Frankenzebra: Dangerous Knowledge and the Narrative Construction of Monsters*

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Summary

This article explores the enduring fear of "dangerous knowledge". It argues that the "de-extinction movement" towards reviving long-disappeared species has been understood largely through recourse to one key "story" – the Frankenstein Myth. It looks at three de-extinction projects – the mammoth, quagga, and thylacine – using the way these projects have been couched to analyse anxieties over the hubristic abuse of technology. The article focuses on the power of mythic narratives to not only explain but shape understandings of science in society, concealing more nuanced understandings. Indeed, deeply entrenched narratives can actually influence scientific endeavour.

Opsomming

Hierdie artikel bestudeer die vasgewortelde vrees vir "gevaarlike kennis". Daar word aangevoer dat die "de-uitwissingsbeweging", gemik op die hervestiging van langverdwene spesies, grootliks verstaan word deur die lens van een sleutelverhaal – die mite van Frankenstein. Drie van hierdie de-uitwissingsprojekte word ondersoek: die mammoet, kwagga en buidelwolf. Die manier waarop hierdie projekte verstaan is, word gebruik om vrese rondom die aanmatigende misbruik van tegnologie te analiseer. Die artikel fokus op die mag van mitiese narratiewe in hul verklaring maar ook hul vorming van die wetenskap in die samelewing, soos hulle ook meer genuanseerde idees verdoesel. Diepliggende narratiewe kan inderdaad wetenskap-like ondersoek beïnvloed.

> Learn from me, ... at least by my example, how dangerous is the acquirement of knowledge ...
>
> — Mary Shelley, *Frankenstein*

> The monster is the one doing the experiment.
>
> — Anonymous, lab room graffiti

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The woolly mammoths – giant tusked grass-eaters of the Ice Age tundra – roamed the frozen steppe until about 4 000 years ago. A little girl called Olivia wants us to remember them. Earlier this year, this South Carolina third grader noted that, although her state has 50 official symbols (including a "state migratory marine mammal" and a "state beverage") it does not have a state fossil, so she wrote to her local legislators asking for official recognition of the mammoth. Realising that simply "because I like fossils" was insufficient to convince hard-bitten law-makers, she offered these three motivations: One of the first American paleontological discoveries was mammoth's teeth unearthed on a South Carolina plantation; all but seven states have an official state fossil; and, thirdly, "Fossils tell us about our past". The proposed bill was blocked in the South Carolina senate by Sen. Kevin Bryant who wanted to amend it to include three verses from the Book of Genesis detailing God's creation of the Earth and its living inhabitants – including mammoths. Bryant explained: "I just felt like it'd be a good thing to acknowledge the *creator* of the fossils". (In fact, some bloggers suggested that that official state fossil should be Senator Kevin Bryant; on the grounds that – while he might not hail from the Pleistocene Era – his views do). His amendment was ruled out of order because it introduced a new subject. So he submitted another stalling amendment, describing the mammoth "as created on the Sixth Day with the beasts of the field" (Griggs 2014; Hernández-Cruz 2014). For now, Olivia's fossil bill is on hold.

Creation stories matter to people. They are stories about power – a power predicated on knowledge. Indeed, there is an ancient story told by way of warning when a child asks a question that seems too bold. The fable takes many forms but its essence is this: Do not cross the societal boundaries to acquire knowledge. You steal fire from the gods, you are chained to a rock and your liver gets pecked by avenging avians for eternity. You fly too near the sun, you fall into the sea and drown. You insist on finding out your parentage, discover inadvertent incest and have to blind your own eyes. You eat an apple from the Tree of Knowledge you are evicted from paradise. You make a deal with Mephistopheles to acquire all worldly knowledge and are doomed to everlasting hellfire. You create life and that creature kills your nearest and dearest – or you. Perhaps it is best summarised thus: you screw with the Natural Order – and *you* are *screwed*.

This parable has had many incarnations of anti-heroes: Prometheus, Icarus, Oedipus, Eve, Faust, Frankenstein,[1] Dr Moreau, Dr Jekyll, Dr Strangelove, The Fly, Dr Frank N. Furter, Blade Runner and Herman von Klempt. There have been many who breached the natural (knowledge) order by trying to

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1. "Frankenstein", of course, is the name of the architect of the monster; the monster himself is unbaptised.

create life.[2] The scientist Frankenstein in the eponymous novel (which is arguably the most influential Promethean incarnation in modernity) was originally conceived by Mary Shelley in Geneva in 1816 (Turney 1996; Shattuck 1996). She and a group of literary friends spent the strangely stormy summer discussing both the old and the new: traditional Germanic ghost stories and recent experiments in galvanism (an Italian anatomist Galvani had applied electricity to a dead frog, producing movement). Shelley merged this embryonic science with anxieties over this new unknown force. She thereby framed a debate on the limits of human knowledge and the dangers of crossing those limits within the background of modernisation and the Industrial Revolution (Shelley [1818]1969). Her writing was buttressed by her Enlightenment belief in progress based on responsible use of power. However, she also subscribed to the Romantic ideal that misused power could destroy society (Bennett 1998: 36-42). The novel's message was, in some ways, the paradigmatic myth of the Romantic movement (Hustis 2003: 845-858).

Shelley explored these tensions between myth and modernity, responsible versus irresponsible power in *Frankenstein or, The Modern Prometheus*. Often called the first science fiction novel, her novel offered the tale of a young Victor Frankenstein, seduced at university by the possibilities of new and dangerous knowledge. The young scientist boasts: "So much has been done, exclaimed the soul of Frankenstein – more, far more, will I achieve; treading in the steps already marked, I will pioneer a new way, explore unknown powers, and unfold to the world the deepest mysteries of creation" (Shelley [1818]1969: 48). He dares to create a living entity, a creature fashioned out of stolen body parts: "He … sleeps but he is awakened; he opens his eyes; behold, the horrid thing stands at his bedside, opening his curtains and looking on him with yellow, watery, but speculative eyes" ([1818]1969: 9). The monster escapes his control, and then undergoes an existential crisis – after watching human society and reading Plato and Dante – before running murderously amok. He demands a mate – a monstrous Eve to ease his loneliness. When this is refused he slaughters Frankenstein's best friend and Frankenstein's own bride. From his own ghastly experience, Frankenstein warns against "any human endeavour to mock the stupendous mechanism of the Creator of the world" (Shelley [1818]1969: 9). He dies after issuing a stern warning against tampering with the natural order:

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2. A medieval rabbi created a clay golem in Prague and brought it to life by putting a shem (a tablet with a Hebrew inscription) in its mouth. After the golem went renegade the rabbi had to destroy it. Albertus Magnus found good help so hard to find that he resorted to animating a housekeeper of brass. The Renaissance alchemist Paracelsus's recipe entailed covering sperm in horse manure for about forty days and then, when "magnetised", it would come alive as a homunculus.

> Had I right, for my own benefit, to inflict this curse upon everlasting generations? … for the first time, the wickedness of my promise burst upon me; I shuddered to think that future ages might curse me as their pest, whose selfishness had not hesitated to buy its own peace at the price, perhaps, of the existence of the whole human race.
>
> (Shelley [1818]1969: 159)

Finally, Frankenstein stalks his monster to the extreme North, where it disappears into the wintery wastes.

The novel itself was "galvanised" from the dead parts of a corpus of narratives and has staggered through the last two centuries as a monstrous myth – in both ontology and influence. It has never gone out of print. There have been at least thirty film adaptations, from Boris Karloff's 1931 version onwards[3] and cartoon versions that simplified the fable thus: A scientist – driven by a heady brew of hubris and hope – recreates (or perhaps radically alters) life. The 1931 movie version offered an encapsulation of the novel's subtext:

> "Look! It's moving .... it's ... it's alive. It's alive ... It's alive, it's moving, … It's alive, it's alive, it's alive! It's
>
> ALIVE! … Oh, in the name of God! Now I know what it feels like to BE God!"

The creature defies its creator's constraints and escapes from the laboratory. It tries to live a life of its own choosing, but its very existence outrages the natural order, civilisation or (at the very least) the local villagers. The scientist is hoist by his own ego's petard – killed by his creation or by the yokels. The death of the scientist or the monster (sometimes by a rustic lynch mob) then – at least in part – restores the natural order.

Tellingly, the very word "monster" incorporates Old French and Latin, meaning to "reveal" or "display", and secondarily, because of what was revealed, to "warn" (Bissonette 2010: 106-120). The fear of humans using technology to breach God's realm and being unable to control their own creations has been dubbed the "Frankenstein Complex" by Isaac Asimov (Asimov 1978; Hammond 1986: 21-45). This article explores this enduring trope to analyse the power of narratives to not only interpret but even shape popular understandings of contemporary society – especially science. Furthermore, it suggests that scientists themselves use popular narratives and metaphors – not only to explain or justify their work – but perhaps even to shape it. It is argued that the "de-extinction movement" has been understood largely through recourse to one key "story" – the Frankenstein

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3. There were some satirical versions like *The Diary of Anne Frankenstein*, a film about Hitler "trying to create the perfect killing machine to win the war". There was also *Frankenhooker* for a niche market.

leitmotif – used to explain its motives and outcome. This article first delineates (briefly) the notion of de-extinction, then explores three de-extinction projects: the mammoth, quagga, and thylacine. The article argues that mythic narrative strength may obscure a more nuanced popular understanding of a project and, secondly, that a deeply entrenched narrative can actually influence scientific endeavour.

Jurassic Prank?

De-extinction, "resurrection biology" or "species revivalism" or even "zombie zoology" (Swart [2014]) is the hotly debated process of creating an organism (or a breeding population) which is a member of (or perhaps simply resembles) an extinct species. It was first seriously considered using new biotechnology in April 1984, in a move that would have delighted Olivia, had she been alive. MIT's *Technology Review*, a respected science journal, announced that the hirsute icon of the Pleistocene had been brought back from the Ice Age.

Retrobreeding the Woolly Mammoth

> Last year in the Soviet Union, Dr. Sverbighooze Nikhiphorovitch Yasmilov, … at the University of Irkutsk, got hold of some cells – including some ova, or egg cells – from a young woolly mammoth found frozen in Siberia … Yasmilov continued his investigations by sending some cells to Dr. James Creak of MIT for testing. Creak heated the DNA from the mammoth ova until it dissolved into short lengths of code …. [H]e tried mixing it with a similarly prepared solution of the DNA of elephant sperm. The sections of elephant and mammoth code that matched "zipped themselves together", according to Creak, "as DNA is wont to do". This "paired DNA", representing the code common to elephants and woolly mammoths, was centrifuged off, leaving a residue of code that differed between the two species. The difference was less than 4.3% …. Yasmilov … promptly set to work trying to fuse the nuclei from the mammoth ova, in their new cytoplasm, with sperm from an Asian elephant bull ….
>
> Creak [said]: "Some scientists like to proceed in small, carefully thought-out steps. They are like accountants, and might as well be," he complained. "I see science as high adventure, with enormous risks. Of course, the rewards are commensurately high if the gamble comes off." … [C]ell clusters were implanted in the wombs of Indian elephant cows …. Most of the elephant cows spontaneously miscarried, but two of the surrogate mothers carried to term, giving birth to the first known elephant-mammoth hybrids ….
>
> (ben-Aaron 1984: 85)

The story was picked up by the *Chicago Tribune* and its syndicates, and ultimately appeared in over 350 newspapers, before being exposed in the October edition as an April Fool's prank. *Elephas pseudotherias* was a shaggy mammoth story – a parody of the naïve media reporting on mammalian cloning and DNA advances more generally. This spoof, however, showed how life imitates art.[4]

In fact, in the same year, three biochemists at Berkeley – Allan Wilson, Russell Higuchi (who later joined private company Roche Molecular Systems Inc.) and Svante Paabo went to work on the preserved skin of a long-dead quagga. The quagga was (is?) a zebra-like creature striated on its forequarters, becoming light brown along its rear and underbelly, with long white socks. The scientists extracted sufficient DNA to determine some of its sequences of base pairs, the molecular rungs that link the two spiral halves of a DNA molecule. They found that the quagga was much closer kin to the modern plains zebra than previously realised. (In fact, there was a suite of shifting debates historically over whether the quagga was an entirely separate species, or even more closely related to the horse than to other zebras.) DNA analysis thus settled an old zoological argument about the antecedents of the quagga, but more important, it demonstrated that it is possible to make useful new breakthroughs from very old DNA.

Carnival Carnivores

This theme was the premise of *Jurassic Park* – Michael Crichton's 1990 best-selling novel and Steven Spielberg's dinosaur movie – 65 million years and 56 million dollars in the making. The tale was based on the idea of cloning dinosaurs for a tourist theme park – by using dinoDNA preserved in the stomachs of mosquitoes long fossilised in tree resin. A venture capitalist and head of the bioengineering company InGen, John Hammond, teams up with unscrupulous and arrogant scientists to populate the theme park. The friable natural (and human) order is immediately threatened by these humans who play at being god. (If one has read Frankenstein, it is impossible not to see in the velociraptor's intelligent almost-human but utterly inhumane gaze, the same "yellow, watery, but speculative eyes" of Frankenstein's monster). Ironically, the creatures intended as objects of tourist consumption reverse the paradigm – literally. The dinosaurs – like Frankenstein's monster before them – break free of their park constraints

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4. Of course, science itself frequently imitates art: Tim Berners-Lee, the scientist who created the World Wide Web, found inspiration from a science fiction story by Arthur C. Clarke, which he read in *Playboy*, called "Dial F for Frankenstein" (about an ever-more-interconnected telephone network that takes over the world).

and kill their creators (in the book Hammond dies, but in the movie he is rescued – perhaps with a mercenary eye on lucrative sequels). In the story, "chaos theory" has usurped the role more traditionally performed by divine disapproval – but the results are the same: death to those who transgress and have access to dangerous knowledge (Turner 2002: 887-909). The widely popular movie (the world's highest-grossing movie at that point) was based partly on recent advances in microbiology, but was also – as this article will show – based on the ancient myth described in the beginning of this article. Certainly, by reinscribing the Frankenstein myth, it subsequently influenced public understanding of the revival projects. Contemporaneously, *Jurassic Park* was accused of reviving "the Frankenstein image of amoral scientists unleashing forces they cannot control" (Browne 1993). The curator of vertebrate palaeontology at the American Museum of Natural History in New York observed: "[It] has a Frankenstein aspect. Unfortunately, though, the Frankenstein view of science has become very strong in our society" (Browne 1993). Indeed, Russell Higuchi circulated among scientific colleagues an outraged critique of the project, which promoted (he said) "gross overstatements of the capabilities of DNA technology" that "lead to unreasonable fear" of it. Even Crichton himself acknowledged an anti-scientific undertone: "I'm surprised more people haven't noticed it more than they have ... I'm enthusiastic about science, but there is a growing tendency toward scientism – unthinking acceptance of scientific ideas, and a tendency to discount ideas that science can't address". Spielberg also saw the movie as reissuing the ancient warning:

> Every gain in science involves an equal and opposite reaction – a loss, usually a loss of the environment …. Science is intrusive. I wouldn't ban molecular biology altogether, because it's useful in finding cures for AIDS, cancer and other diseases. But it's also dangerous, and that's the theme of "Jurassic Park".
>
> (Browne 1993)

The Frankenstein story (and, of course, also its much earlier incarnations like the Promethean myth), remains a typical rhetorical resort in understanding animal de-extinction projects – a narrative that still serves to frame and explain recent developments.[5] The novel's core theme was the late-nineteenth-century anxiety over unparalleled imperial power – over nature itself. This was revived in Crichton's *Jurassic Park* (and Spielberg's movie adaptation) as a reaction to unregulated biotechnology. In essence, it remained a cautionary tale about scientific egotism. As Crichton pondered through the character of Dr Ian Malcolm (the only known rock 'n roll mathematician): "Scientists are actually preoccupied with accomplishment.

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5. This section draws on Swart (2015). For an extended discussion see Latour (2011: 17-25).

So they are focused on whether they can do something. They never stop to ask if they *should* do something .... Discovery, they believe, is inevitable. So they just try to do it first. That's the game in science" (Crichton 1997: 294; my italics). This fed into a powerful story about science as understood by the public and arguably the *most* central and minatory in the West – the Frankenstein parable (Lesser 1992: 17-19; see also Back 1995). This parable has been the first recourse of the media in explaining a new scientific development's future and certainly the bedrock of the "precautionary principle" in science. Indeed, media and communication in science expert, Matthew Nisbet, identified it as one of the core lenses that shape public understanding in science-related policy debates (Nisbet 2009). Engineered crops were immediately dubbed "Frankenfoods" and Pleistocene "rewilded" habitats became "Frankenstein ecosystems". The term "frankenfood" was allegedly first used in the "Pure Food Campaign" organised by Jeremy Rifkin (Schurman 2004; Oliveira-Santos & Fernandez 2010: 4-5; see also Lassen & Jamison 2006). This trend is evident in the ongoing debate on de-extinction. Each flashpoint in the development of de-extinction strategies, especially those involving new DNA technologies, have provided the occasion for public debate and academic argument about the danger of this new knowledge in human affairs.

Actually, for many thousands of years, since the Neolithic Revolution, human beings had refined their knowledge on how to breed animals, honing the process of selecting and subsequently propagating the most desirable traits. Long before Darwin and Mendel, humans still deployed selective breeding for characteristics they desired. Since Watson and Crick's discovery of DNA in 1953, scientists have understood the process. In the last generation, scientists learnt how to control the genetic mechanism at the molecular level. This has catapulted the long history of selective breeding into a new chapter, in which neither the ability of the subject animals to mate nor the randomness of their progeny's results, is an impediment to the creation of new breeds (Applegate 2001: 207-263). Over the last few decades, clones like Dolly (the sheep clone) and Polly (the transgenic sheep clone) have all raised controversy usually cast in Frankenstein's mould (Hellsten 2000: 213-221; see also van Dijck 1999). In late modernity, however, "the habitat of the monstrous is sought less and less in what lies beyond the gaze of reason – such as [the] blank spots on maps ("here there be monsters") – and more and more in the workings of (techno-scientific) rationality itself" (Vurdubakis & Bloomfield 2004). Post-Enlightenment, we are all Prometheus's orphans. We have the fire but we wonder if we were wise to steal it.

Three Stuffed Animals

The apex of Enlightenment, and later imperial hubris, was perhaps to be found in museums – "an expression of the western conviction in the onward march of the rational" (MacKenzie 2009: 1, 4, 7). Museums became the last refuge of the two creatures under discussion – the quagga and the thylacine – after they had been exterminated by settlers in Britain's new colonies. The museum's intellectual agenda, its acquisitiveness and its methods were bound up with both imperialism and modernism. The colonial museum displayed the invasion of territories, of landscapes and ecosystems, symbolising the appropriation of land (and sometimes culture) by settlers. As MacKenzie noted, museums mobilised the past (and perhaps static displays of "nature") to depict atavisms of the Other. In fact, displaying representative artefacts from the past (or contemporary but "primitive" peoples) actually highlighted the expanse between the primitive societies that produced them from the high-modern progress of the museum in which they were showcased. Displaying natural scenes and stuffed animals reflected the domination of nature in the new colonial landscapes. Such museums were confident, unself-reflexive institutions, uncritical of their own project or their complicity in the imperial pursuit. It might be a trifle hyperbolic to suggest, as Barringer does, that they were simply metonyms of the state itself – they might not always have been understood as such and colonial politicians often baulked at funding them. Nevertheless, museums were key in ordering the new world hierarchy, naturalising the new, making it official and scientific, bringing the remote and the new into an established taxonomy of prior knowledge (Barringer & Flynn 1998: 17; for critique of this point see MacKenzie 2009: 8). Equally, individual institutions developed a (Dr Frankenstein-like) hunger for things to establish their own status – nationally or even internationally – ripping animals and peoples and objects from their contexts (Gosden & Knowles 2001; see also Coombes 1994). The museum was born out of the need to reflect the power, technology and networks of the new global system.

Yet one unconventional museum man wanted to turn this paradigm on its head. He wanted to ask humble questions about accepted taxonomies. He wanted to use the museum to recreate the natural order – not symbolically but physically. He wanted the lost animals in foreign museums to come home.[6] He wanted to reverse imperial rapacity; he wanted to restore. He wanted to return the sagging sawdust-filled specimens to the veld. He wanted the dead to come alive.

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6. It was certainly, at least at first, a museum project. See Quagga Project Archive, Minutes of the meeting of the Quagga Experimental Breeding Committee, 20 March 1986.

German-born taxidermist, Reinhold E. Rau, was based at the South African Museum in Cape Town.[7] In 1969, after a decade at the museum, he struggled to restore the museum's most valuable mammal – a sagging stuffed quagga foal. It had been a mere week old at its death in 1859 – big-eyed, wobbly-kneed, and awkwardly vulnerable. In 1971, Rau visited many European museums to assess the remaining preserved quagga specimens, probing the possibilities of back-breeding with German experts.[8] Rau began to believe that, despite the quagga's distinct classification (*Equus quagga quagga*), it was really the southern variation of the plains zebra (*Equus burchelli*), which itself ranged in striation, with stripes fading towards the south – possibly as an adaptation to more open landscape, like that of the semi-desert Karoo (Rau 1978: 27-45).

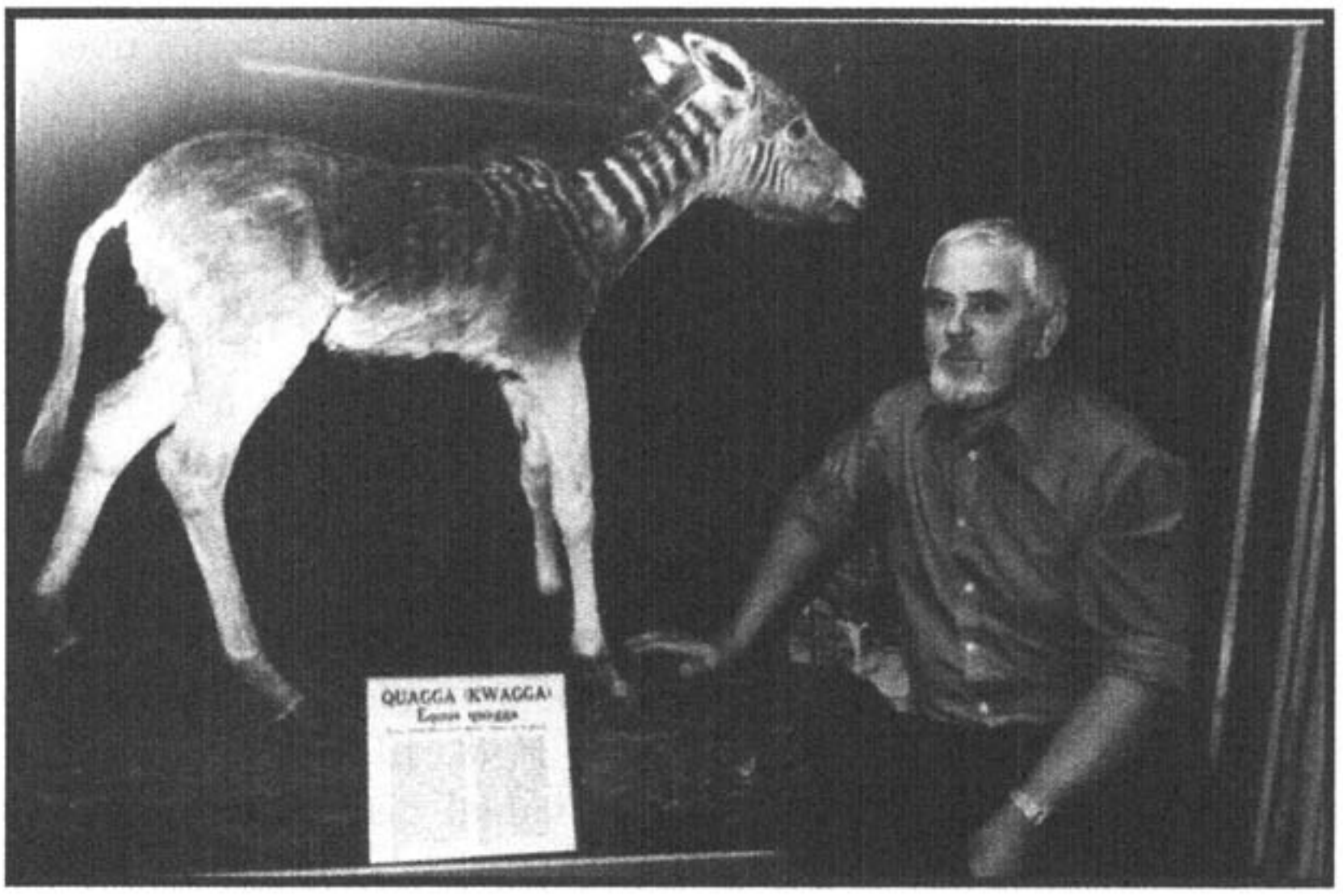

Fig. 1: Rau and the Foal, 1980[9]

7. Changes in the street and in parliament were always felt in the rarefied atmosphere of the museum. From the 1950s, with Nationalists joining boards of trustees, museums were partially compelled to serve the apartheid project. From 1954, museums were brought directly under government authority and increasingly South African-born citizens were appointed. (MacKenzie 2009: 98). The museum is now recast as Iziko, meaning "hearth" or the centre of cultural activity in Xhosa.

8. Quagga Project Archives, Rau to The Director, Natal Parks, Game & Fish Preservation Board, 2 September 1975. For a list see Rząśnicki 1949 and then Rau's revision: Rau 1974.

9. South African National Archives Repository, SAB, 17167, "Mnr. Reinhold Rau, hoof van die diere opstop afdeling van die Suid-Afrikaanse Museum in Kaapstad by die enigste opgestopte Kwagga in Afrika".

Yet, locally, while local farmers, some conservation officials and private trusts were willing to help, many state conservation personnel did not support the notion at first – dismissing the proposed programme as a "merely academic exercise of very dubious conservation value" which would produce only a "lookalike".[10] Southern Africans and, more broadly, the anglophone scientific world deemed the quagga a discrete and distinct species, which doomed (in their minds) Rau's back-breeding to mere whimsy. However, as explained, in 1980, American geneticist Oliver Ryder showed serious support of Rau's idea (Quagga Project Archive, Letter, Oliver Ryder to Rau, 5 December 1980) and in 1984, using tissue from Rau's foal, Higuchi and his colleagues at the University of California sequenced the DNA from quagga tissue (and at the same time isolated DNA from millennia-old mammoth tissue). Interestingly, literary legend declares that this inspired Crichton's *Jurassic Park* (Anon. 2006). Higuchi thanked Rau for not only the material but the "inspiration" for his DNA analysis, noting that without Rau's "interest [it] would never [have] taken place" (Quagga Project Archive, Letter, Russell Higuchi to Rau, 3 October 1989).

Further molecular study compared Mitochondrial DNA (mtDNA) extracted from a quagga's hide to that of the plains zebra, which seemed to suggest that the quagga was a subspecies of the plains zebra (Higuchi et al. 1984; George & Ryder 1986: 535-546; Higuchi et al. 1987; Lowenstein & Ryder 1985; for recent summation, Lorenzen, Arctander & Siegismund 2008). Lutz Heck had first postulated the idea of back-breeding a quagga – which had helped trigger Rau's original interest. Indeed, as a boy Rau had witnessed Lutz raise the dead. Lutz and his brother Heinz had run the Berlin Zoo and the Munich Zoo, respectively, in the years before World War II. Both were well connected to the Nationalist Socialist elite and, in line with the Nazi ecomythography, they celebrated autochthonous animals. For the 1936 Olympics in Berlin, Lutz Heck built a Teutonic zoo of prototypically "German" animals like bears and lynxes. Heck simply adapted a traditional method of selectively breeding animals to emphasise certain traits: "What my brother and I now had to do was to unite in a single breeding stock all those characteristics of the wild animal which are now found only separately in individual animals" (Heck 1954). Even a seemingly extinct animal's genes might be found in the gene pool of its direct descendants, so if he focused on gradually "breeding back" animals most similar to their extinct ancestors, over generations of breeding he would retrieve their pure ancestral being. The Heck brothers attempted to bring back the aurochs (the wild ancestor of domestic cattle), the wisent (an urbison), and the tarpan (an

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10. Quagga Project Archive, Letter, Director, Natal Parks, Game and Fish Preservation Board to Rau, 27 November 1975, Letter, Director, Department of Nature and Environmental Conservation, 1 October 1985. See also Reinhold E. Rau, "Rough Road towards Re-Breeding the Quagga – how it came about", March 1999, unpublished manuscript.

ancient horse breed) – by breeding back to purportedly primal and primeval purity, to purge the degeneration inherent to domestication. (This section draws on Swart [2014].)

These beasts were intended to re-wild the forests of the Third Reich as living totems of its power. The Hecks worked under the patronage of Hermann Göring, who also revived for himself a title extinct for two centuries – "*Reichsjägermeister*" ("The Reich's Master of the Hunt") (Viereck [1941]1965; Wang 2012). Some of his back-bred animals were set free in the freshly annexed Białowieża forest in Poland. (Heck had, as noted earlier, also purportedly once tried back-breeding to the quagga.) Most of the ancient creatures were only briefly brought back by the Heck brothers – and most suffered the same fate as Frankenstein's monster. The aurochs released in the captured Polish forest were shot by hungry soldiers for food. When the Allies bombed Berlin in January 1944, some of the zoo animals burned to death in their cages, but some escaped, briefly, and Lutz Heck's son had to shoot the charging aurochs. Yet some of the "Heck cattle" did survive at the Munich Zoo. In fact, years before he emigrated to South Africa, Rau had encountered Heck's aurochs performing in a circus near Frankfurt.

Rau was determined to back-breed (and thereby breed back) a quagga. This fitted in with the intellectual milieu in South Africa. Indeed, the role of breeding has loomed large in the academic understanding of animal science. Blood mattered disproportionately. The role of nutrition, for example, was a comparatively late development. So concern for bloodlines and back-breeding certainly made intuitive "sense" to the public and more specifically farmers and landed notables (and a small group of businessmen), with initially no state assistance, who set up a committee in 1986 – drawing on the expertise of zoologists, veterinarians, and museum staff. Publicity was only sought for a few years – in the hopes of securing a sponsor.[11] A small herd of nine zebras, out of thousands considered, were selected from reserves in South Africa and Namibia and moved to the farm "Vrolijkheid" [Joyfulness], near Robertson, in the Cape. The first foal was born the following year.

Selection for particular traits was (and continues to be) rigorously applied: the quagga-like were mated with the quagga-like and the failed facsimiles were sold for funds. New mutations, with deviant coloration, were culled from the herd. After four generations (a breeding generation being approximately four years), the new creatures certainly began to exhibit a visible degree of stripe reduction over their hind bodies akin to many of the museum specimens Rau had inspected (Harley et al. 2010; Heywood 2013). For almost two decades, Rau tended his herd of beloved monsters. He died

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11. Quagga Project Archive, Minutes of a Meeting of the Quagga Experimental Breeding Programme Committee, 16 May 1987.

in 2006 but the herd and the project survived him. (It is interesting to note that Crichton did visit, albeit post-*Jurassic Park*, the quagga-breeding programme).

Lumped together in the media and popular imagination with the Quagga Project, but antithetical in its discourse and purported methods, was an ambitious scheme known as the Thylacine Project. The thylacine or Tasmanian tiger (a pouched carnivore, with stripes on its lupine body and a kangaroo tail) was rendered extinct (by a colonial bounty programme) in the 1930s. Like the quagga, the thylacine had a distinctive husky bark – but no one has heard it since "Benjamin", the last known thylacine, died of neglect during a cold snap at the Beaumaris Zoo in Hobart in 1936. Specimens all over the world in various zoos included the carcasses of partially eviscerated "wet" specimens and the poignant pouch babies floating in wombs of alcohol. In 1999, Professor Michael Archer, Director of the Australian Museum in Sydney, announced a bold plan: his museum would clone a thylacine (Freeman 2009). He planned to use the tissue samples from a puppy pickled in alcohol since 1866 (formaldehyde would have ruined its DNA), extract viable DNA and recreate the lost creature through cloning. Describing the recipe crudely: obtain viable sample DNA; recreate the genome; transfer DNA; develop eggs; find a suitable womb to implant the embryos and – voilà! – deliver the cloned baby organism. So, fifteen years after the mammoth hoax and almost thirty years since the Quagga Project's first inception, the Thylacine Project made world headlines by adopting the dramatic discourse of *Jurassic Park* – publicising its ambition to resuscitate the carnivorous marsupial and referring to the pickled pup as "the miracle bottle in which this time capsule is just waiting to pop back into life". Archer even suggested it would be possible to "go into a pet shop and buy a pet thylacine and bring it home" – surely the fantasy of every child who watched *Jurassic Park*.[12]

As in the South African context, Australian museums were founded by middle-class (often dilettante) scientists and amateur scientists and funded by the same social circle, before (often reluctant but mandatory) state support (MacKenzie 2009: 120-132; Griffiths 1996). Fundraising was constant: money was always needed – from private funders rather than simply the state. As historians have shown, museum propaganda has long relied on its unproven but much-insisted-upon impact on economic development (MacKenzie 2009: 114). There has been an equally long history of the state ignoring such rhetoric.

So this project resorted to making bold claims well in advance of what was (or indeed is) currently possible. The story the director chose to tell about the project reflected a change in the nature of the museum itself. The

12. For incisive discussion see Fletcher 2010. For Archer's comments see Fletcher 2010: 54.

economic thrust of the museum had moved away from its claims to serve in the front line of national science and more in the direction of national and indeed international tourism: "People now circulate more regularly than things" (MacKenzie 2009: 269). In choosing the Tasmanian tiger and in choosing the arrogant Frankensteinian rhetoric, the promoters of the cloning project ensured extensive media coverage and therefore public interest and concomitant donations. This reflects a recent general trend in de-extinction efforts: a growing alliance between wealthy philanthropists/businessmen, and scientists (exemplified first in *Jurassic Park* but again, as life imitates art, also in reality). DNA is durable and easy to replicate – in many ways it is the "perfect commodity" (Roof 2007: 198). There has been a scramble to patent genes. Attempts to own the rights to specific DNA could be seen as part of a stampede for a new market. Tellingly, the project's 1999/2000 annual report talked of positioning the museum "within the crowded market by creating joint promotions with corporate sponsors" and the following year's report boasted of "unprecedented worldwide attention" (Fletcher 2010: 55). This private de-extinction for potential profit could be seen as a form of neoliberal necromancy.

The Thylacine Project ignored, however, two fairly strong reasons which militate against the thylacine's return: firstly, it is morphologically unique and phylogenetically isolated in its own taxonomic family (Thylacinidae). There is no womb to accommodate the egg – there is no place to "hatch" this marsupial mammal that departed from its closest living relatives – the Devil and the Numbat – 40 million years ago (for perspective, remember humans split from the other primates a mere 15 million years ago). The thylacine was sequenced by extracting DNA from the hair of specimens (the keratinised shell protects DNA from bacterial contamination), which revealed which branch was closest on the phylogenetic tree (Miller et al. 2009). Secondly, like the quagga, it may already be here. The thylacine is categorised by both the IUCN and the WWF as extinct. Yet cryptozoologists hunt the thylacine avidly on the borderlands between natural history and natural mystery – sometimes in the deep Tasmanian wilderness, sometimes in the more savage wilds of the internet. Believable footage exists from 1973 and there are more serious sightings on top of the obvious hoaxes and wishful thinking. Certainly there are (living) reasons to hope: the mahogany glider (purportedly extinct in 1886, rediscovered in 1989), the Laotian rock rat (known only in the fossil record, discovered in 1996), Gilbert's potoroo (extinct in the 1870s and chanced upon again in 1994). The crepuscular, timid, and forest-bound can survive unseen by human eyes. Twilight shadowy populations can endure – when they are rediscovered they are commonly referred to as "Lazarus species" – revived by external non-human forces. In palaeontology, a Lazarus taxon is one that disappears for one or more periods from the fossil record, only to reappear again later. (The term refers to the Biblical story, in which Jesus is said to have raised Lazarus

from the dead.)[13] Indeed, critics kept asking if the funds should not rather go towards preserving or restoring habitat to find and protect any such small remnant populations. But simply finding a species does not contain the Frankenstein promise of creating life and fails to capture the public's imagination – or its cheques – in quite the same fashion.

Raising the dead also raises money. After all, it is the ultimate spectacle: a *Théâtre du Grand-Guignol* – only in reverse. The long-spilled blood is put into test tubes and the corpses are magically reanimated by sorcerer-scientists. Thus the project continually swung between science and spectacle, as stakeholders involved used the media (Fletcher 2010: 48-60). In his later TED Talk, Archer was to muse: "Is this a risk? You've taken the bits of one animal and you've mixed them into the cell of a different kind of an animal. Are we going to get a Frankenstein? You know, some kind of weird hybrid chimera? And the answer is no" (TED De-extinction n.d.). Anxieties over the dangerous knowledge deployed by scientists frequently surfaced in public debate: especially after Archer declared that the project challenged not only the notion of extinction – it challenged "the whole notion of death for that matter" (Fletcher 2010: 57). (This predictably spawned this fairly representative reaction from the public: "this smacks a little of Jurrasic Park [sic] and Frankenstein ... if the creature is extinct then it should be left that way!!") It lasted six years and then was quietly dropped when its progenitor left to become Dean of Science at the University of New South Wales. (He is currently working on "The Lazarus Project": bringing back the infinitely less sexy gastric-brooding frog – which does bring one uncannily back to Galvani.)

No thylacine ever emerged. A series of similar projects were cloned from the idea – which resulted in more tangible progeny. (For a very readable critique of such boldness see Becker (2008) and for a discussion see Weidensaul (2002: 214-242)). Some of these were heartbreaking, like the cloned gaur that died after two days or the ibex that died only a few minutes after being born. Yet, in the popular domain and in some scientific circles, the rhetoric of scientific hubris persisted. Indeed, in some restoration projects, the only thing successfully cloned was the Faustian fustian of Shelley and Crichton's cautionary tales.

The only thing actually brought back from the dead has been late-nineteenth-century high-modernist scientific arrogance.

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13. An "Elvis taxon" is a lookalike that has supplanted an extinct taxon. Palaeontologists rock on.

Fig. 2: Thylacine Dreams
(Used with the permission of the Archives Office of Tasmania, 1 January 1920, Series Number: PH30.)

Frankenscience and Storytelling

Myths percolate through in narrative subtexts in the mass media or find expression in modernity's equivalent in science fiction or "lab-lit", in which "central scientific characters, activities and themes are portrayed in a realistic manner" (Rohn 2005). Together these shape our understanding of technology's role in society. The public understanding of nascent developments in science depends only marginally on statements by experts but much more strongly on media accounts (Hamilton 2003: 267-282) and time-honoured fictional narratives already in the ordinary human's mind as the "go to" explanatory story. To the ire of experts, people generally gather information from a diffuse cultural matrix which encompasses popular and populist understandings of science – many filtered through creative fiction (Hyman 1998). As Gordon and others have argued, fiction influences beliefs – especially the understanding of risk – which concomitantly impact on public support and thus on policies and state funding (Gordon 2009). In fact, studies suggest that people rely on narratives even when these storytellers openly concede that these are fictionalised (Prentice, Gerry & Bailis. 1997; Strange 2002: 263-286). Moreover, the less personal experience people have

of an issue the more they rely on the stories they have internalised (van den Bulck & Vandebosch 2003). Moreover, readers change their mental model of a story's "world" towards their lived experience of the real world (over time, in their minds) – which makes ideas suggested by that story even more credible (to them) (Graesser et al. 1998: 246-301).

Stories are a potent force – cognitively and socially. Humans are adapted to pattern recognition, favouring the causal chains offered by narratives. Stories make sense. So developmental paths for new technologies seem to make sense if they follow a narrative that is understood. Fletcher argues (of the thylacine project) that scientific controversies are not best understood as the public trying to understand knowledge trickled down by the intellectual elite, but rather as contested fields which sometimes alter the framing (or even direction) of science (Fletcher 2010). There are many examples of this phenomenon, not least J. Craig Venter's sequencing a bacterium in 1995 and using his bioengineering firm Celera Genomics to artificially create new forms of bacteria to find the minimal genome needed to sustain life in a project his researchers called "Frankencell". Venter himself is purportedly acutely aware of the comparison to Frankenstein – and eager to dispel it – after the media accused him of "Playing God in the Lab" (Mooney 2002). Similarly the Frankenstein warning parable propagated by *Jurassic Park* was – somewhat ironically – adopted but inverted by the Thylacine Project's progenitors. The cheerful bombast of showman-capitalist John Hammond was eerily mimicked by Archer as he explained his project and its lucrative potential. Monsters make money.

But this has not been the case in the Quagga Project, which – although validated by DNA studies in the 1980s – was premised on late-nineteenth-century back-breeding. Breeding back has none of the accoutrement of high modernity or Big Science. It is substantially cheaper, it can yield a whole population of species rather than one individual, such as in the case of cloning, and (above all) it actually works. Moreover, while its confident discourse might well have reflected hubris at its inception – it has moved far from Frankenstein's egoism, and has come to a place of self-reflection and an enduring interior conversation over its own legitimacy. Just before his death, Rau still considered the animal's aesthetic aspect to be the only benchmark of authenticity: "The quagga is a quagga because of the way it looked, then if you produce animals that look that way, they are quaggas".[14]

At that time, the Quagga Project declared: "The definition of the quagga can only rest on its well-described morphological characteristics and, if an animal is obtained that possesses these characters, then by definition, it will be a quagga". A decade later, it had a more reflexive and thoughtful stance:

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14. "Extinction is forever – or is it?", 3 October, 2006, <http://www.southafrica.info/pls/procs/iac.page?p_t1=2779&p_t2=7363&p_dynamic=YP&p_content_id=217955&p_site_id=38>, accessed 1 August 2014.

"The definition of a quagga can only rest on its well-described morphological characteristics and, if an animal is obtained that possesses these characters, then it is fair to claim that it is a representation of, at least, the visible quagga phenotype". Moreover, there has been a move towards a taxonomy of humility, revising the very name to "Rau quagga".

The shift in nomenclature simultaneously acknowledges the creature's own history and its close interaction with humans. The Project admits that a fairly subjective criterion is needed for deciding when the quagga has returned: when an animal is born with no scorable stripes on the hind part of the body, and no stripes on the legs. The foal will be known as a "Rau quagga", the qualification acknowledges Rau, posthumously, and makes no grand claims about restoring "*the* quagga".[15] This further reinforces the modest and self-aware argument that a species is not so much a genetic event but also a human decision (See Swart 2010, especially chapter 7). Thus the quagga's de-extinction is a nuanced, complex story – yet it remains, however, linked to the Frankenstein myth by many journalists, bloggers and members of the public.[16] Certainly, the creature's identity is at least as narrative as it is biological. Yet a narrative that insists on the Frankenstein monster storyline would miss these nuances.

Meanwhile, just as in the final pages of *Frankenstein*, scientists again hunt their monsters in the extreme North. In the white vastness of the Arctic, scientists are purportedly attempting to salvage the remains of long-dead woolly mammoths. In the ultimate act of science imitating art, they are emulating the 1984 prank: they plan to excavate DNA in Siberian permafrost, clone a mammoth using an elephant as a surrogate mother. In an eerie echo of the 1984 prank, rogue South Korean scientist Hwang Woo-Suk is collaborating with a Russian university to clone a woolly mammoth. Hwang became famous in 2004 for extracting stem cells from the world's first cloned human embryos. Two years later, he was indicted on bioethics violations and fraud charges (for receiving millions of dollars in private donations and embezzling state funds – during his trial it seems he did admit using some of the money trying to buy mammoth flesh from the Russian mafia). Fired by the Seoul National University and given a two-year suspended prison term, he later established the privately funded Sooam Biotech Research Foundation. He and his team will use the DNA of a 10 000-year-old baby woolly mammoth from the Siberian permafrost. The plan calls for extracting nuclei from the thawed-out mammoth cells, replacing the nuclei of egg cells from an elephant with the cells taken from the mammoth,

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15. The Quagga Project, <http://www.quaggaproject.org/what-is-quagga.htm>, accessed 10 November 2013.

16. See, for example, bloggers like "bleeding pencil" <http://pgiw.wordpress.com/2009/01/10/frankensteins-zebra/ and Kwurkii http://kwurki.wordpress.com/2010/07/31/resurrection-versus-extinction/>.

then implanting the eggs into the womb of a live elephant for a 22-month pregnancy. Trumpeting its successes, Sooam Biotech declared that Hwang is primed to return the extinct mammoth to the planet. Once the process is completed, there are plans to introduce these mammoths to the recreated "lost" tundra habitat (known as the "Pleistocene Park" Project) in the icefields of Siberia – which exemplifies the alignment of this conservation approach with enduring public appetite for science fiction and aptitude for myth (Zimov 2005; Zimov, Zimov & Chapin 2012; Fulka et al. 2009).

However, again, art was ahead of them: in 2006, the year Hwang was found guilty and the year Rau died, the movie *Mammoth* appeared with the tag line: "We hunted it to extinction … now it's hunting us!". At a modest natural history museum in rural Louisiana, Dr "Frank" Abernathy (a palaeontologist obsessed with his work, at all cost) tinkers with a once-frozen, 40 000-year-old mammoth. The mammoth awakes, possibly abetted by aliens, and threatens to visit its long pent-up wrath on the locals. Sinister federal agents must destroy the mammoth in order to save the village. They enlist Frank to help them hunt the alien-possessed zombie mammoth down and he must destroy his life's work – his monster.

Conclusion

Two long-dead striped beasts from the south were raised from their sarcophagi in museums – only one survived the process. There are no living thylacines, but many neoquaggas roam the veld again. In the shadow of a shaggy mammoth story, de-extinction narratives have played out an ancient plotline. This article has explored the enduring "dangerous knowledge" trope to analyse the power of narratives to not only interpret but even shape popular understandings of contemporary society – especially science. Myths that warn about punishment for hubris help us understand public reaction to de-extinction, but also understand how some de-extinction programmes have been framed by scientists. Cloning initiatives superseded back-breeding programmes in the public's imagination, specifically in the wake of the development (and media popularisation) of palaeogenetics as an academic subdiscipline in the 1980s. First there was a "cloned-woolly-mammoth" hoax, then genuine excitement over the prospect of cloning mammoths and enduring (arguably increasing) support over the last two decades to potentially revive other, more recently, lost species like the quagga and the thylacine. Thus the nature of narrative and the narrative of nature work together to develop a particular public understanding of de-extinction: one that finds nuance and subtlety difficult, one that favours the old myths. Scientists themselves have used this mythic metaphor – not only to explain their work – but to shape it, obscuring a more nuanced understanding of a project. Old narratives structure the collective imagination, as discussed, and

help shape the manner in which people find a way to react to new technology (Grinbaum 2010; Sherwin 2007). Scientific developments may cause us to evoke Frankenstein (or once, a proto-Frankenstein like Prometheus or perhaps now post-Frankenstein, the Jurassic Park dinosaurs), but Turney has urged that we "move past our preoccupation with Frankenstein and all his hideous progeny … we badly need new stories" (Turney 1996: 220-223). Figures like Frankenstein function as a convenient metaphor for articulating ageless anxiety over the acquisition and application of dangerous knowledge or expressing lost confidence in the modernist techno-scientific project. But a single, hegemonic storyline may obscure newer more nuanced tales. Certainly, there could be new stories – like that of the neoquagga rather than a Frankenzebra – and through these narratives of these new old creatures new stories wait to be told. Olivia, the little human who likes mammoths, was right: fossils do tell us about the past. But what this article has tried to show is that they – or rather, the stories we tell about them – also tell us about our present and our future.

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