



Re-enacting memory: an exploration of ritual in art and science in the context of a proposal for the burial of radioactive waste in Sardinia

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Abstract.

This paper discusses the role of *ritual* in art and science concerning the transmission of memory in nuclear heritage practices.

10 The concept of ritual is analyzed following its use in religious studies, science, and artistic research: as a means of transmitting memory about nuclear waste, as well as in relation to the concept of “nuclear mundane”, here intended following Pannekoek’s definition as “contemporary techno-political mechanisms through which the unthinkable timescales of nuclear energy become banalized and figured as regular industrial risk” (Pannekoek, 2020). The paper focuses specifically on the territory of Sardinia, Italy, to address a proposal to build a nuclear waste repository, through artistic research and the

15 artwork “Canticle of the nuclear sun”. The artwork explores the ancient practice of “Canto a tenore”, a form of polyphonic singing for four voices, via a ritual created to transmit knowledge about nuclear waste. In the artwork, the re-enacted ritual is conceived as a repetition of forgotten instructions, which overlaps with the remnants of an ancient prayer, thus failing to transmit a clear message. Through an analysis of this research, the paper intends to make the point that “scientific rituals” function in the same way as religious rituals in that they can confer sense to the ungraspable and the overwhelming of

20 nuclear heritage practices, by filling the gaps of human knowledge. The nuclear mundane, encompassing what is overlooked in nuclear politics, becomes, through ritual, an expression of those institutional practices that claim to master the unknown.

1 Introduction

Through its ceremonial re-enactment, ritual entails performative practices of remembering, transposing time through bodily gestures to evoke primordial acts as signifiers of the past. But what does it mean to retain memory when it concerns the

25 unwanted, the discarded, the waste? This paper examines the similarities between rituals in art and science, with a focus on nuclear waste, through artistic research. My artistic work develops in what I have defined as “ritual patterns”, namely, artistic practices that loosely stem from the broader umbrella of rituals. My method involves a reappropriation and re-interpretation of traditional ritualistic practices through performative artworks. Ritual is here explored through artistic



research to question existing systems of knowledge production in relation to the disposal of nuclear waste. In my artistic approach, rituals are considered a form of cross-generational sentience, or material memory transmitted through the body. If sentience refers to the ability to experience, through the means of ritual, this ability may extend beyond that of the single individual, as well as beyond a single human generation.

When looking at practices that could enhance remembering across generations, and specifically memory about the burial of nuclear waste, the two poles of the sublime and the mundane come into question: the nuclear sublime encompassing the unthinkable, those aspects of nuclear technologies that slip one's ability to grasp them, such as the incommensurability of a nuclear apocalypse, and the infinite timescales of nuclear decay; on the other hand, the nuclear mundane is enacted in the ordinary, in the small numbers that bear no supposed effect on health, in the banality of scientific routines.

The concept of "nuclear mundane" has been articulated by Laura Pannekoek in a dialogue with Frances Ferguson's definition of the "nuclear sublime" (Ferguson, 1984). If the "nuclear sublime" describes the paradox of thinking the unthinkable, the "nuclear mundane", according to Pannekoek, defines the "contemporary techno-political mechanisms through which the unthinkable timescales of nuclear energy become banalized and figured as regular industrial risk" (Pannekoek, 2020, p. 189). Following this definition of the nuclear mundane, I consider scientific rituals in the techno-political management of nuclear waste as an expression of those institutional practices that claim to master the unknown, to address a primary concern regarding the socio-political and ecological implications involved in the perpetual management of nuclear waste. This concern points to the fact that it is not possible to predict the human and geological future in a way that can surely prevent future harm, as it might arise from the long-term burial of nuclear waste to both humans and non-humans. The temporalities involved in managing this kind of waste simply exceed human capability to predict or control the future, identify and prevent all possible risks. Radioactive waste has, however, been produced and will continue to be produced, thus augmenting the scale of the problem and the exceptional nature of its aftermath.

Considering that one of the issues regarding the burial of nuclear waste is how to assure transmission of memory across different temporalities and generations, a focus of this article is an analysis of rituals in art and science from two different standpoints: rituals are seen as a possible way of transmitting transgenerational memory, as well as a way of making sense of something otherwise ungraspable; when the overwhelming and the unknown come into question, ritual practices may be used, intentionally or not, to fill in the gaps of human knowledge.

This is not a novel position. A similar reading of ritual in relation to nuclear science has been proposed before. Anthropologist Hugh Gusterson, for example, has looked at nuclear weapon testing as a form of ritualistic practice, suggesting that the ritualized performance of nuclear testing in Livermore Laboratory, USA, until the late 1980s functioned as a way of creating "a space where participants are able to play with the issue of human mastery over weapons of mass destruction and symbolically resolve it." (Gusterson, 2013, pp.142-143). In other words, the performance of nuclear testing as a ritual served to convey a sense of control over the destructive power of the bomb. In the same guise, while I am not intending to diminish expert knowledge in the sciences, I want to make the case that scientific protocols, such as safety inspections, can be read as a form of ritual that functions in a similar manner to religious rituals in that they allow political



powers for the neglect of personal and societal responsibilities by entrusting “higher forces” when a sense of control is lacking. The entity to which such responsibilities are entrusted is, in this case, not a deity but the power of science.

65 Rather than assigning a positive or negative value to ritual, I wish to think through ritual within the context of artistic research. If rituals in science may serve as a means of reinforcing political statements, the scope of art is different, in that it often aims to challenge existing power structures. My research approach examines artistic practices as forms of embodied knowledge, specifically by reinterpreting rituals as a way to reflect on transgenerational sentience, memory, and the deep temporalities of nuclear energy practices. In the title of this paper, the idea of re-enactment refers to repetition as
70 one of the characteristics of rituals. My artwork “Canticle of the nuclear sun”, examined in relation to the transmission of memory about nuclear waste, is thought of as a ritual, caught in the process of its own re-enactment: if ritual entails repetition of a primordial act, in the same way, remembering is repeating an origin; but repeating also involves creating and re-creating new origins to be repeated. A re-enacting of memory through ritual thus necessarily blurs this memory in the very act of transmitting it.

75 2 Research context

This research develops along with the artwork “Canticle of the nuclear sun” which I created, in collaboration with the group Tenore Murales from Orgosolo, to address the Italian government’s proposal of planning a facility for the disposal of radioactive waste in Sardinia, where eight sites have been identified as possible locations to host a national repository. The construction of a nuclear repository for radioactive waste in Italy represents a solution to an old problem: Italy voted against
80 nuclear power in a public referendum in 1987, which followed the Chernobyl nuclear disaster. This resulted in the shutdown of all Italian power plants and research reactors between the late 1980s and the early 1990s. However, the new legislation did not provide regulations for the decommissioning of the plants, but only a temporary hold, which ultimately led to neglected care for the already produced waste. The proposed construction of a national repository was initially planned as another temporary solution to store this waste for the next 300 years; this initial phase likely served as a testing ground to seek
85 consensus between the institutions and the local population. Furthermore, while the construction of a repository for storing radioactive waste addresses an existing issue, it also implicitly enables the future production of this kind of waste: in fact, Italy has just reverted its anti-nuclear stance and committed to reintroducing nuclear energy in 2030.¹

Nuclear waste derived from past production is currently not present in Sardinia. However, 60% of NATO military bases in Italy are located in this region (Fig.1). The military areas have also been used as a testing ground for experimental
90 weapons, along with the disposal of old weapons and chemicals. Birth malformations and cancer within the population, as well as a number of animals reported as born with deformities, are connected to these practices, in particular to emissions of depleted uranium. The island of Sardinia is sparsely populated and distant from the mainland; nuclear policies implemented in this territory thus reflect a history of colonial practices that have accompanied nuclear energy production since its inception (see, e.g., Nixon, 2011; Nye, 2021).



95 **Figure 1: A fence delimiting military ground in Sardinia. Image: Aurora Del Rio.**

2.1 Canto a tenore

Sardinia is one of the oldest geological formations in the Mediterranean Sea, and traditions rooted in folklore are believed to date back to prehistoric times (Fig. 2). The art project “Canticle of the nuclear sun” departs from the ancient folkloristic practice of the Canto a tenore, a local form of polyphonic singing for four male voices, to address the issue of radioactive waste disposal and heritage practices. In the artwork, the ancient singing is re-enacted in the form of a ritual as if it had been passed down to future generations. The singing of the traditional Canto a tenore is performed by four voices; while the solo voice sings in the local Sardinian language, following a musical repertoire that often addresses themes of cultural identity and political issues, the three voices composing the “choir” produce sounds that have been identified as imitating the sounds of livestock. However, these sounds performed by the choir have recently been interpreted in a novel way: for linguist Andrea Deplano (2020), even though apparently without meaning, these sounds are understandable when interpreted through the Sumerian/Akkadian language; interestingly, the sense of those forgotten words can be read as an ancient prayer to the Sun-deity.

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110 **Figure 2: A Domus de Janas, burial site dating back to the Neolithic in Sardinia. Image: Aurora Del Rio.**

Deplano's research follows a new theory on the etymology of the Sardinian language recently proposed by Salvatore Dedola, who has analyzed similarities between certain Sardinian words and toponyms and those of Sumerian and Akkadian (Dedola, 2012). According to this research, the singing of Canto a tenore can be deemed to incorporate a language that dates back to the Nuragic civilization (1800-1000 BC). Considering how this singing has enabled the survival of ancient prayers through
115 millennia, and considering how, following anthropologist Paul Connerton (Connerton, 1989-2014), ritual ceremonies are a way society uses to convey memory, in the artwork, I envisioned the traditional singing as a ritual that may still be performed in the deep future: the work speculates on the possible transmission of some memory concerning the burial of radioactive waste through the song. Connerton proposed the idea of "habit memory", in relation to ritual, as a performative feature: for Connerton, rituals are a privileged form of encoding memory through the learned attitudes of the body,



120 transmitting a form of tacit knowledge that is passed down through generations. In the context of this research, I consider the idea of “habit memory” conveyed through ritual as cross-generational sentience, namely, non-verbal embodied knowledge.

The idea of the ritual in the artwork is not intended to suggest that memory can be successfully passed on to future generations through singing. On the contrary, ritual acts as a repetition of forgotten instructions, a lost map to the knowledge of the buried waste, which ends up overlapping with the Sun's adoration expressed in the ancient prayer. This overlapping is reflected in the Sun-myth, which the artwork follows. The sun is seen as both a source of energy and an object of adoration. If nuclear processes occur naturally in the sun through a fusion reaction of hydrogen nuclei into helium, then nuclear technologies can be thought of as striving to achieve on Earth a process that belongs to the stars, and our sun. The Sun-myth in the artwork thus aims to merge two worldviews: an ancient adoration of the Sun as a deity, with its current re-enactment: a striving to produce energy in the guise of an almost religious adoration. The significance of the ritual thus lies in reconciling somewhat opposing meanings into a new understanding of underlying mythical and symbolic elements. The meaning of ritual itself encompasses opposite stands: if ritual can be used in nuclear politics to establish a sense of control over the outcome of uncertain operations, such as managing radioactive waste across generations, art and artistic research, on the other hand, use ritual in this case to point to what exceeds the boundaries of human knowledge.

3 Ritual theories and ecology

135 In common use, the term ritual describes a repeated pattern of behavior, which often constitutes a custom or a practice shared by a group of individuals. Although belonging to an interdisciplinary field, ritual studies are a subset of religious studies. Similar in meaning to the word *rite* in the description of a practice, ritual is considered a symbolic action that differs from rite, which is linked to a specific religion or cult. This article presents rituals as generated and explored through artistic research, specifically in my project “Canticle of the nuclear sun”, and in science. The focus of this analysis is on how rituals, intended as a form of cross-generational sentience, may inform or impact nuclear heritage practices. My artistic method uses a re-interpretation of existing rituals through performative artworks. In the context of my artistic research, I have defined “ritual patterns” as artistic practices that loosely originate from rituals. Artistic research in relation to ritual is examined here as a means to question existing systems of knowledge production.

The definition of the term is relatively recent, dating back to the turn of the past century.² The word ritual itself, which comes from Latin, may have derived from the Sanskrit *Ṛta*, with a reference to the principle of a natural order, or the structure of cosmic events (Boudewijnse, 1998, p. 278). Following the meaning of this possible origin, a ritual action may serve to align those who perform it with a wider cosmic order. This is an interesting idea when considering the use of ritualistic practices in the context of the current ecological crisis, particularly in relation to the need for continuous care of contaminants that did not exist before, such as human-produced radioactive waste. Rituals may symbolize the possibility of restoring an ecological order by restoring to normalcy what has gone astray.



As early as 1967, historian Lynn White proposed that the Judeo-Christian idea of creation, dominant in the West, can be the root of the ecological crisis. Specifically, for White, such a worldview implies a deeply anthropocentric perspective, where the world, and nature itself, are intended as created to serve mankind's purposes; in other words, to be exploited. At the opposite pole is, for White, pagan animism, where the existence of "spirits" in nature and inanimate objects fosters an attitude of respect towards the non-human; an attitude that the Judeo-Christian tradition has ultimately lost. White proposes that "since the roots of our trouble are so largely religious, the remedy must also be essentially religious, whether we call it that or not" (White, 1967, p.1207).

Something similar has been illustrated by anthropologist Ronald Grimes. In "Ritual theory and the environment", Grimes reflects on how rituals have been considered in the context of the ecological crisis, opening the question of whether ritual and ritualizing may be ultimately "good for the planet" (Grimes, 2003, p. 43). According to Grimes' analysis, a possible reason for considering a positive influence of ritual on ecology is that rituals may foster a return to balance in both the human nervous system and, accordingly, this may impact planetary health (Grimes, 2003, p. 38). However, when addressing how rituals may produce societal change or even ecological healing, one needs to consider the importance of distinguishing the particular kind of rituals that are examined, as well as the ideologies or political grounds on which these rituals are based and performed. For ritual necessarily conveys an intention that goes beyond a sole religious attitude, and such intention emerges as intertwined in a specific socio-political context. Even if an ultimate positive answer on the impact of ritual is challenging to sustain from an ecological or otherwise social perspective, the current state of research brings attention to a possible relationship between ritual and ecology.

Could some form of ritual then, either related to an existing religion or not, act as an ecological remedy? In the case of the burial of nuclear waste, a remedy would mean, at the very least, that the placement and the nature of the waste are remembered across generations. One remarkable aspect of rituals is how they can convey and repeat specific forms of behavior across time, thereby contributing to the transmission of transgenerational memory. This has been illustrated by anthropologist Paul Connerton, who has identified rituals and specific ceremonial practices, or commemorative ceremonies, as a privileged means of transmitting societal memory. For Connerton, ritual conveys bodily memory, or "habit-memory" (Connerton, 1989-2014, p. 23), which is a performative feature: "in habitual memory the past is, as it were, sedimented in the body" (Connerton, 1989-2014, p. 72). As a form of performative encoding, commemorative ceremonies have the special characteristic of a ritual re-enactment because they "explicitly refer to prototypical persons and events, whether these are understood to have a historical or a mythological existence" (Connerton, 1989-2014, p. 61). This characteristic, according to Connerton, is a prerequisite for the transmission of communal memory.

An example that Connerton provides is how bodily practices tacitly communicate rank or social status through culturally encoded postures. As concerns ritual in commemorative ceremonies, the reproduction of a posture, for example, kneeling, identifies "the disposition of their body with their disposition of subordination" (Connerton, 1989-2014, p. 59). A particular kind of resistance to other forms of narrative and preservation of memory is thus entailed in bodily practices, which can "believe or override our conscious decisions and formal actions" (Connerton, 1989-2014, p. 93).



185 As we have seen, this paper considers the possible impact of ritual in relation to the transmission of memory about
radioactive waste. A need to preserve such knowledge concerns the planning of deep geological, or final repositories for the
long-term management of radioactive waste, which can extend over a timeframe of up to a million years in the
future. Assessing the Earth's geological future is an incredible challenge as well as an unprecedented task, which exceeds
human capabilities to predict the future of the planet as well as the future of the human race itself. If ritual is considered here
190 as a possible way to transmit memory, on the other hand, it is clear from the onset that such a memory is bound to the
survival of the civilizations that retain the knowledge about the waste. However, it is also in the wake of these kinds of
uncertainties that ritual operates.

My claim is that ritual practices encompass a variety of human attitudes, which are manifested through repetitive
symbolic actions; these actions, which extend far beyond what is immediately definable as ritual, nonetheless function in the
195 same way as religious rituals in reinforcing ideologies and collective narratives through repetitive behavior. Such ideologies
are currently tied to the root metaphor of capitalism: a narrative that regards energy as a primary concern of capitalist
societies. The same narrative regards the ecological/societal price to be paid to supply an increasing need for energy as
feasible, even when not enough information is available to sustain such a position. Following this line of thought, I call
“scientific rituals” those procedures used to ascertain what constitutes knowledge, such as determining the outcome of an
200 uncertain operation on the basis of the scientific protocols that are followed. Concerning nuclear waste, specifically,
scientific rituals are what enable ethical questions, such as those on the feasibility and safety of the planned operations, to be
set aside. The following section elaborates on this.

3.1 Scientific rituals

The concept of a scientific ritual is not new. If, as we have seen, Gusterson has specifically addressed nuclear weapon testing
205 as a ritual, scholars that are considered the precursors of STS have previously opened the ground for such a discussion by
looking specifically at the changing concept of technology and its functioning, for example, in the framework of actor-
network theory (Latour, 1987). A novel position is proposed by anthropologist Bryan Pfaffenberger, who considers
technology as a humanized nature (Pfaffenberger, 1988, p. 244). What is intended is a stress on the complex social
intercausal relations between society and technology. The analyzed example illustrates how infrastructures, in specific Sri-
210 Lanka irrigation settlements, are conditioned by existing ideologies while at the same time they shape new social relations.
Pfaffenberger proposes that if, on the one hand, technology emerges from current socio-cultural worldviews, on the other
hand, technology itself creates a new social context; indeed, new principles for social relations emerge through the creation
of new technologies. At the same time, for Pfaffenberger, “creating a successful technology also requires creating and
disseminating the very norms that define it as successful” (Pfaffenberger, 1988, p. 250). It follows that such norms are easily
215 taken for granted.

An interesting reading of ritual in relation to new technologies comes from religious studies. In “Laboratory ritual”,
scholar in religion, science, and technology Robert Geraci, following Latour, has made the point that religion and science



share “the significant characteristics of particulates embedded in mediated networks” (Geraci, 2004, p. 901). Geraci further defines laboratory research as “a form of human ritual open to interpretation in the manner of religious ritual”. The claim is that scientific experimentation can be analyzed through ritual theory. Laboratories are, therefore, for Geraci, places of ritual experimentation, where knowledge is produced according to an existing framework that defines the network itself; ritualized procedures would then act “as the safeguard of reliability”. Geraci also stresses the liturgical aspect of ritual, which is characterized by endless repetition: “should the ‘relators’ be correctly aligned, the experiment will yield the desired results. Truth takes on the power of the sacred through ritual, be it scientific or religious.” For Geraci, the main difference between science and religion is to be found in what questions are respectively asked by the different disciplines.

As concerns nuclear technology specifically, a focus of this paper, the technological advancements of the last century, particularly the discovery of radioactivity in 1896 and the subsequent production of radioactive energy for military and civilian use starting in the 1950s, brought the modern world to face an unprecedented issue. Nuclear energy generates nuclear waste as a byproduct; as we have seen earlier, the open question that nuclear-producing countries are addressing today is how to deal with the radioactive waste, considering that some of this waste will remain radioactive for a timeframe that will likely exceed the lifespan of current societies. Radioactive waste has been categorized in relation to the time needed for its decay: as concerns what has been called high-level waste, the proposed inventory of final geological repositories, the timespan that European countries are considering when taking into account its safety for future humans is 100,000 years. As historian Gabrielle Hecht has noticed, this timeframe “exceeds human *language* horizons” (Hecht, 2018, p. 132). Given the difficulty of transmitting information across such an incommensurable time, scholars have looked at the use of speculative practices in various ways; in the following, I will focus on the use of semiotics and artistic research for the aim of marking a waste site, namely, delivering some sort of messages to the future generations about radioactive waste.

3.2 Ritual markers

Semioticians have been repeatedly involved in the task of finding a possible way to communicate the dangers of radioactive waste to future generations. Interestingly, Mazzucchelli and Paglianti have analyzed different approaches to nuclear speculative semiotics over the past forty years, noting that nuclear semiotics appears to have shifted its focus from delivering long-term messages to developing strategies of “heritagization” of waste sites (Mazzucchelli & Paglianti, 2022, p. 23). Typical of a process of “heritagization” is considering the waste site as a kind of monument. Following the logic of the monument, waste repositories have been considered in different ways: as an informative monument, where a spatial system is built to warn an unaware intruder; this is represented by the example of the Human Interference Task Force project for the Yucca Mountain site in the 1980s (Mazzucchelli & Paglianti, 2022, p. 27); as a negative monument, which would give the sense of something to be avoided; an example is the Waste Isolation Pilot Plant project in the 1990s (Mazzucchelli & Paglianti, 2022, p. 27); outside of the logic of the monument, another proposed way of considering the site is as a place that would invite the visitor in, suggesting that the site could become a lived landscape. This could take the form of a forgotten



250 site, as planned, for example, in Finland, where the nuclear waste burial place will remain unmarked and given back to nature, as the current proposal is to leave the contaminated environment as close to its original state as possible.

Under the umbrella of the waste site as a lived landscape are proposals of artworks that have been submitted in response to different contexts: “Blue yucca ridge” is a proposal by artist Ashok Sukumaran (2002) to mark the Yucca Mountain site in the USA through a genetically modified blue yucca. Stéphane Perraud and Aram Kebabdjian’s “La zone
255 bleue” (2015) is, similarly, a genetically modified blue forest, proposed as a response to ANDRA’s open call for an artwork to mark the French nuclear waste site. Another proposed alternative is to consider the site as an institution, and the quoted precursor for this model is biosemiotician Thomas Sebeok’s idea of a cult of radioactivity. This proposal was based on the knowledge that religion has successfully delivered messages across long time spans. Here, the concept of a ritual becomes central. Sebeok envisioned that all information about the nature of the waste should be entrusted to an elite group of
260 scientists and other required expertise, and that this group would be self-selective over time. Society would remain unaware of the real danger, but still receive the necessary information to keep future intruders away from the burial place; this information, through a cult, would take the form of a religious admonition not to enter. Interestingly, Sebeok considered that such a cult could function through the perpetuation of a “ritual and legend”:

265 A ritual annually renewed can be foreseen, with the legend retold year-by-year (with, presumably, slight variations). The actual ‘truth’ would be entrusted exclusively to – what we might call for dramatic emphasis – an ‘atomic priesthood’, that is, a commission of knowledgeable physicists, experts in radiation sickness, anthropologists, linguists, psychologists, semioticians, and whatever additional expertise may be called for now and in the future (Sebeok, 1984, p. 24).

270 Such an idea is clearly controversial, as it is evident that it presupposes a kind of control exercised by the state that is possible only in totalitarian systems. Even if the exceptionality of the issue, the management of waste over millennia, may be seen by some as a potential excuse for an abrogation of democracy, one needs to consider that every cult entails believers as well as non-believers: those who would act in the opposite way to what is expected from them; therefore such a solution cannot be accounted for as reliable in the first place.

275 Sebeok’s idea was not original; the term “atomic priesthood” was borrowed from physicist Alvin Weinberg, who first wrote about a possible “military priesthood” to guard against an inadvertent use of nuclear weapons (Weinberg, 1972, p. 34). However, Weinberg’s definition was intended as metaphorical: unrealistically, for Weinberg, the mere existence of this kind of technology was to function as a guarantor for the perpetuation of an “atomic peace”:

280 As matters have turned out, nuclear weapons have stabilized at least the relations between the superpowers. The prospects of an all-out third world war seem to recede. In exchange for this atomic peace we have had to manage and control nuclear weapons (Weinberg, 1972, p. 34).

Weinberg also famously used the Faustian myth to describe radioactive energy:



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We nuclear people have made a Faustian bargain with society. On the one hand, we offer—in the catalytic nuclear burner—an inexhaustible source of energy. [...] But the price that we demand of society for this magical energy source is both a vigilance and a longevity of our social institutions that we are quite unaccustomed to (Weinberg, 1972, p. 33).

290 This last statement refers to a myth, while Sebeok's attention was on a ritual and legend. In both cases, the use of metaphorical and symbolic thinking draws upon a mythical or religious repertoire to achieve greater effectiveness. Myth and ritual have been studied as interconnected fields in anthropology, where different theories on the possible origin of ritual from myth or vice versa have historically emerged. Inherently intertwined, myth can be interpreted as the narrative that may accompany ritual actions, while ritual entails the performative aspect. Given the use of symbolic metaphors as represented
295 by myths, and ultimately rituals in relation to nuclear heritage practices, this article reflects on how rituals have informed and reinforced nuclear heritage speculations, to make the point that scientific rituals may function similarly to religious rituals in enabling actants to shrink personal and societal responsibilities by entrusting "higher forces", especially when there is no guarantee of control over the outcome of the planned operations. As we have seen, this is not an original claim. Several theorists have critically examined rituals and myth in relation to the nuclear sciences.

300 In "A cosmogram for nuclear things", historian Gabrielle Hecht describes the concept of "nuclearity" as being "not so much an essential property *of* things, as it is distributed *in* things" (Hecht, 2007, p. 101). To define the concept, Hecht proposes looking at the nuclear through the metaphor of the cosmogram, or an inventory map of the world. The reason for this is that "cosmograms concretize: they offer a set of practices, of rituals to enact participation in the world" (Hecht, 2007, p. 102). The emphasis on rituals thus appears to facilitate an embodied understanding, a way of gaining knowledge through
305 participation. Hecht goes further in using rituals as a metaphor by defining the scientific practice of "inspection rituals":

310 The Additional Protocol changed the form and content of IAEA safeguards, giving inspection rituals greater power to stabilize the world. Note, however, that the fundamental ontological function of the rituals remained the same as in the 1970s. By offering a means to balance the spread and containment of nuclear things, inspections (and safeguards) also served as a mechanism through which to define the nuclearity of things (Hecht, 2007, p. 105).

For Hecht, the definition of "nuclearity" is crucial, as it justifies and enables the political actions carried out according to what is defined as "nuclear".³ The use of "scientific rituals" thus actively contributes to defining nuclear politics and legitimizing their choices.

315 In the Swedish context, Professor Jonas Anshelm critically presents an overview of how Swedish industrial politics have used narratives from myths to communicate with the broader public, using rhetorics based on "a premodern or enchanted conception of the world" where "a strong belief in progress and modernity was combined with an almost magical view of nature" (Anshelm, 2010, p. 47). Considering that "nuclear technology had enabled a generation of power of a magnitude that earlier had only been heard of in myths" (Anshelm, 2010, p. 50), these narratives often represented nuclear



320 scientists as magicians, able to “accomplish miracles” (Anshelm, 2010, p. 48). Following this logic, regarding the handling of nuclear waste, it is evident that nuclear politics today rely on the hope that the *miracles* of science will, in the future, provide a *solution* that this generation is unable to find. This is particularly concerning when it comes to choices that will have a lasting impact on the future of humanity.

Another analysis of the use of myths in relation to nuclear heritage practices in Sweden is presented by geographer
325 Anna Storm in “When we have left the nuclear territories”. Storm proposes that animals and vegetation “are attributed the role of guardians of radioactive remains” (Storm, 2020, p. 318):

When radioactive waste management more prominently entered the picture, the nuclear industry found itself in between a detailed technical discussion and humanity’s existential questions of survival and communication with future generations, extending further into the future than any archaeological record extends into the past. Perhaps that is why mythology is part of the human imaginations of radioactive futures, and why the nonhuman is put in charge of guarding our nuclear heritage (Storm, 2020, p. 338).

While extensive scientific research has been carried out and is still being carried out to take into account all possible
335 variables that the current generation has been able to imagine when it comes to figuring out how human and geological future will behave through deep time (see e.g., Ialenti, 2020), the idea of the repository as an example of a “scientific ritual” concerns in specific the way political decisions are made, what counts as priority and what is neglected. I am not trying to diminish scientific expertise when stating that it is impossible to empirically test the outcomes of a repository before it is put in use. However, the timeframe required to see the results of containment actions is at least 100,000 years in the future. As
340 researcher Jantine Schöder has remarked, the construction of a nuclear repository for high-level waste is, for this reason, to be considered a “long-term socio-technical experiment” (Schröder 2016, p. 687).

The correlation between scientific and religious rituals is intended in this paper through the correspondence of a social, religious-like attitude that may emerge when facing the unknown. If what is described here is, on the one hand, inherently part of the human condition, the incredible technologies that the Western world has developed during the last
345 century present an unprecedented issue, which has become increasingly problematic. The following section presents examples of artistic research in relation to nuclear science and ritual.

3.3 Ritual art

Contrary to science, art as a discipline does not claim to provide solutions to societal matters; its contribution to knowledge production resides instead in an attitude that seeks to unravel overlooked issues and subvert the order of what is considered
350 true or untrue; this happens often through asking, implicitly or explicitly, questions that regard these societal matters. As an example, philosopher Alva Nöe has compared art to philosophy and described works of art as “strange tools” that humanity produces in order to make sense of itself (Nöe, 2015, p. 30). Art thus bears the task of exploring the unknown and may even



present possible, unacknowledged scenarios that speculative sciences could utilize; however, this happens without aiming to deliver a univocal solution to specific issues. An example of an artwork that fosters an understanding of deep time through a symbolic-ritualistic practice is “Inheritance” (2016) (Fig. 3): a highly radioactive necklace, produced by artist Erich Berger and jewelry designer Mari Keto.



Figure 3: “Inheritance” installation detail, The Burden, digital print on Dibond 30x30cm, Berger/Keto 2016. Image by Anders Bøggild.

When the artwork is passed on, a scientific ritual has to be performed: namely, a ritual of measurement of the radioactivity of the objects, a ritual which imitates a scientific protocol. However, this ritual employs a different logic than that of a regular scientific protocol, which is followed to prevent harm. Berger and Keto envisioned the perpetuation of a ritual measurement of the decay of the jewelry every time it is passed on to the next generation, as it would be the case for a jewelry that can be worn; still, in this case, the ritual shows, again and again, that it is not possible to wear it. The performed measurement is therefore completely unnecessary: it is clear that the jewelry was created not to be worn. The measurement ritual, whether



seen or imagined, may then function to reach a form of embodied knowledge of time's incommensurability and human finitude when considering the timespan of radioactive decay.

Another example of a re-enactment of a ritual specifically to mark nuclear waste has been proposed by scholars in landscape architecture Liska Chan and Elizabeth Stapleton.

370 The researchers consider that culture has proven to be more durable than human-made artifacts and, therefore, they have examined rituals as a means to preserve memory (Chan & Stapleton, 2018, p. 387). Chan and Sapleton consider ritual as a series of actions “often symbolic in nature, which are regularly repeated, often in a collective manner, to mark changes, reinforce values and tell narratives”, which may be used as a way to “reinforce collective conscience and memory outside the sacred realm” (Chan & Stapleton, 2018, p. 386). Their proposal revisits the common idea of a memorial as a means to
375 preserve transgenerational memory, through the readaptation of the concept of the memorial as an object, into something rather intangible: a ritual pilgrimage. This proposed ritual would unfold by marking a path between the source of nuclear waste, uranium mines on Navajo land, and the supposed burial place of radioactive waste, which they provocatively placed underneath Las Vegas (Chan & Stapleton, 2018, pp. 390-391). Furthermore, such a ritual pilgrimage intends to draw attention to itself by walking at a dramatically slow pace:

380

If the everyday activity of walking is made strange, done in non-normative ways, and even in ways that reflect sacred rituals, perhaps it can be one way to reflect the ominousness of hidden dangers buried beneath the ground (Chan & Stapleton, 2018, p. 393).

385 There is a tradition in experimental theater of modifying everyday actions that follows experiments conducted by Jerzy Grotowski since the late 1960s. Grotowski combined “‘ancient ritual techniques’ (or ones foreign to most Europeans and Americans) with theater exercises long known to students of Konstantin Stanislavski or Vsevelod Meyerhold” (Schechner, 1995, 248). In “The Future of Ritual”, theater director and scholar Richard Schechner describes a relation between ritual and healing:

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In both animals and humans rituals arise or are devised around disruptive, turbulent, and ambivalent interactions where faulty communication can lead to violent or even fatal encounters (Schechner, 1995, p. 230). [...] But human ritual, too, might be said to short-circuit thinking, providing ready-made answers to deal with crisis. Individual and collective anxieties are relieved by rituals whose qualities of repetition, rhythmicity, exaggeration, condensation, and simplification stimulate the brain into
395 releasing endorphins directly into the bloodstream yielding ritual's second benefit, a relief from pain, a surfeit of pleasure (Schechner, 1995, p. 233).

Theater scholars, including Schechner, consider theater as a direct development of ritual, stemming from Greek tragedy. There is an ancient connection between healing and ritual in the Western tradition. The practice of temple sleep, also known
400 as sleep incubation, was a ritual in ancient Greece where individuals would sleep in a temple to encounter a deity in a dream,



with the intention of curing an illness. A similar practice was already employed in ancient Egypt over 4,000 years ago. Historian and ritual scholar Mark Beumer highlights how the healing ritual of temple sleep has been later transformed and re-adapted by the Christian tradition, while its aims and methods have remained unchanged (Beumer, 2020, p. 28).

I recognize a contemporary version of the temple sleep, specifically related to nuclear contamination, as described
405 by anthropologist Shannon Cram in “Unmaking the Bomb”. Cram illustrates the experience of becoming a spectator of a
ritualistic performance that happened in the B reactor of the Hanford site, the most contaminated nuclear waste site in the
United States. “Nuclear dreams: an oral history of the Hanford site” (2019), the title of the performance, was created by
composer Reginald Unterseher in collaboration with librettist Nancy Welliver, who worked as an environmental scientist on
the site. The performed songs present a collection of the dreams of the workers involved in the cleanup process. As a
410 spectator of this performance, the contaminated site is experienced by Cram as a temple, where the sacredness of the
impossible task of making the waste disappear collides with the sacrifice of the workers, which is reflected through their
dreams as well as the radioactive poisoning taken by their bodies. For Cram, the performance “presents the dreamworld as
physical: its myths and metaphors originating in the body, at once uncanny *and* mundane” (Cram, 2023, p. 129).

4 Canticle of the nuclear sun

415 If theater stems from ritual and ancient healing practices, performance art can also be seen as a direct descendant of ritual
practices. Given the supposed connection between ritual and art, and particularly performance, it is unsurprising that
contemporary artists utilize ritual in relation to healing and, specifically for this historical moment, healing the environment.
However, as seen in the quoted artistic positions, healing itself cannot be determined as an artistic intention: it would be
naïve to state that an artwork can heal; but a reflection on the necessity to heal the environment, or prepare us for the changes
420 that will come, is what many of these artworks still convey.

The project “Canticle of the nuclear sun” reflects specifically on the capacity of ritual to transmit transgenerational
memory. The title of the artwork references what is thought to be the most ancient text in the Italian language, a poem from
Saint Francis of Assisi, dated around 1224: “Canticle of the sun”, a hymn to nature and life. The poem praises the Christian
God for creating existence, beginning with a celebration of the radiance and beauty of the sun. Even though it is associated
425 with a different deity, this poem reconnects the Christian tradition with the older tradition of adoring the Sun. As historian
Lynn White has noted, when considering the influence of the Judeo-Christian heritage on the current ecological crisis, Saint
Francis represents an exception to an otherwise anthropocentric perspective, in that this view of nature takes on a quasi-
animistic perspective; in White’s words, “a unique sort of pan-psychism of all things animate and inanimate” (White, 1967,
pp. 1206-1207).

430 As we have seen in the introduction, the video work “Canticle of the nuclear sun” reinterprets an ancient Sardinian
form of polyphonic singing, known as Canto a tenore, in the form of a lost ritual (Fig. 4).



Figure 4: The group Tenore Murales from Orgosolo sings in traditional costumes on a cliff. Image: Aurora Del Rio.

The artwork draws upon the research of linguist Andrea Deplano on the etymology of the Sardinian language, specifically
435 focusing on the meaning of the sounds produced by the choir, which Deplano has decoded as an ancient prayer to the Sun-
deity. I developed the artwork in collaboration with the group Tenore Murales, from Orgosolo. The group has been active
since 1991 and is one of the most well-known interpreters of the Canto a tenore in Sardinia today. The core idea for the
video work was to portray the ritual singing as occurring in the deep future, as if caught in the act of transmitting a message
about the danger of the nuclear waste that has already been buried. Instead of conveying a clear message, the singing
440 combines the adoration of the Sun-deity with a partially forgotten message, from the perspective of a hypothetical future
generation that perpetuates the Canto a tenore as a way to transmit a warning. Considering all the uncertainties and
impossibilities of predicting future scenarios, such a message is necessarily doomed to fail, and in the artwork, it does fail to
transmit a warning through the singing.

A connection between the singing tradition and the adoration of the Sun is also reflected in the styles of singing that
445 I asked the group to perform. In particular, the used styles included “Sa Vardeina”, a pastoral song to the crops, which is a
hymn to the fertilizing god, reflecting the idea of the Sun-deity. “S’Attitu”, or “Tattaiu Meu”, another style used, is an ironic



requiem used to mock the dominant powers, which is traditional during carnival. This style connects the message conveyed through the singing to traditional carnival rites.⁴ In the composed songs, this style is used to mock humanity's longing for nuclear energy and presents the Sun-deity as being violated through the greed of modernity. As we have seen, a reference to the Sun as a deity is particularly relevant for this artwork, in which I propose that the adoration of the Sun, present in different traditions, is comparable to the current "adoration" of energy in Western modernity. When considering nuclear energy in particular, a parallel between the astronomical sun, as related to the Sun-God, and this type of energy concerns the fact that the sun produces natural radiation through a nuclear fusion that occurs in its core. The image of the *nuclear sun* thus concretely brings together an old and a new form of adoration of the Sun, to highlight an ambiguity inherent in this ritual and Western modernity: how the rational mind excludes itself from what is observed, thus failing to acknowledge the irrational as part of the rational discourse, namely, that the very rational mind cannot operate as detached from itself, or disembodied. Here, ritual comes as a rescue, bringing back a different form of sentience and knowledge that resides in bodily habits, to bring about certainty even in the lack of evidence, but perhaps guided by a deep intuition, a form of knowledge that rationality cannot reach.

5 Conclusion

In the artwork "Canticle of the nuclear sun" I intend the traditional singing of Canto a tenore as a recipe that is followed as an ancient ritual, to extend its temporal dimension into the future but questioning the possibility of transmitting a clear message, and at the same time questioning nuclear technologies and the politics that guide decision-making, thought of as a ritual. The metric of the song, drawing upon a long tradition, resembles the metric of the decisions that are taken following scientific procedures that draw upon other kinds of traditions. They are all techniques invented, repeated, and performed by humans in the form of a ritual; this form allows them to keep the fallacy of control. As Gabrielle Hecht has stated, the nuclearity of things is also set through rituals:

The nuclearity of things keeps coming under question. And the rituals that set the limits of the nuclear are constantly being refined and redefined in the hopes of increasing their power to circumscribe nuclear meanings and things (Hecht, 2007, p. 106).

In the case of a scientific ritual as described by Hecht, we have seen that science politics may utilize it to affirm a need to control unforeseen outcomes, for example, when handling high-level radioactive waste. On the other hand, art uses ritual not to hide but to point to what exceeds the boundaries of human knowledge. As we have seen, future thinking, and specifically deep time thinking, involves an abstraction that is particularly difficult to conceive, and such an abstraction often even lies beyond the capability of human reasoning (see, e.g., Ialenti, 2020; Schröder, 2016; Joyce, 2020). It is in this gap that *ritual* intervenes, artificially constructing a sense of security through the repetition and perpetuation of symbolic acts that,



concomitantly, delegate power and responsibilities to higher forces. However, ritual in artistic research does not seek control, nor does it need to provide a solution to societal problems; still, in a similar attitude of abandonment, it may pose societal and existential questions. Such questions will remain unanswered, but may open up more questions about the nature of those same societal problems that Western modernity is currently facing.

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Notes

¹ Following a general aversion of the regions to host a national repository, where a first scoping phase ended with no candidates, stand May 2025 the minister of energy has stated that a single repository will not be realised. A month after, the same minister has recommitted Italy to reintroducing nuclear power. The plan to build a nuclear repository has thus shifted from that of a surface repository to store existing waste, to a final repository to host old and new waste. This is now planned for 2039.

² According to scholar Barbara Boudewijnse (1998), the original meaning of the word *ritual* in the English language refers to “a book directing the order or manner to be observed in celebrating religious ceremonies” (Boudewijnse, 1998, p. 279). Boudewijnse has traced the development of the meaning of ritual in the British context of religious studies as related to the concepts of “magic” and “taboo” (Boudewijnse, 1998, p. 287). For Boudewijnse, the meaning of the term has changed, in the context of the Reformation, in relation to a reading of Catholic ritualized practices as irrational forms of behavior (Boudewijnse, 1998, p. 292).

³ An example that Hecht presents is the invasion of Iraq in 2003 by the United States, on the false claim that Iraq had a nuclear bomb.

⁴ A ritualistic death and resurrection of the king of vegetation is present in Sardinia, for example, in the tradition of the “Mamuthones” and “Re Cancioffali”.



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