Vehicles of Collective Memory: Casting Shadows for an Atomic Future

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I declare that this **Critical Cultures Research Project** is all my own work and that all sources have been fully acknowledged.

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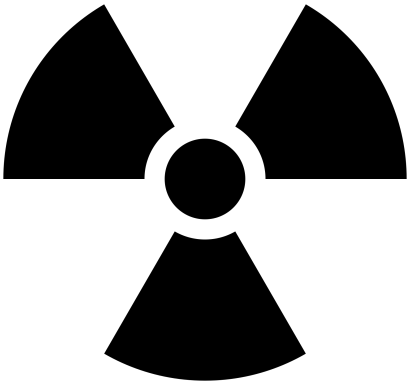

Fig 1

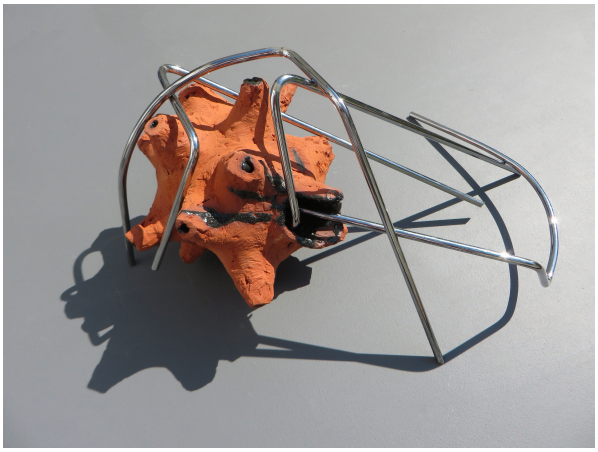

Fig 2

Fig 3

Introduction

> *'Collective memory differs from history in at least two respects. It is a current of continuous thought whose continuity is not at all artificial, for it retains from the past only what still lives or is capable of living in the consciousness of the groups keeping the memory alive.'*
> ***Maurice Halbwachs: The Collective Memory** (1925)*

Memory is fallible, it exists only in the mind of the individual, and dies with them. One could argue that culture began when memory became information, a commodity transferable between humans and able to transcend lifetimes. This revolution began with language, be it simple stories around a campfire, songs about great events, and later the written word. It expanded through the power of art, first with cave paintings depicting early life, then through totems of fertility and religious depictions. These vehicles of collective memory allowed for the creation of cultural artefacts through which we could communicate with the future; thus allowing myths and legends form, the power of religion take hold, the utility of science to materialise, and the practice of remembering to begin. However, within these pursuits the audience has always been assured, rarely do we come across works in which the intended viewer becomes an abstraction. The realm of semiotics itself is centred around the core of the viewer, without a clear audience it becomes near impossible to transmit information. When forming a sign it is vital to take into consideration the language and culture of the audience, without this the meaning of the sign is lost (Chandler, 2002). Saussure argued that the relationship between the sign and the viewer is just as important for the creation of meaning as the intended meaning of the original sign. He stated that *"There is nothing at all to prevent the association of whatsoever with any sequences of sounds whatsoever....the process which selects one particular sound-sequence to correspond to one particular idea is arbitrary" (Chandler, 2002, p. 26).*

So then comes the peculiar task of creating a sign for a viewer of which there is nothing known regarding their culture or language, even their biology. What practices or techniques can we rely on to create meaning where there is no cultural consensus? The realm of Nuclear Semiotics is such a pursuit, aiming to communicate meaning deep into the future, working with timescales far beyond human comprehension. Nuclear Semiotics deals with the problem of protecting nuclear waste repositories from human interference after the knowledge of these sites is lost to time, communicating with our future selves up to 100,000 years into the future (Berry et al., 1984). This field intersects with the realm of collective memory, a practice adjacent to history that focuses on the production of culture through the act of remembering, (Halbwach, 1925). Maurice Halbwach is considered the father of Collective Memory studies, in his text 'La Mémoire Collective' he is the first to distinguish between the realm of history as a scientific practice and the action of collective memory as a sociological phenomenon. 6Our first instinct may be to remove ourselves from the realm of culture in dealing with such issues, for at first glance the transmission of warning signs may have little to do with culture. However, as we'll see, the power of cultural expression becomes the cornerstone of communication with the unknown. Not least because it's the only language we've ever known to survive far beyond our lifetimes, permeating deep into the speculative future.

The following text is broken into three chapters, chapter one explores the history of Nuclear Semiotics and highlights the need for a unique interdisciplinary solution to the problems faced in the storage of nuclear waste. Chapter two highlights the work of Thomas Sebeok in the field, analysing his nuclear priesthood and comparing it to the work of Cecile Massart, a contemporary artist whose work tackles similar themes. Finally, chapter three analyses the work of Paolo Fabbri and his ray-cat solution, drawing comparison to the 'Cumbrian Alchemy' exhibition. The main sources for this text are as follows, the essay 'Communication Measured to Bridge 10 Millenia' by Thomas Sebeok (1984) highlights his methodology for the nuclear priesthood, this text was seminal in the field and set out many of the core challenges faced when storing nuclear waste. It was also one of the first to propose a method within the field of cultural memory studies, giving birth to a variety of unique and groundbreaking approaches. The text 'Des Chats, Des Sirènes, Des Hommes' by Paolo Fabbri (1984) was also a vital text during my research process, again forging new ground and introducing the field of zoo-semiotics in the conversation regarding Nuclear Semiotics. The documentary 'Into Eternity' by Micheal Madsen (2010) was also a vital resource, contextualising the problems faced in a digestible and honest manner. Finally the research essay titled 'The Nuclear Anthropocene' by Elle Carpenter (2014) and the text 'Radioactive Waste Management and Constructing Memory for Future Generations' (2015) which accompanied the 'Constructing Memory' conference both introduced me to contemporary practitioners within the field, providing me the tools to analyse how this vital practice has developed in the years following Sebeok and Fabbri.

Chapter One

Nuclear Semiotics: Remnants of the Atomic Age

> *'Once upon a time man learned to master fire, something no other living creature had done before him. Man conquered the entire world. One day he found a new fire, a fire so powerful it could never be extinguished. Man revelled in the thought that he now possessed the powers of the universe, then in horror he realised that his new fire could not only create but also destroy. Not only could it burn on land but inside all living creatures, inside his children, the animals, all crops. Man looked around for help but found none, and so he built a burial chamber deep in the bowels of the earth, a hiding place for the fire to burn, into eternity.'*
> ***Into Eternity: Micheal Madsen*** *(2010)*

1.1 The Issues at Hand: An Objective Past and Speculative Future

In 1984 the Human Interference Task Force published a report into the looming danger posed by nuclear waste storage sites (Berry et al., 1984), they concluded that while it was reasonably easy to isolate nuclear waste from humans it was far more difficult to ensure humans stayed away from such sites in the long term. In the short term such a task was easy; in 1946 the University of California Berkeley Radiation Laboratory (Chung, 2021) developed a new sign to represent a radiation warning (Fig 1). The methodology behind this sign was to generate a unique and visually distinctive icon that had no prior meaning, at the time each government institution in America used vastly different signs to communicate radiation danger, such as a blue triangle or a pink square. The problem was clear, without a universally accepted sign for danger, accidents were bound to happen. This was further explored in 1966 when Charles Baldwin conducted an experiment to determine which signs had the greatest memory recall with the least meaning ascribed to them (Vox, 2018).

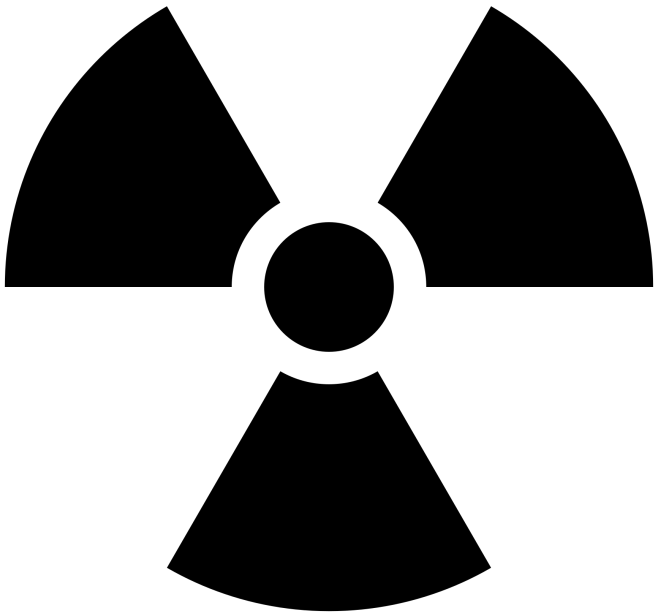

Fig 1 - Radiation Warning Design, University of California Berkeley Radiation Laboratory, 1946

The signs for biological and radiation hazards were the perfect fit, they were visually unique and yet completely unknown to the general public, allowing safety authorities to use them without fear of miscommunication. These signs became standardised in the 1950s and today they are universally accepted as representing danger, (Vox, 2018) but there is also an emerging problem with such signs. They have no cultural significance and no indexical or iconic meaning. An Indexical sign is a sign in which meaning is inferred based on contextual evidence, for example smoke indicating fire. Whereas an Iconic sign is a sign representative of the concept being communicated, for example the recycle sign indicating renewal. (Short, 2007) The radiation sign proposed by University of California Berkeley Radiation Lab was designed to be iconic, attempting to represent radiation emitting from a source. However, I would argue that an understanding of nuclear physics is a prerequisite for comprehension, and therefore for many viewers it could also be regarded as a symbol, in which its meaning has no relation to the concept being signified and can only be understood based on a cultural consensus.

These symbols have existed for less than a lifetime, and it seems unlikely their meaning will be understood tens of thousands of years into the future, for we cannot predict the nature of our future selves, something that made perfect sense in ancient Egypt may have no context today. Indeed, we have generated entire professions dedicated to the translation of ancient signs, namely archeology. Yet even with our wisdom and technology much of the nuance and detail of the ancients elude us, as this is the very nature of time. It erodes meaning exponentially. This is where the long term problem with nuclear waste storage arises. There are currently around 250,000 to 300,000 tonnes of nuclear waste around the world, most of which will be hazardous to humans for at least the next 100,000 years (Madsen, 2014). No form of human communication has ever lasted for such a long period, in fact methods of visual communication among humans have not even existed for this length of time. The earliest record of cave paintings have been dated at around 40,000 years - if human life can change so drastically in such a time, it stands to reason it will change again. (Brittanica, 2020) With such immense scales of time to overcome, the practice of Nuclear Semiotics was born, proposing ideas and methodologies to create signs that might bridge the next four thousand lifetimes.

'This place is not a place of honor... no highly esteemed deed is commemorated here... nothing valued is here. What is here was dangerous and repulsive to us. This message is a warning about danger.' (Hora, Von Winterfeldt and Trauth, 1991) These are the words selected by the Sandia National Laboratories in their 1991 report 'Expert Judgment on Inadvertent Human Intrusion into the Waste Isolation Pilot Plant.' (Hora, et al, 1991) Their goal was to set out the terms required to explain the nature of the Waste Isolation Pilot Plant (WIPP) as a dangerous and undesirable place to future generations. This was a daunting task, aiming to produce a collective memory where none existed. While most people have a general understanding of nuclear materials as dangerous, there is little public consciousness when it comes to the challenge of nuclear waste. To this day, most storage facilities require constant maintenance and security, and are extremely sensitive to natural disasters or human intervention (Madsen, 2014). The WIPP facility is designed to counter these variables, burying waste deep into the bedrock and sealing it away from human interference (Hora, et al, 1991). But our memories are short and our desire for resources are ever growing, even deep beneath the ground these materials pose a threat. One of the considerations of the report was to question the material needs of future generations, arguing that a plot of land that seems useless to us today

may prove vitally important to the societies of the future (Hora, et al, 1991). While the first assumption might be to seal away the site, leaving it unmarked, both the Sandia report and the Human Interference Taskforce concluded that clear and unambiguous warnings were in fact a safer option. If human interference with the site isn't just a possibility but an eventuality, how might these warnings be communicated, and how might they be constructed to weather the centuries.

Increasingly, the realm of hard science in this field has reached a natural stopping point, as the problem of long term communication has been consumed by the field of philosophy, anthropology, and artistic practice. In Elle Carpenter's 'Nuclear Anthropocene' (2014) she explores the burgeoning field of Nuclear Semiotics in the field of arts and humanities stating *'The general feeling seems to be that science has run out of language and skills to solve the next set of problems. In the age of the Anthropocene 'people' or 'publics' no longer have a utopian belief in science, so more complex cultural strategies are required to make sense of the continuing present, and understand how to communicate over long time frames and across generations'* As science fails us, we open up new fields and artistic practices to develop a framework of communication outside the normative world of hard truths and objectivity. Instead, the following case studies fill the gaps between truth and speculation, proving that there is much more to semiotics than simple imagery or prose.

Chapter Two

Religious Remembering

2.1 A Theological Construct: Sebeok's Nuclear Priesthood

Thomas Sebeok, a Hungarian-American semiotician and linguist, set out his thoughts on long term nuclear waste warning signs in his seminal text 'Communication Measures to Bridge 10 Millenia,' (Sebeok, 1984). He approaches this unique challenge through the lens of religion as a distinct semiotic process, relying on the power of culture to disseminate warnings about nuclear repositories. His opinion on a solely linguistic approach was clear: any such method was fatally flawed. The oldest surviving written records can be found dating as far back as 3100 BCE from the early dynastic period of Ancient Egypt (Sebeok, 1984), a measly timescale in comparison to the half life of Uranium. His position is sound - even if a written warning *could* survive for future generations to read it, there is no guarantee it would be understood. You need only look at the discovery of the Rosetta Stone to see that without a translation, ancient languages are simply abstract shapes with no meaning at all. According to Saussure's theory of signs, language and its relation to meaning can be considered arbitrary because the signs (letters/words) hold no relationship to the inferred meaning apart from the cultural consensus behind them. (Yankin, Totu, 2014) Sebeok writes, *'It is thus focally relevant to the problems of human interference and message exchanges involving long periods of time, over which spoken and written languages are sure to decay to the point of incomprehensibility, making it necessary to utilize a perspective that goes well beyond linguistics.'* Languages twist and warp, they're as fickle as humans, and according to Sausure's theory once they die they become essentially useless; hollow signs, hollow messages. The material that binds language together, that fills them with meaning, is culture, yet we cannot fathom the culture or language of civilisations ten Millenia into the future, and we cannot produce translations for languages that do not yet exist.

Sebeok's alternative to a linguistic approach was that of religion, citing the need for 'folkloric' methodologies to ensure the survival of such warnings. He writes, *'These persistent and widely diffused mythological and iconographic resonances of the assignment to which the Task Force is seeking a resolution to wit: that information be launched and artificially passed on into the short-term and long-term future with the supplementary aid of folkloristic devices, in particular a combination of an artificially created and nurtured ritual-and-legend.'* His proposal, to found an 'Atomic Priesthood' run by scientists and academics, with the sole purpose of disseminating the myth of cursed ground upon the site of the nuclear waste. The truth about the site would only be revealed to the members of the priesthood, knowledgeable enough to understand it. This is a methodology based upon fear, designed to simplify the message into an abstraction, *do not go here, this is hell on earth*. At first glance such a concept seems strange, but one need only look at the history of humankind to see its appeal, religion as a vehicle of collective memory has proved its potency. Religion can also be understood as a semiotic practice in itself. In his book, 'Elements of a Semiotic Theory of Religion' (Murphey, 2003) writes, *'Religion is a practice of semiotic construction and displacement… religion is not a unique kind of activity, but only a more aggressively symbolic form of a very basic and ordinary human activity, namely, interpretation... The encompassing definition of language...is just its*

vocabulary and its rules of grammar, i.e., its rules for the combination of words. Similarly, a religion is both its canon and its interpretation of that canon.' Through this, religion can be understood as the process of interpreting signs. The act of religion, one can argue, is not the belief itself but the process by which cultural artefacts are digested, regurgitated, and digested again, each time searching for further truth within these signs. This however poses a problem for Sebeok, as the basis of this repeat interpretation gives way to a shifting of meaning across time, for his Nuclear Priesthood to be successful the original meaning must remain immutable, hence his proposal to hide the truth. In Sebeok's priesthood, the culture and ritual may change to fit ongoing trends, but the core tenants of the faith remain unchanged, guided by an elite group dedicated to the cause.

Religions have survived wars and famine, revolution and rebirth, in all its forms religion has permeated our lives for as long as history has existed. In 'Religion and the Study of Social Memory,' (Sakaranaho, 2011) writes, *'There is no religion devoid of social or cultural memory. Although it is an individual who remembers, memory is always and unavoidably collective by its very nature.'* In this way, Sebeok's priesthood hijacks our ability for collective memory and uses it against us, creating a framework for the *imposition* of cultural memory upon us, instead of a solely organic development. There is no future for a memory held alone, it's destined to perish with the viewer, but a collective memory transcends the dimension of time, allowing it to survive for as long as it remains important. This 'importance' is also worth noting, Sebeok spoke not only of the content of messages, but also the methods through which they are disseminated. The method of communication can have a huge impact on an audiences response, an order scribbled on a rock has no authority to the uninitiated, but reframe it as scripture written by God's hand and the commandment becomes an act of divine intervention. Religion has a way of overriding our desires and raising the ordinary into the realm of divinity. In this way Sebeok's nuclear priesthood has a unique advantage, our culture, and indeed our very psyches are hardwired for the action of religion. Of all the ways to send a message, it goes to reason Sebeok's priesthood has a greater chance of survival than most.

2.2 Comparative Analysis: Cecile Massart's Nuclear Sarcophagi

However, within the field of nuclear semiotics there are also many visual practitioners whose unique perspective can shed light on the issues beyond a purely academic approach. One such practitioner is the artist and researcher Cecile Massart, whose work in the field of nuclear semiotics dates back 20 years (Carpenter, 2014). Massart has been pivotal in developing an artistic methodology on the issues of collective memory and nuclear warnings. However, we can can also draw parallels between Sebeok and Massart, most notably with her installation 'Sarcophagi: Fragments of a Monument' which featured a selection of hybrid sculptural pieces of clay and metal (Fig 2). Her proposal for the exhibition described an ever-growing clay sculptural monument surrounding a site containing nuclear waste (Ess, 2021). With each passing year the clay sculpture will grow in size, as each new generation applies their own layer to be cooked by the radiation below. This approach lies between the gaps of art and practice, providing a tangible containment measure that doubles as a monument for future generations. Massart is actively engaging the public in the process of defending their future, and giving them the agency to protect themselves from harm. Her approach focuses on the praxis of remembrance as opposed to the theoretical approach of Sebeok and his contemporaries,

Massart's sarcophagi is built by the hands of the public, demanding they engage in the process of cultural memory in a tangible way.

The relationship to Sebeok's practice is clear, both practitioners have a clear understanding of cultural memory as an active process which needs constant attention. In the same way that Sebeok's priesthood is designed to develop and re-enforce its cultural surroundings so to does Massart's Sarcophagi. Both pieces are designed to grow and warp with their surroundings, passing information to each new generation as it weathers the centuries. Sebeok's priesthood is guided by the whims of the elite, hiding the truth from its parishioners, whereas Massart had enough faith in humanity to trust us with the reality of such sites. This is touched upon in Elle Carpenter's 'Nuclear Anthroponcene' (2014) which reflects upon contemporary work within the field of Nuclear Semiotics, she writes *'As a contemporary artist, Massart has identified the need for each generation to work with its own cultral terms of reference to mark sites, not simply through long-term totemic markers, but by engaging diverse stakeholder groups of experts and communities to learn about the sites and mark them for the next generation.'* The relationship to Sebeok's priesthood is clear, envisioning an active process of regenerative cultural construction as opposed to a static and fallible technique such as the written word. However it forges new ground in centring art as the medium through which this is achieved, choosing to engage future generations in the process of making as opposed to the process of telling. Sebeok's priesthood relies on the interpretation of knowledge, whereas the Sarcophagi requires the public to build and then interpret their own signs. Massart's communal sculpture fosters a greater sense of accomplishment and personal investment in the process than Sebeok's approach ever could. Sometimes called the 'IKEA effect' this idea was explored in the text 'The IKEA Effect: When Labor Leads to Love' (Norton et al, 2012) and describes the process by which we favour objects and ideas we built or conceptualised ourselves.

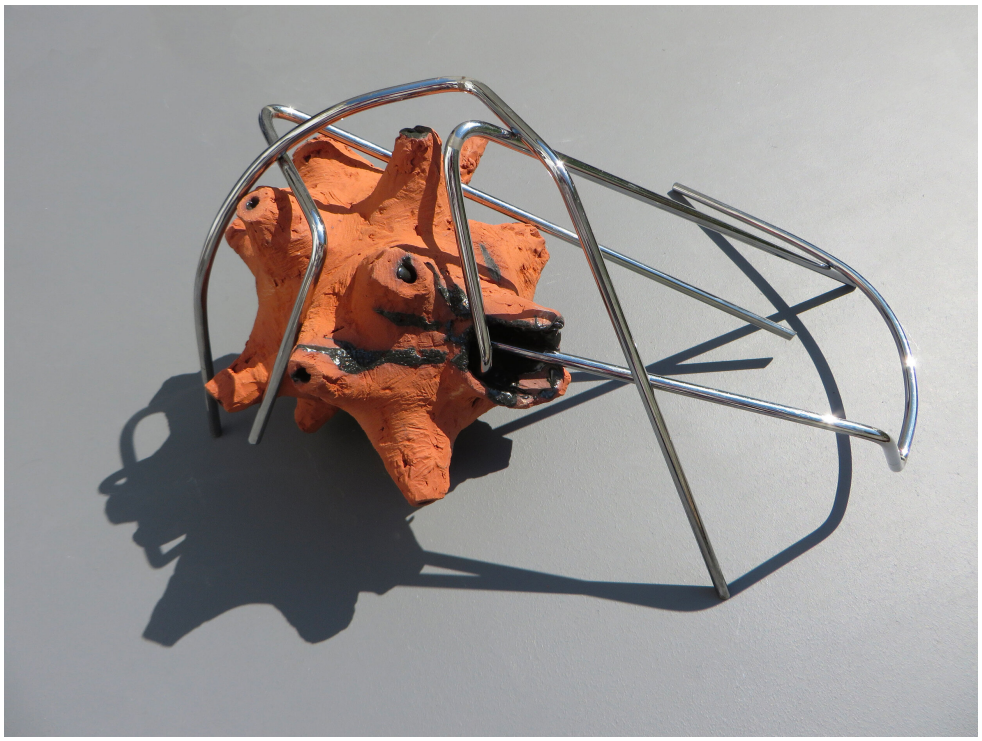

Fig 2 - Sarcophagi: Fragments of a Monument, Cecile Massart, 2021

The use of ‘Sarcophagi’ in this exhibition is also worth analysing here, because of its unique symbolism with regards to collective memory. The Sarcophagi in Massart’s work conjures the themes of ancient civilisations, death, decay, and entombment. This is a unique descriptor for a contemporary issue and calls on the viewer to contemplate the nature of the challenges we face, in 100,000 years our civilisation will be ancient and decaying. Compounding the effects of the Anthroponcene, we will become enshrined forever within the chemical composition of the earth, it’s not often we are confronted with the future in such stark terms (Carpenter, 2014). In the text ‘Myth, Meaning, and Memory on Roman Sarcophagi’ (Koortbojian, 1998) analyses the ‘Sarcophagi’ as a distinct artefact within our cultural lexicon. Stating, *‘The sarcophagus sculptures are vehicles for remembrance. These images, the correlatives of dreams of a hoped-for future, reclaim the past and keep it alive…/ The powers of nostalgia depend on this complicity between past and present, between myth and reality. These powers derive from the most general aspects of religious practice and are rooted in the belief that the "dead and the living can affect one another mutually." Thus the mythological images carved on the sarcophagi are not merely allegories they enact with a trenchant realism a belief about the relation between death and life that lies at the heart of human affairs.’* This is where the similarities between Sebeok and Massart become most clear, in this way both practitioners are seeking answers within the field of theology.

Just as Sebeok hoped to engage the public in the act of religion, and thus the act of interpreting signs, so too does Massart’s work. The construction of the Sarcophagi could also be interpreted as a religious process, building a tomb for the past and relying on our current theological framework to permeate meaning into the deep future. For as long as culture has existed, we have memorialised the dead, and thus the past itself; it stands to reason that a future generation would have the same understanding of these rituals. Sarcophagi reflect something deeper than just culture, instead these shrines could be seen as a reflection of our innate understanding of death, and consequently, memory itself.

Chapter Three

Atomic Kittens: Mythic Memories

3.1 Fabbri's Zoo-Semiotic Approach

In the same period as Sebeok, another practitioner was working on a proposal for the nuclear waste problem. In his essay "Des chats, des sirènes, des hommes," (1984) Paolo Fabbri (working alongside the writer Françoise Bastide) forged a broadly distinct approach within the field, utilising the realm of bio-semiotics to transmit messages and the power of mythology as a framework to ensure they are understood. However much like Seobek, Fabbri begins his text by establishing the need for the truth about nuclear sites to remain hidden, he writes, *'Some people may be tempted to use their knowledge to eliminate their opponents, and/or to install a dictatorship based on terror. Others might consider the "dangerous"…/ nature of these places as a challenge to their courage…/ As a result, radioactive deposits would become "attractive" instead of repellents*[1]*.'* This establishes an interesting precedent, that in order to protect the best interests of any future civilisation, one must misrepresent the truth, the implication being that there are far better motivators in the world than the threat of death itself. Humanity has often prided itself in its curiosity and vitality, usually to our detriment. In order to protect an individual from themselves, argues Fabbri, information is not enough, you must weave the very subject into their cultural lexicon, threatening the shame of public scrutiny as a consequence. The relationship between shame and social cohesion is an interesting one, one could argue that shame is the primary motivator that holds groups together, be it shame of damnation as Sebeok evoked, or simply the shame of acting outside the norm.

However, this brings forward the ethical implications of Sebeok's work, which Fabbri seems to approach. Eerily reminiscent of the Atomic Priesthood, Fabbri states that the foundation of an 'elite' group responsible for safeguarding the secret of the facility would have significant downsides. *'There is still too real a risk of seeing initiates…/ use deposits to terrorize their lower brothers in knowledge.'* This is also a concept explored in the text 'Hans Jonas, Günther Anders, and the Atomic Priesthood: An Exploration into Ethics, Religion and Technology in the Nuclear Age,' (Musch, 2021) in which he states , *'This is not accidental, as the Atomic Priesthood models an elite caste whose designated role comprises preserving knowledge and ensuring the integrity of a dogmatic core and its accompanying scripture. This caste of experts would be the sole carrier of the true purpose of the storage site and would create a mythology with the purpose of deceiving the broader public,'* This is an ethical approach that Fabbri seems to reject, despite his conclusion that future civilisations should remain in the dark about such deposits. Instead he proposes that the knowledge should be lost entirely, and replaced with other techniques such as his proposed ray cats. In this he establishes that a different approach is required, one that has faith in our ability for cultural memory, but protects us from our own worst instincts. His ethics in this regard lie somewhere in the gaps left by Massart's and Sebeok's proposals. However, as I established in my analysis of the Atomic Priesthood, there are few artefacts that survive the ravages of time, and fewer still that remain intelligible once recovered. Here Fabbri distinguishes himself by proposing the use of 'biological messengers' instead of

[1] Text has been translated from original French.

linguistic or pictorial ones, using the realm of zoo-semiotics. The study of signs as they pertain to animals is known as zoo-semiotics and is a subsection of the field of bio-semiotics, in the text 'Introduction to Biosemiotics,' (Barbieri, 2008) proposes that cultural semiotics can actually be considered a subsection of bio-semiotics because humans are themselves animals, he also explores the influence of the discovery of DNA in the field, after which the cell itself began to be seen as a semiotic system. This field was clearly a strong influence for Fabbri, as the act of using genetic information as a communicative device forms the core of his proposition. With this in mind, Fabbri proposes the use of a biological 'radiation detector' in the form of a cat, using genetic engineering to produce bio-luminescence in the presence of radiation. Proposing to disseminate the myth that glowing cats mean danger, and that they should be avoided. He claimed that our ongoing proximity and relationship to domesticated animals is likely to continue, writing, *'The presence of the detector should constantly occupy the mind of the host…/ so that he can constantly remember it, in order to simulate the effect of religious faith or aesthetic pleasure…/ it is likely that the habit of perpetuating a particular race can withstand time.'* This logic is sound, evolution notwithstanding genetics are a relative constant when compared to other semiotic approaches, all but ensuring the purity of the sign remains intact. The rate of change in organisms due to evolution is in the scale of millions of years, therefore far beyond the timescale needed for this approach, meaning it bears no influence on the viability of organisms as semiotic devices.

Humans are the only animal species that exhibits culture as we know it, apart from some smaller instances of elephants and primates exhibiting behaviours that are location specific, humanity is the only species so reliant on the dissemination of practices through memory we could scarcely survive without it. In the text 'Collective Memory and Cultural Identity,' (Assmann, Czaplicka, 1995) our ability for collective memory is compared to that of a 'pseudo-species,' bypassing the function of genetics in steering animal behaviour and allowing us to develop as a species at a pace incapable through evolution. They write, *'According to Nietzsche, while in the world of animals genetic programs guarantee the survival of the species, humans must find a means by which to maintain their nature consistently through generations,'* However, this perceived benefit also comes at a great cost, culture is impermanent, and while the ray-cats may remain unchanged there is no guarantee our collective memory will remain the same. This is where the realm of zoo-semiotics must intersect with cultural memory, and Fabbri has a solution for this - he states that while religion alone may be more successful for the function of collective memory, it is too easily changed. Instead he believes in the power of mythology as a solution, proposing that a myth or legend surrounding his ray-cats would have a greater chance of survival than a concrete religion. He writes, *'However, it is doubtful whether art is able to transmit knowledge as technical as that which would make it possible to build a meter or reconstruct the map of waste repositories by specifying their nature and age. On this issue, a religion would have performed better, thanks to its historical concerns; therefore, it is fortunate that we have suggested before that the precise details should be forgotten, since we must take into account the possibility of cultural upheavals that would transform religious practices.'* This is an interesting approach, not least because religion is actively re-enforced by a group of elites, in this way religion can change and *be* changed in order to fit the desires of that group. Myths are more successful then, because myths are revered by cultures, they are protected as a societal inheritance, one could argue they are treated with more respect than

gospel itself. The myth of a glowing cat just might last longer than a religion dedicated to it, if the myth were to become an aspect of the national or social identity of those repeating it.

3.2 Comparative Analysis: Cumbrian Alchemy Exhibition

Another piece within the field of Nuclear Semiotics that questions the power mythology can have is seen in the 'Cumbrian Alchemy' project, an archival research exhibition exploring the folklore and history of Cumbria's nuclear power industry. Held in 2012, the exhibition showcased a series of drawings, artefacts, and archival pieces on the theme of nuclear power and nuclear waste (Fig 3). Bridging the gap between past, present and future, the exhibition mixed Cumbria's history with speculative future scenarios, acting out a version of Sebeok's priesthood on a hill above the nuclear site. This work is unique in its exploration of formal and informal mythologies within the field of nuclear semiotics, here we can see similarities to Fabbri's work within the field, favouring myths and legends as a means of collective memory. The exhibition itself interrogated the place of folklore in collective memory practices, something explored in Astrid Erll's introduction to 'Cultural Memory Studies' (2008). She writes, *'Myth, religious memory, political history, trauma, family remembrance, or generational memory are different modes of referring to the past. Seen in this way, history is but yet another mode of cultural memory.'* Interestingly, the exhibition blurs the lines between historic and fictional representations of the issue, presenting speculative ideas alongside archival records. This decision highlights the nature of Nuclear Semiotics as a practice that must juggle two opposing ideals. As Elle Carpenter discussed in 'The Nuclear Anthropocene' (2014) in order for messages to transmit deep into the future, objective fact and speculative fiction must meld together into a hybrid form. A successful proposition must contain science and fiction in equal measure, in order to hijack the most long-lasting aspects of our culture, myths, legends, art, and religion. 'Cumbrian Alchemy' encapsulates this ideas successfully, asking the audience to engage in the process of imagining a mythic nuclear future, and to ponder the real-life science driving the need for such solutions.

The similarities between Fabbri's ray-cat solution and 'Cumbrian Alchemy' are clear, both rely on the power of mythology as a means of sending messages into the future. Both rely on the importance of cultural memory as a communication method as opposed to traditional methods such as a linguistic warning sign. However they differ on a few core principles, firstly Fabbri's work was centred around a single idea, placing all his eggs in one basket as it were. Fabbri had the strength of conviction in his approach to propose it individually, whereas 'Cumbrian Alchemy' focused on a multidisciplinary approach, instead relying on the power of archiving and history to create a lexicon of ideas which the public can engage in. This curatorial approach had the benefit of trust in the wider population, exploring the roles that museum infrastructure plays in reenforcing cultural memory. The exhibition held no concept higher than the other, instead taking the public on a journey through the field and allowing them to form their own conclusions. As said in the 'Constructing Memory' conference of 2015 *'Memory is often found between parentheses that do not overload the spirit but enclose it in rules that facilitate forgetting... which is a vanity of the present moment. The past must always have the role of providing future ferment. And then the transfer occurs that can open up to history.'* In this we can view the act of 'archiving' as playing a vital role in the process of remembering. In the place of Sebeok's grand priesthood, Massart's ambitious Sarcophagi, or Fabbri's curious

ray-cats, perhaps the greatest way to remember is to keep our past alive, through the practice of interrogating our history.

Fig 3 - Cumbrian Alchemy Exhibition, Bryan McGovern Wilson, Robert Williams, 2012

Conclusion

Nuclear Semiotics is a field that highlights our unique ability for collective memory, revealing the very nature of remembering itself. To see so many practitioners dedicating years of their life to a future they will never see, and to protecting the lives of fellow humans they will never know has been a joy. In our ever growing need for power and resources during the 20th century, it was rare for humanity to take stock of the implications of our greed. However, the methodologies put forward in this text show a distinct shift in our cultural understanding of responsibility. In the wake of the Anthropocene and developing research in the field, we have begun to understand the need to protect the future from our current failings. In conducting this research project I have been able to realise my passion for visual culture and artistic practice, and discover its unique place in the world of science. Never before could I have imagined a place for such ideas in the framework of physics, mathematics and industry, and I have begun to wonder about where future projects on this topic could lead. Perhaps within the framework of a Master's it could be possible to integrate the case study of the 'Voyager Space Mission' within my research to explore the semiotic approach taken when the intended audience is no longer human. The case studies I have explored have revealed the importance of *culture* as a distinct system to transmit vital information. Instead of relying on the hard science that developed these challenges, we have relied on the very nature of our social structures to provide a solution. With the power of Sebeok's religion, the vitality of Massart's art, the ingenuity of Fabbri's ray-cats, and the dedication of Cumbrian Alchemy's archive; we can seek new solutions to the nuclear waste problem, and hope to dream of a safer future for us all.

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