft regulations, that the disposal site be marked with the most permanent markers practicable to indicate the dangers of the wastes and their location.[7,8] The Environmental Protection Agency (EPA) has also proposed 10 000 years as the time period of interest.[8] Part of the decision to mark the site is the acknowledgement that the generation which produces the wastes has the responsibility for the disposal of those wastes. A corollary to this is that a marking system which requires long-term maintenance is not acceptable.[9]

The United States, then, has a regulatory responsibility to mark the disposal site. To this end, the Office of Nuclear Waste Isolation convened the Human Interference Task Force.[9] The author was a consultant to the Task Force and was directed to focus on the physical aspects of marking the site itself.[10] The marking system design focuses on future societies which have the technology to disrupt a repository. The final presupposition of this work is that a society which has reached a technical level similar to our own is likely also to have a similar level of development in the humanities and social sciences.

## The Need for a Physical Marking System

One consultant to the Task Force suggested a generation-by-generation relay of the information in the form of an 'Atomic Priesthood'.[11,12] The basis for this suggestion is the observation that languages change and that any written message would be unreadable after 10 000 years. Languages do change with time, and this effect is examined in the section on ancient markers (see below).

There are, however, three difficulties with this approach. The first is that it violates the premise that no responsibility must be placed on later generations for the marking of the repository site.

The second difficulty is more subtle and requires familiarity with oral traditions. The examples discussed here are the *Iliad* and the *Odyssey* of Homer. There is little doubt that these were originally oral compositions. There were many versions of the Homeric epics when they were first written down, about the 6th century BC. Even after the work of an outstanding critic in the 2nd century BC, there were still texts which differed in length or substantial wording.[13] But once they were written out, it was the literary tradition, not the oral, which preserved Homer's epics for our time.

Research and studies of modern 'singers of tales' primarily in the Balkans, have been done by Parry and Lord. It is useful to quote some of Lord's comments:

> If the singer of oral epic tradition always sang the same song in exactly the same words, it would be possible, of course, to ask him to repeat the performance a number of times . . . but bards never repeat a song exactly . . . . Those singers who accept the idea of a fixed text are lost to oral tradition processes.[14]

Oral tradition is an inherently vibrant and mutable phenomenon. We cannot control the ways in which it, like language itself, will mutate, nor how it will change with each generation of transmission.

Moreover, Lord indicates that the oral and literary traditions are mutally exclusive for an individual; once there is a concept of a set text, the oral tradition is destroyed.[14] In other words, the literary tradition supplants the oral tradition. To rely upon oral tradition to warn future societies is to overlook the fact that those who build the repository are part of a millenia-old tradition - a *literary* tradition. It is on this tradition that the primary emphasis of the marking system should be placed.

The third difficulty is the reception that this suggestion has met with the press.[15] It does not appear to be an option which the public considers viable.

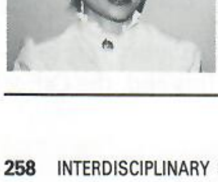
## Archaeological Data

The question then becomes: 'How do you design a marking system which will survive and function for 10 000 years?' One approach is to turn to archaeology, a field which concerns the transfer of information across time through changes in language, religion, and culture. There are man-made markers which have survived for extended periods of time. The monuments chosen for the study were selected to represent a variety of cultures and climates and had to be at least 1000 years old.

### The Pyramids, Egypt

The 4th Dynasty pyramids at Giza, Egypt (Figure 1) are an obvious starting point: they have already survived for nearly half the EPA's suggested time frame. We know they were built by Khufu, Khafre and Menkure as burial places. This information survived through several periods when the centralized government collapsed, known as 'Intermediate Periods', and through several changes of culture. The purpose of the pyramids, who built them, and their contemporary condition are accurately described by several later historians, including Herodotus (Greek, 5th century BC), Pliny the Elder (Roman, 1st century AD), and Abd el Latif (Arab, 12th century AD). Even without this transmission of information, the sarcophagi within the pyramids and the texts written on the walls of the later pyramids (6th Dynasty) would proclaim their funerary purpose.[16]

On the negative side, the pyramids have survived because of their massive size. There is still sufficient material left to make a stunning impression on any visitor, even though they were declared quarries around AD 1200. In addition, each pyramid marks a



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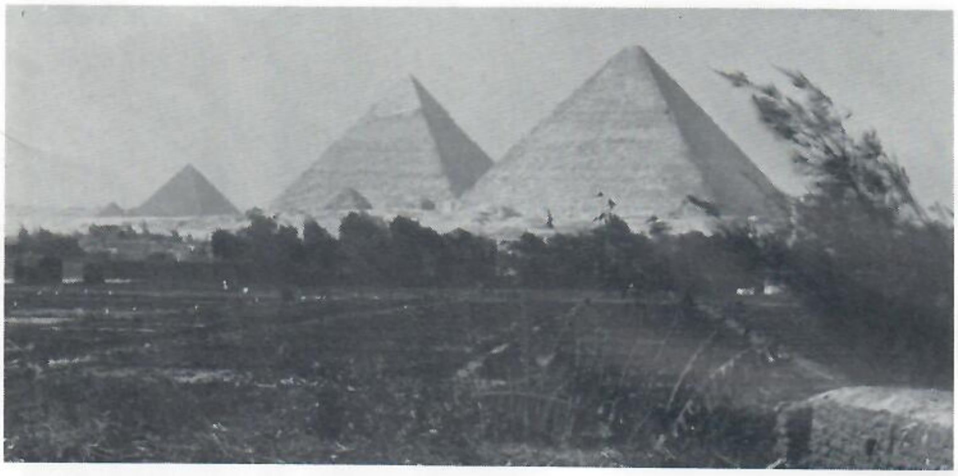

**Figure 1.** The Pyramids, Egypt. These have survived for 4500 years but have too much bulk to be effective repository markers.

point, while we wish to delineate an area. Building a pyramid to cover the entire area of the disposal site is impracticable. If a smaller pyramid is built and it says 'do not dig here' we have not adequately defined the area we want to remain undisturbed.

Finally, the contents of the pyramids were looted shortly after closure. This fact has been used to call into question the effectiveness of any marking system.[11] This opinion overlooks the important difference between the two situations. The tombs were known to have valuable contents, sufficiently valuable to be worth the risk of getting caught. This will not be the case with a disposal site, which will offer little incentive to disregard the warnings.

**Stonehenge, England**

Stonehenge, England, was the second ancient marker investigated for this research (Figure 2). The magnificent monument standing on the Salisbury Plain is the culmination of nearly a millenium of use and remodeling. Carbon-14 dates indicate that the earliest features may date to about 2700–2500 BC, while the latest work may have been completed by about 1900 BC. The ancient approach to the monument takes one past the outlying Heel Stone to a gap in the banks and ditches which surround the circles of standing stones. This gap is flanked on one side by the fallen 'Slaughter Stone', possibly one of a pair which formed a gateway. Ringing the inner side of the bank are the 56 Aubrey holes, named after John Aubrey, who noticed them in the latter part of the 1600s. The visitor now faces the immense standing stones arranged in a ring of upright stones with lintels, an inner ring of smaller imported stones without lintels, a horseshoe formed by five trilithons (two uprights with a lintel), and a horseshoe of imported upright stones.[17]

Stonehenge is another example of a man-made marker which has lasted for nearly 5000 years, this time in a moist climate. To protect the ditch and bank from the constant flow of tourists, these areas are now roped off. The monument has survived, however, while Britain has undergone invasions (in 55 BC, AD 48, and AD 1066), the internecine Wars of the Roses (1455–1485 AD) and two World Wars. Stonehenge may be very useful for a marking system because of its redundancy. The standing stones are much more efficient in delineating an area than are the pyramids. The use of multiple components means that the plan of an area can be reconstructed even though some of the components are missing. Stonehenge has lost approximately one-third of its stones, yet there is no debate about its plan. The height of the largest stones in Stonehenge can also provide an estimate of the largest-sized component we might want in the marking system.

Unlike the pyramids, there is no contemporary written information associated with Stonehenge. This has severely limited our understanding of the monument. We do not know the names of those who ordered its building and remodeling. We do not know exactly why it was built, for Stonehenge has features which occur with no other stone ring in the British Isles. The monument does show astronomical alignments, but whether this was its sole purpose is still debated.[18] We did not have an accurate estimate of its age until carbon-14 dating. The fact that part of it is roughly contemporary with the pyramids was a surprise and necessitated some rethinking of the Neolithic period in Britain.[19] Oral tradition was not much help, for although it was recognised that some stones were imported, Geoffrey of Monmouth (about AD 1136) tells of Merlin saying 'Send for the Giant's Ring in Ireland', when the stones actually originated in Wales.[20]

**The Acropolis, Greece**

The situation is quite different for the Acropolis in Athens, Greece (Figure 3). There is a plethora of contemporary texts which have survived until today. We know Pericles (died 429 BC) was the prime mover in the decision to rebuild the Acropolis on a monumental scale after peace was made with Persia. In

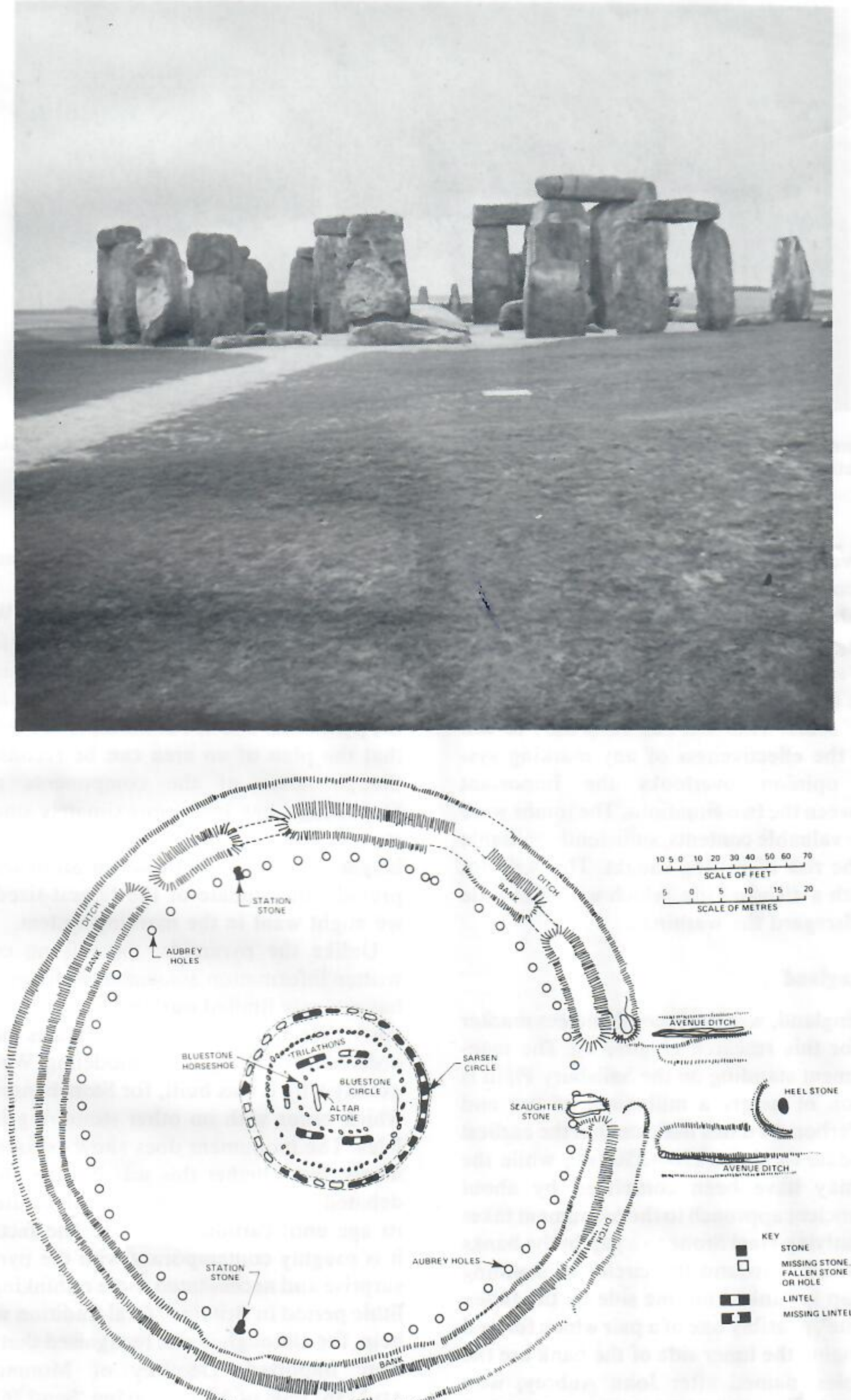


**Figure 2.** Stonehenge, England. The standing stones are far more effective in delineating an area of interest than are pyramids. Stonehenge has also survived for several millenia, but the lack of contemporary written records hampers our understanding of the monument.

many cases, we know the architects and sculptors who worked on the different buildings. We know that money was raised from the sale of old building material, from grants from the Treasuries of Athens and Hephaistos, and from private donations, and we also know that Pericles was accused of squandering funds from the Delian League in order to beautify Athens. Even the annual building accounts for the Parthenon and Propylaia were publicly displayed on the Acropolis. There has never been any doubt that

**Figure 3.** The Acropolis, Athens, Greece. The buildings here have suffered more from the hands of man than from the ravages of nature. Acid rain, war, and improper materials in restoration have all led to the present state of deterioration. The marker system must be designed to withstand the acts of man as well as nature.

the major buildings of the Acropolis had a religious purpose. This is borne out by the transformation of the Parthenon into a Byzantine church and, later, a mosque.[21]

The Acropolis is an excellent example of a collection of monuments which have suffered far more at the hands of man than from the ravages of nature. Acid rain is dissolving the marble sculptures and buildings. The caryatids on the Porch of the Maidens of the Erechtheion are being replaced by casts.[22] Nicolas Balanos replaced the iron bolts and girders with ones of steel in the restoration work done in the early 1900s. Aside from weakening, steel expands as it corrodes. This extra stress has caused cracking of the marble in which the steel is imbedded. In some places this has led to an immediate danger of collapse; this should be a solemn warning to those who might propose technologically advanced materials which have not had the chance to undergo the test of time.[23]

Finally, the Parthenon was intact, though modified for the architectural needs of different religions, until September 26, 1687. At that time it was being used as a powder magazine and received a direct hit from a Venetian mortar. The resultant explosion blew the temple into two parts, destroying most of what was in the middle.

### Great Wall, China

The Great Wall of China (Figure 4) is another monument which has lasted for over 2000 years. It originally stretched from Shanhaiguan on the Yellow Sea to Jiayuguan in the west, a distance of some 2980 km. It is built on such a grand scale that it is visible from space. Built by the order of Qin Shi Huang Di, the wall was begun in 221 BC and completed in 210 BC. Construction methods differed along its length, depending on the local building materials. In the east,

**Figure 4.** The Great Wall, China. Although it has stood for twenty centuries, the Wall has required continual maintenance, something the marking system for the disposal sites must avoid. One-piece construction for each component would minimize this problem.

where stone was plentiful, a foundation of rubble was laid without mortar. The wall was built of dry, tamped earth (*terre pise*) and the upper level was covered with brickwork. In the later Ming period (AD 1368–1644), granite foundation stones as large as 4.25 m by 1.25 m were used. The rubble or earthen core of the walls was faced with either brick or stone. Further west, the wall cuts across wide expanses of loess soil with little stone for building. This very fine silt was mixed into a slurry and poured between frames to create the wall, which was faced with stone or brick where possible. Stone was used again in the westernmost segment.[24]

During its history, the Great Wall has been breached and repaired, but never forgotten. Its history is carried in a body of literature ranging from poems about its beauty to tales of the horrors endured by the conscripted laborers who built it. The Wall itself is marked at each end by a tablet, though the texts are not very informative to us today. As with other monuments, the more detailed information which survives is in the contemporary written literature, whether this occurs on the monument itself or not.

Because it was built with small components, such as bricks, the Wall has needed continual maintenance over its lifetime. For our project, it is important to note that the Wall received this care probably because it served a protective purpose for the rulers of the country. The marking system for the disposal site will also serve a protective function. Although the system will be designed to need as little maintenance as possible, the Great Wall indicates the possibility that the marking system may be updated and repaired by future generations, should this be required.

### Serpent Mound, Ohio

The last marker investigated was the Serpent Mound in Ohio. It is an embankment of earth in the form of a serpent in the act of uncoiling. In its present state of restoration, the Serpent Mound consists of two parts, the serpent proper and the oval shape in front of its mouth. The oval has diameters of 38 m and 18 m and is 1.25 m high. A small mound of burned stones lies in the center of the oval. The length of the serpent is 380 m, but the coils and convolutions fit within a 225-m arc. The average body width is 6 m. The height is generally 1.25 m to 1.5 m, but it tapers until the tail terminates in a bank about 0.3 m high and 0.6 m wide. The core is stone and clay. Early excavations produced no material which could be closely dated, although the mound is associated with the Adena Indians, who built other earthworks in the vicinity (800 BC to AD 100).[25]

The Serpent Mound is an example of what not to do. The serpent form obviously meant something to the builders, but this has been lost to us. We may take this as a warning that marking a site only with symbols or pictures may not be sufficient to convey all the information we wish to future investigators. The Serpent Mound has no parallel in the United States. Likewise, there may be only one high-level waste repository in the United States. Developing a unique symbol for high-level waste repositories may be counterproductive, since it may be used a limited number of times. This lack of redundancy is something to be avoided in the marking system design.

## Lessons Learned

How do we summarize some of the lessons learned from ancient markers? First and foremost is the importance of contemporary written records to the future understanding of the monument. Languages will change, and we cannot predict which language will be readable or recognizable several millenia from now. But if we do not include written messages, we remove the possibility of reconstructing the information at some future time. It appears that only language – as opposed to pictures and symbols – may be capable of carrying higher levels of information and detail. Symbols may be of use in the relatively short-term, when their cultural contexts are still understood. The use of symbols with associated texts will give future generations the possibility of regaining the meaning of the symbol. The combined use of pictures and language is also likely to create a synergetic effect in recovering the intended information. In other words, the marking system should incorporate symbols, pictures, and languages to convey its warning and information.

The materials which survive are natural ones, earthworks and stone. This is not an effect of the technological level of the cultures which built the monuments; metals were in common use when most of the markers discussed here were built. What we see, however, is that metals show a disturbing tendency to be recycled. The Parthenon once bore a set of bronze shields erected by Alexander and an inscription by Nero. We know of them only by the written records and the holes left by the mounting pins.[26] Archaeological evidence is therefore important for indicating the difference between 'survivability' and 'durability' of materials. There are metals which are certainly durable, but their intrinsic value means they are unlikely to survive.

The monuments indicate that the primary emphasis of the marking system should be on detectability at eye-level. There is also a subtle relationship between the size and placement of the individual components and the size of the entire monument. Stonehenge, the Acropolis, the Pyramids and the Serpent Mound can all be taken in at a single glance. The patterns and forms of the monuments are immediately perceptible. The inability to perceive a monument in its entirety may hamper the investigator's ability to understand it. This phenomenon may explain why the stone circle of Avebury, which is far larger than Stonehenge, is less widely known. The component parts of Avebury are small compared to the scale on which they are set, and it is easy to stand in one part and not realize that the remaining section of the monument exists.[17] Thus we can see that the components of the marking system must be scaled to a size and placed in such a manner that an individual standing on the site recognises the overall pattern.

## Preliminary Marking System Design

### Physical description

We now present a preliminary marking design based on the information taken from ancient monuments. Its primary feature is a series of monoliths ringing the perimeter of the disposal site. The placement of these monoliths should allow an investigator to stand at one monolith and see the next one on either side. Each monolith will be inscribed with a series of symbols, pictures, and languages to convey a warning and information about the site. Repeating the information on every monolith provides the system with a great deal of redundancy. This approach allows us to be able to lose a few monoliths without jeopardizing the ability of the system to convey information.

Archaeological information has been used to suggest materials and sizes for the various components. For the perimeter monoliths, stone is suggested because of its durability and low intrinsic value. Marbles, limestones, and sandstones are already deteriorating in the acid rain we have today and so are unsuitable for this purpose.[27] (See Figure 5.) The types of stone we find mentioned least in conservation literature are those which are hard, compact, nonbrittle and relatively homogeneous, such as granite and basalt.[28] These stones are difficult to work, but then they are also more difficult to deface. The form of the monolith is tapered to shed water and to make it more difficult to re-use. The surface is polished so that water cannot collect in the numerous small-crevices and pits of an unfinished surface. A raised band around the edge protects the inscription from severe wind erosion. The façade of the Treasury at Petra in Jordan is probably in better condition than other façades at the site because it is recessed into the cliff wall.[29]

As for size, we propose a guideline of at least twice human height; most objects in museums are below this size. For an upper bound, the largest stones at Stonehenge measure 7.6 m and stand 6 m above the level of the plain. Like the stones at Stonehenge, the surface markers should be monoliths - the one-piece construction minimizes material interfaces where corrosion can begin and makes it more difficult to disassemble and re-use the marker.

### Message development

We now turn to the nonphysical aspects of the marking system - the message we wish to convey. It is relevant to indicate that we are taking an empirical approach to developing the message. The fields of semiotics, psychology and psycholinguistics, for example, are not sufficiently developed to allow the message to be designed from 'first principles down'. Yet the fact that we can translate texts which are several thousand years old tells us that messages can survive and have survived through time, cultural and linguistic changes, even if we do not understand the processes by which this occurs.

Figure 5. Medinet Habu, Egypt. Destruction of wall carvings by salt crystallization. Excellent drainage must be provided for each marker to avoid this problem.

There are three general domains for the presentation of information: symbolic, pictorial, and semantic/language.[30] There is a debate about whether pictorial and symbolic information is processed differently within the human mind from written information.[31] In any case, it appears that redundancy in the message enhances the likelihood of interpretation:

> 'Even out of context, re-presentation of an item may lead to some degree of recognition, and in this situation recognition can be enhanced by active reconstruction of the initial context'.[32]

This reinforces the conclusion from the archaeological data that all three types of messages should be used in the marking system.

### Symbols

Three possible symbols for the marking system were identified (Figure 6). The first is the uranium symbol

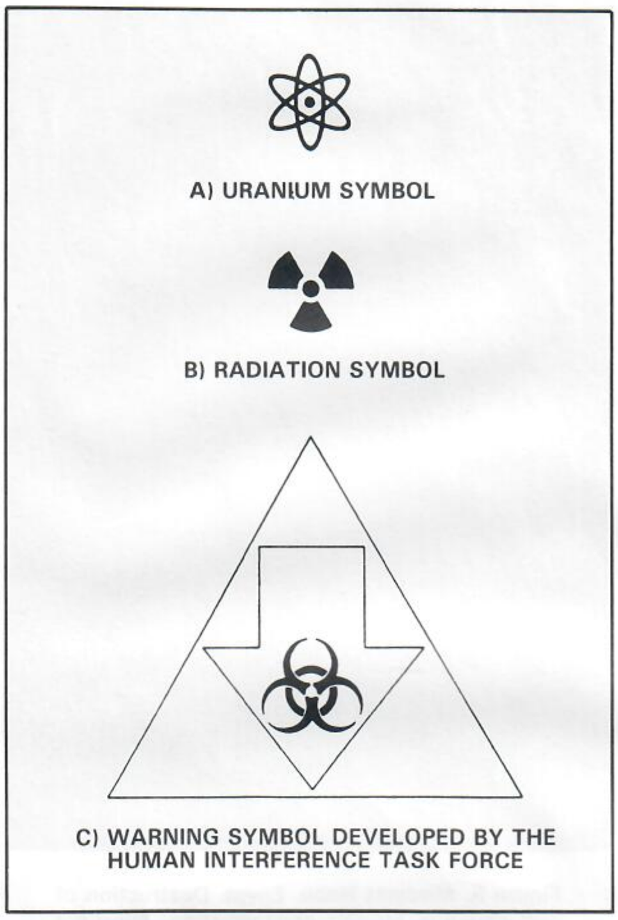


**Figure 6.** Options for the warning symbol for nuclear waste disposal sites.

which appears in an authoritative guide to international graphic symbols.[33] Two points weigh against the use of this symbol. First, its meaning is merely descriptive, and it is preferable to have a symbol with a warning connotation. Second, the waste is a mixture of long-lived radioactive wastes and it is preferable to have a symbol which identifies this situation.

The second option is the standard radiation symbol. It has the properties of symmetry, regularity, and simplicity – making it a 'good' figure.[33,34] The symbol has a warning connotation and it does not restrict the definition of the materials emitting the radiation. The radiation sign also has the positive features of long-term usage and international acceptance. It was recommended as the standard radiation symbol by the International Commission on Radiological Protection in 1956 and was adopted by the US Nuclear Regulatory Commission in 1960. The American National Standards Institute adopted it in 1969.[35]

The third option is the symbol developed by the Human Interference Task Force.[9] The triangle denotes warning, originally an arbitrary choice, but now in widespread usage in signs. The arrow pointing down is placed within the triangle to countermand any downward action. Within the arrow is the international biohazard symbol.

The Task Force chose the biohazard symbol on the grounds that there might be only two to five high-level-waste repositories in the US, while there are potentially many thousands of sites for biohazardous wastes. This reasoning ignores the many sites which could be marked with the radiation symbol, as for example, transuranic wastes, low-level wastes, and uranium mill tailings. In addition, the hazard of radioactive materials diminishes with time while toxic wastes remain hazardous indefinitely. It is not beneficial to confuse these materials in the public's mind.

The symbol may also be trying to accomplish too much. The American Institute of Graphic Arts comments on symbols in general:

> 'We are convinced that the effectiveness of symbols is strictly limited .... They are much less effective when used to represent a process or activity .... The use of symbols alone, without consideration for the verbal messages and all other signing, will only add to the confusion'.[36]

The symbol, by including the directional arrow within the warning triangle, is trying both to portray a process and to interdict it. In addition to a confusing message, the symbol may be less preferable on *gestalt* grounds because of the asymmetrical clutter at the center.[37] It is this author's preference to use a symbol which is good in *gestalt* terms, already has international acceptance, and has three decades of use to establish its context. This symbol is the radiation trefoil.

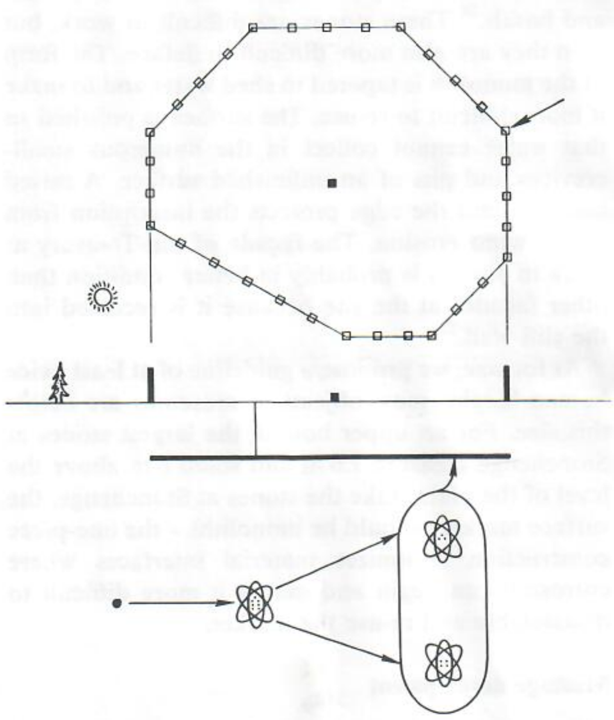

**Figure 7.** Pictograph for the location of a repository for reprocessed high-level wastes. For an actual site, the relationship between the width of the marking system and the depth of burial should be accurately portrayed.

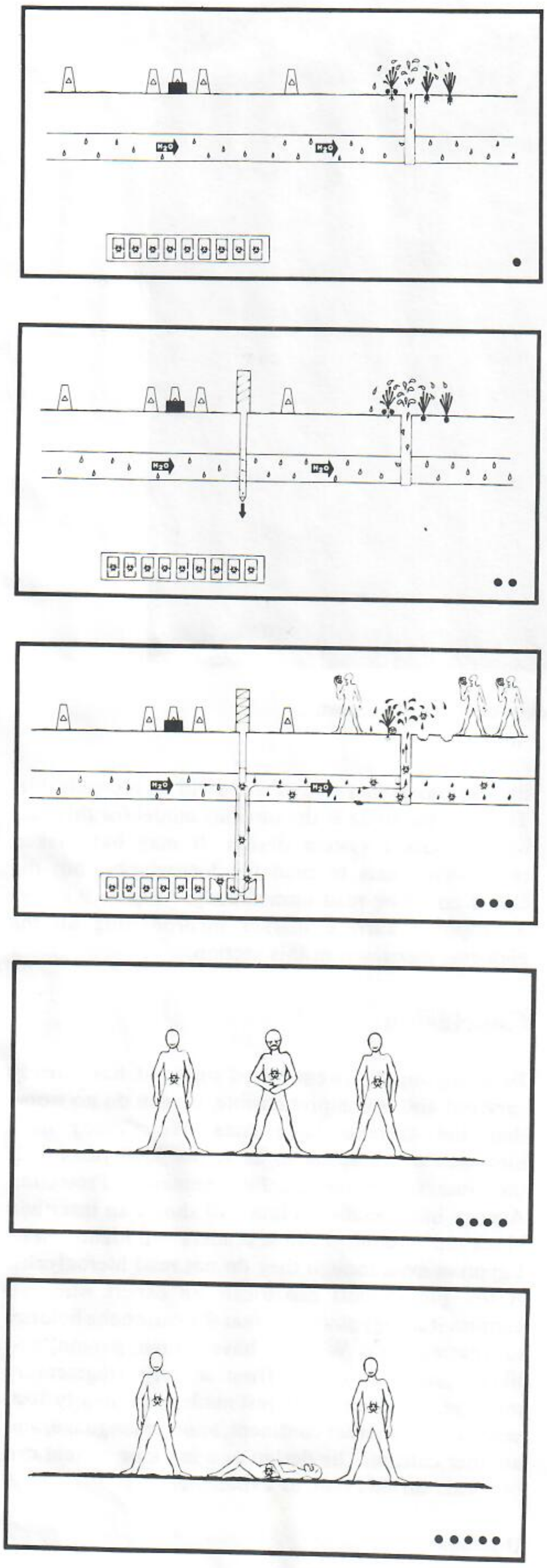

**Figure 8.** Pictograph developed by the Human Interference Task Force indicating the consequences of disrupting the disposal site.

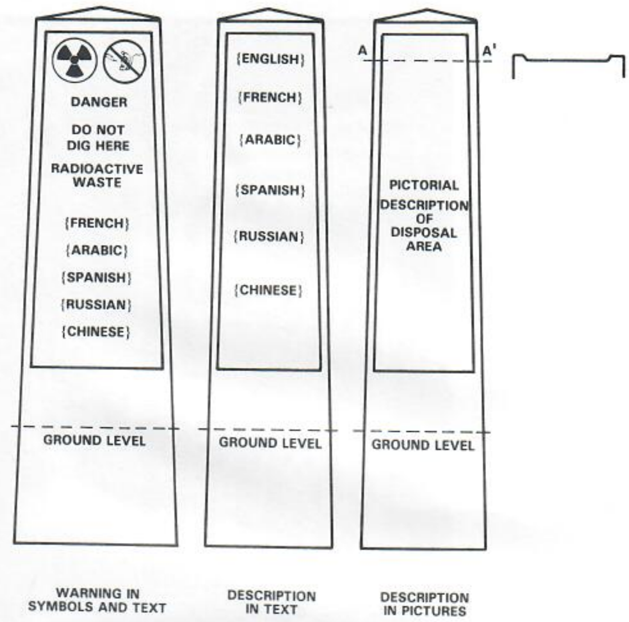


**Figure 9.** Proposed surface marker. The marker should stand at least twice human height above ground level. The width of the marker may be set by the amount of space required to accomodate the longer text in the six languages. Letter height may be set by the assumed distance of viewing.

## Pictures

A key to understandable pictures appears to be simplicity coupled with visual realism.[38] Three different ideas can be conveyed by pictures: 'do not dig', 'where the waste is buried', and the consequences of disturbing the site. A 'do not dig' pictograph can be developed, based on the principles used in designing international driving signs. The picture of a person digging with a line drawn across it overstates the hazard of the site, but it is a fairly simple message to convey. The location of the waste can be shown by a map of the site with the markers specifically identified (Figure 7). The relationship between the width of the marking system and the depth of burial should be accurately portrayed. The Task Force developed a pictograph showing the hazards associated with a high-level waste repository (Figure 8). Although the drilling operation is shown in a rather abstract way, the image of someone becoming ill and dying is clear.

## Language

Based on the work of Givens, four message levels have been identified: caution, warning/simple message, detailed information, and detailed technical information.[39] For the first text, we propose 'Danger. Do Not Dig Here. Radioactive Wastes.' Again, the surface soil will not be contaminated. The distinction that surface activities are acceptable, but that deep activities are not, may be very difficult to convey over the long term. In 35 letters and 7 words, the text conveys a warning, a description of the material, and specifically identifies a prohibited action.

Figure 10. An inscribed block shown out of context.

The longer text should include the following additional information: a further description of prohibited actions, the consequences of disturbing the site, why the system was built, when it was built, and who built it. The marking system, then, should contain enough information to answer the questions: who, why, what, where, and when. Several publications on technical writing stress simplicity, brevity and clarity.[40] A proposed text which meets these requirements is:

> This area is a disposal site for radioactive wastes. The area of the disposal site is ____ by ____ metres and is outlined by these markers. The radioactive waste is buried ____ metres down to put this dangerous material far away from people. Do not dig or drill ____ metres down. Do not drill and use a well for water without checking for radioactivity. Do not do anything to change the rocks or water in this area. Disturbing the site may cause exposure of humans to radioactivity. This may result in sickness and death. Illness may not occur until several years after exposure. This disposal site was built by the United States Government in (year).[41]

We suggest that the texts on the marking system be repeated in the six languages of the United Nations. These languages span several linguistic families - Indo-European, Sinitic, and Semitic. They are suitable for an international body, so they are appropriate for this purpose. Using six languages that are in widespread use today significantly increases the likelihood that one of them will be recognizable. The Rosetta Stone is the obvious model for this part of the marker system design. It may have taken twenty-five years to read the hieroglyphs, but the Greek could be read immediately.[42] Figure 9 shows a proposed surface marker incorporating all the elements discussed in this section.

## Conclusion

By designing a system based on what has already survived and is comprehensible, we can do no worse than the ancients have done. We already have messages which speak to us across 5000 years, half the time frame the US Environmental Protection Agency has specified. Figure 10 shows an inscribed block out of context. Most readers will identify it as Egyptian even though they do not read hieroglyphs. A few phone calls can locate an expert who can confirm it as Egyptian and that the cartouche belongs to Thutmose IV. We now have a time, person, and likely place of origin from a very fragmentary message. The connection just made spans nearly 3000 years across another continent, another language, and another culture. The design of a marking system can be based on this type of experience.

### Disclaimer

This article is written from the viewpoint of a person with a PhD and field experience in archaeology and seven years' experience in nuclear waste management. The author's views are strictly her own and do not reflect the official views of any of the agencies mentioned in the article.

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