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Living detectors and complementary signs: cats, eyes, and sirens

Article translation

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Abstract/Summary: The article proposes that society should allow any information about the exact locations of radioactive waste repositories to be forgotten and to pass on to further generations only the knowledge about the fact that radioactive waste repositories do exist and about methods of radiation measurement. This is to prevent politically relevant knowledge from being exploited. A biological option is recommended for radiation measurement: in order to make nuclear radiation perceptible to humans, animals should be bred that react to radioactive irradiation with skin discoloration. This animal species should exist as part of the ecological niche of humans, and its role as a radiation detector should be anchored in cultural tradition by introducing a suitable name (e.g., 'ray cat') and by proverbs and myths. If someone unknowingly enters a radioactive waste repository, they shall be war-ned by iconic-indexical signs. A representation of a human body part (e.g., an 'eye brea-king into pieces') should serve as a visual signal and a siren powered by radiation ener-gy, whose volume and sound correspond to the intensity of radiation, should serve as an acoustic signal. However, the authors are skeptical about the likelihood that these signs will actually be understood by the addressees and accepted as a warning.

1. POSSIBLE SCENARIOS FOR THE FUTURE

From a semiotic point of view, the problem of the transmission of information relevant to survival over a period of 10,000 years really is a challenge. Before we make our own proposals, sketching some possible scenarios of the development of mankind seems necessary to us.

First of all, we have to imagine that mankind has survived up to the point in time in question without any substantial change in its morphological and psychological characteristics – even though completely different cultures (and languages) will have existed. If this were not the case, then the presence of radioactive waste would not be much of a problem (incidentally, it is not even a source of danger to certain species inhabiting the Earth).

Moreover, the problem only arises if the practice of storing radioactive waste in deep geological repositories or in the depths of the sea has been abandoned by the time in question; otherwise, there would be maps showing the radioactive waste repositories and other similar waste disposal sites, and with the help of such maps, these places could be inspected by those responsible for radioactive waste storage on a regular basis. It should also be emphasized that the radiation emitted by radioactive waste is a clear signal for someone who knows what to look for. For a civilization that still uses nuclear energy, the detection of radioactive radiation is technically not a problem.

Therefore, we have to deal with two opposing future possible developments:

a. The first possibility is that mankind (intentionally or unintentionally) turns away from (and forgets about) all scientific achievements of our time. Thus, the production of radioactive waste and the manufacture of devices for measuring radioactive radiation would cease.

b. The second possibility is that mankind develops technical solutions for the handling of radioactive products that are not as primitive as mere disposal of these materials is. The measuring instruments would then be available, but would not be used to look for hidden

radioactive waste repositories before their existence is suspected.

Knowledge about radioactive waste can be broken down into two components:

(i) the general knowledge that such hazardous repositories exist at all,

(ii) the specific knowledge of the locations and age of the repositories (or dates of deposit), which allows the assessment of risk for each point in time.

If both of these types of information are unknown, a certain amount of danger arises from the accidental discovery of such a deposit by researchers or scientists who are not prepared for the possibility of nuclear radiation. Another type of danger arises from sudden or continuous changes in the geological situation: what was previously deeply buried or covered by the sea could become accessible or begin to surface. Furthermore, the methods used for sealing radioactive material in order to prevent their spreading (with consequences such as high-level poisoning of the environment) could turn out to pose a risk in the long run: a certain degree of control or monitoring could become necessary to prevent any critical dissemination of radioactive substances.

Both types of information mentioned widely being known and passed on to later generation, (we will discuss the possibilities of this later) would risk either a kind of collective psychosis or, on the contrary, a general disbelief that would leave the population unprepared in the event of any increase in danger. Furthermore, some individuals might be tempted to use their knowledge for the destruction of their enemies and/or gain power through terror. Others might conceive of the 'dangerous' or, worse, the 'forbidden' places as daring challenges in the same way in which 'sacred' places have always attracted unwanted intruders. Instead of appearing repulsive – as intended by the dissemination of knowledge about them – the repositories might become sites of attraction.

One way forward could be to make all the information about radioactive waste repositories disappear from the memory of most people and to make the relevant knowledge, especially the exact knowledge of the places, a secret of some 'happy few'[1]. As people tend to be conservative about maintaining certain privileges that separate them from their fellow people, the elitist traits of such a society would certainly help keep that secret remembered. However, the risk then arises that the initiates may be driven to megalomania by their exceptionality, or that they may employ their knowledge of the repositories to terrorize their subordinate brothers and sisters whenever their authority is in doubt. *Quis custodiet ipsos custodes*?

We believe that the two types of information mentioned above should be treated differently over the long period of time that separates our civilizations from those of our descendants. The existence of such dangerous places as radioactive waste sites should be remembered, as should a method of detecting radiation. The exact places and times, however, should generally be forgotten.

In case of accidental discoveries, danger signs should nevertheless be affixed on the containers themselves and installed in their immediate surroundings. Ideally, these signs should simultaneously have the effect of warning those who are unaware of the danger as well as disturbing those who would dare to enter.

2. HOW CAN A MESSAGE BE RECEIVED FOR THOUSANDS OF YEARS?

It is likely that a certain knowledge will be forgotten and not passed on to the next generation if it is no longer of immediate interest. In the past, people of faith have succeeded in transmitting their knowledge about life and death in wonderful stories and suggestive rituals. Unfortunately, there is no absolutely universal religion at present, and if there were, it would still be difficult to introduce new information into its system unless permitted by the religion's authorities. As for the founding of a new religion: that is unlikely to succeed, since we know well how many old religions have already disappeared.

Works of art (or what passes for works of art, even if originally intended for other purposes) will probably continue to be passed on and copied or restored when necessary. Hopefully, radioactive waste will inspire numerous well-known poets, novelists, musicians, painters and sculptors. But it will be difficult to convey knowledge and terminology as complicated as that required to build a radiation detector in this way. The same goes for knowledge of the exact location and age of any given repository. The latter information could probably be better preserved by means of a religious system, which, after all, has a historical dimension. But, again, many of the required details will likely be lost. Because cultures will have changed considerably, many contemporary religious practices and works of art will merely be dissertation topics for archaeology students of the future.

Establishing dates and places by means of ancient documents represent a scientifically successful and efficient method of investigation. This method would have to be used by our descendants when today's units of measurement and points of reference will have changed. For example, the shape of the seas and continents and even today's astronomical landmarks could become misleading over time as the continents shift and the astronomical sky evolves.

According to what has been said so far, it seems to us that the only way to preserve technical knowledge 'forever' is through its own reproduction. Since reproduction without any particular external motivation is a property of life, we are forced to think in zoosemiotic terms about a living radiation detector. Of course, in order for a species not to go extinct, it should have a suitable ecological niche. And what better niche than that of humans, at least

1 English in the original text.

insofar as we hope for them to survive as well! For our purposes, we have to choose between the many animals which have been preserved by humanity so far. For us to get an effective detector, the animal should react to an increase of radiation with a noticeable change – but not with death. Death could mistakenly be interpreted as random natural death. Moreover, it would threaten the process of reproduction. There is an interesting case of hypersensitivity to radiation. In xeroderma pigmentosum, due to a genetic defect in the DNA repair mechanisms, radiation covers the skin with spots and marks. This is just one example of a sensitivity to radiation that could be transferred to other species.

Nevertheless, the question remains how the use of such a detector should be remembered by people. Even though the problem is not as pertinent if we relate it to a living being, the solution depends on a careful choice of the species. For example, it would not be convenient to choose a microorganism that only becomes visible when radiation increases. Rather, the presence of the detector should constantly occupy its host in thought and trigger something like a feeling that facilitates remembering in the same way in which religious beliefs or aesthetic pleasures have increased the chance of preserving certain other information. If the detector were a nice, undemanding, and friendly animal (for example, a cat, which was already held in high regard as a housemate by the ancient Egyptians), it is likely that the descendants of that species could persist through the millennia. The species should be given a carefully chosen name that is at once suggestive and enigmatic. It should arouse the curiosity of new generations. For example, by explaining the name 'ray cat' (French 'radiochat', German 'Strahlenkatze') the detector properties of the animal could be passed on to future generations.

In principle, any animal that people have become accustomed to taking into their homes and feeding, or even any decorative plant that has been manipulated for detector purposes, could be employed. A large variety of live detectors should be offered and tested by people who live near nuclear power plants and are aware of the risks as soon as possible. It is easier to accustom people to a certain knowledge if it allows them to follow the well trodden path of an ancient cultural practice, than it is to found a new religion or to impose new works of art on people.

As soon as the detector in question will have proved its efficiency in the near future, its use will remain in the collective memory through proverbs, fairy tales, stories or myths that will arise spontaneously. A collection of folk tales could be prepared, for which an understanding of the artistic use of language could be useful. Knowledge of the kind described could possibly be protected from the effects of cultural change by occasionally passing into pleasant customs or into the worship of a household god.

3. WHICH TYPES OF SIGNS WILL STILL BE EFFECTIVE IN 10,000 YEARS?

Before designing signs for the future, it seems appropriate to us to take a critical look at the signs used today. Peirce and Greimas offer appropriate classifications here. First, we can distinguish:

a. Signs of an abstract kind (symbols), which are intelligible within a given culture, and

b. Signs of a figurative kind (icons), which can be identified by their similarity to everyday observable properties of things.

Only the second type can be used for our intentions. Iconic signs may represent, for example, an anthropomorphic figure performing an action, or a particular object. In the latter case, the question is how the relation between the object and the actions that the sign calls for can be modelled by the sign. Let us clarify these problems with a few examples:

The image of a fried chicken leg means that there are chicken legs for sale in the place marked by this sign. In this case, the represented object is exactly the object that can immediately satisfy a certain need. However, the drawing does not reflect the dimensions of the object, so it could just as easily be identified as a ham leg or as an impact weapon. This can be prevented if other, clearer signs are present – for example, those showing the cook (identifiable by a chef's hat) preparing the chicken. In other cases, signs do not represent the very object to which the required actions are to be directed: a sign depicting a knife and fork means 'possibility to eat', but not 'possibility to buy a knife and fork'. The sign here shows a tool that is culturally related to the practice of eating. A skull with crossed bones, on the other hand, is supposed to show the final state of a person who attempts to intrude on the location designated by the sign. Now, in another culture, couldn't a picture with a knife and fork mean that unwelcome intruders are being eaten? Or could the Jolly Roger not mean that customers here have the opportunity to buy bones?

In order to solve the problems pointed out, one could tell the whole respective story in pictures – starting with the sender and ending with the final state of the reader. But what prevents such a story in pictures from being read backwards? To return to the first example: Instead of 'Here is something specific to eat', why doesn't it read: 'How to become a cook'? The reader might also give a paradigmatic interpretation to a series of drawings instead of a syntagmatic one. If a signal complex like a 'cartoon' were needed, semioticians would have to think about how to convey what should be the initial and final signals and how to guarantee the irreversibility of reading. The question of irreversibility must also be considered in cases where the signs represent human figures performing an action. These signs seem to be more suggestive in the long run than signs representing objects: whether an object is attractive or repulsive cannot be conveyed in a drawing. Rather, such judgments depend on the general tastes that are shaped by a subject's cultural environment. Desire,

pleasure, fear, or disgust, on the other hand, are signified to an observer through facial expressions and gestures. These expressions are dependent on human morphology, not on cultural norms. They are therefore less sensitive to a general change in taste. Moreover, morphology is a human characteristic that is unlikely to change much in 10,000 years because it has been around much longer.

Concerning the marking of the waste containers themselves with a sign signifying radiation, the imagination is limited by technical constraints. The sign should be simple enough to be automatically applied to the containers during the processing of radioactive waste. Based on the above considerations, we would like to propose an anthropomorphic signal. The image of an eye breaking into pieces comes to mind. The eye is a common metonymic representation of the human being because the face is one of the predominant ways of contact with the perceptual world. Since the eye is a receptor for light, the sign also makes reference to rays. The image of the broken eye is a figurative sign representing discontinuity. Discontinuity is associated with one's own death and unforeseen (natural) disasters. Therefore, it is likely to continue to be difficult for humans to bear if the natural tendencies of human fear persist. In order to make it clear that it is, in fact, the process of breaking and not an already broken eye that is being depicted, the line running through the breaking eye is drawn wider at the top than at the bottom. This suggests that the ever-present gravitational force of the earth will cause the eye to irrevocably fall apart. Of course, the representation of the eye should not be symmetrical so that it will be read correctly regardless of location (an eyebrow could be added, for example). The properties of this sign should deter people who have accidentally discovererd a radioactive waste repository. If technically possible, red color could be used, since red is the color of spilled blood and is associated with danger of wounding and death.

The proximity of the storage site should also be signaled, although it is uncertain whether such signs can survive, since the topology of the site could change over time (while the containers are supposed to be indestructible!). An acoustic signal could conceivably be used to complement the visual sign: acoustic signals, unlike visual ones, have a built-in syntagmatic structure. However, it could be difficult to develop a device that produces sounds which is still functional after 10,000 years. This is true even if the radiation emitted by the waste were to serve as its power source. It might be safer to use the intruder itself as a source of noise, with the volume passively modulated by echoes or acoustic insulation. If the repositories are former mines, certain means to reflect the sound generated by the intruder might be applicable.

Regardless of the specific solution for sound generation, it should be implemented so that within the periphery of the dangerous place, the sound will be louder when someone is moving toward the deposit – and quieter when someone is moving in the opposite direction. That way, those who do not want to be in danger are guided toward the exits. Near the danger zone, on the other hand, the intensity of the sounds will be modulated in an aleatory manner to confuse, discourage, or hold back those who intend to proceed further into the repository. The passage system of a mine, for example, could play the role of a labyrinth, confusing intruders not only by the topography of the site but also by the nature of the acoustic signals. If a reliable sound-producing device were available, more sophisticated sound modulations would also be possible. Besides variations in intensity and rhythm, changes in wavelength would facilitate guidance. A signal intended to guide towards a specific location can be effective only if one or more of its qualities change in relation to target distance. A simple warning signal, on the other hand, must be able to draw attention to itself first and foremost. Normally, this can be achieved by sudden activation and/or termination, by repetition of sound sequences, or by other processes that are characterized by what semioticians call their 'aspect'.

In addition, the signal should be similar in some way to the phenomenon it warns of, at least as far as its euphoric or dysphoric character is concerned. For example, during the last war, the approach of bombers was announced by sirens and the end of the danger was signaled by short repeated sounds. Sound signals like these are syntagmatic phenomena. When they begin, they create a sense of expectation: those who hear them will try to guess what might follow. If the sounds have a fixed rhythm, this is easy: if someone tries to identify a melody, they will find any surprising turns in the pattern to be pleasant; repetitions, on the other hand, seem tiring, but one can get used to them and forget the sequence of sounds. The sound of sirens, however, seems depressing, which could be due to the fact that it has no definite 'form'. The unsettling character of the signal could be enhanced by completely unexpected sequences, which would prevent the identification of any kind of structure. Such sequences could be produced by random variation of sound frequencies and intensities, or by randomly distributed periods of noise and silence. This could be accomplished with a single source of noise or with multiple devices producing irregular and random interference. The basic idea of these considerations is to produce a kind of maze, or rather, chaos, that confuses both human and non-human intruders.

It should be noted that a similar effect could be achieved if appropriate modifications of light signals were used. However, there is the problem that any play with light could be interpreted as a sign of beauty.

For this reason, among others, we would like to ask a final relevant question: will a subject take the meaning and perlocutionary effect of the warning message literally and accept it? Or will they read it as fiction? If so, the predictable effect would be quite different from the desired one – and we could not change it.

For a mouse, a trap is a trap. That is why mousetraps work.