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Dark Degenerations: Life, Light, and Transformation Beneath the Earth, 1840-c.1900

ABSTRACT

This paper offers a distinct contribution to several bodies of scholarship by historicising the supposed capacity of darkness to transform, and perhaps monstrously distort, bodies and minds. It does so by focusing on a single – though expansive - dark environment where several discourses of dark degeneration converged across the mid-late nineteenth century. Orbiting Kentucky’s immense Mammoth Cave, this paper interrogates conceptualisations of the physical effects of deep darkness on the bodies consumed by it. The cave was the stage for several allied discourses of dark degeneracy that conjured images of corporeal fragility and the disintegration of particular bodies and minds via exposure to the cave’s all-encompassing darkness. This examination of various forms of dark degeneracy highlights one manifestation of an intensifying nineteenth-century focus on the *how* of natural processes and a growing sense of the transformative significance of the apparent cohesion of malleable bodies with their wider environments.

‘Three hundred miles and more from Chimborazo, one hundred from the snows of Cotopaxi, in the wildest wastes of Ecuador’s Andes, there lies that mysterious mountain valley, cut off from all the world of men, the Country of the Blind.’ So begins H. G. Wells’ 1904 novella of the same name, in which a mountaineer stumbles upon an isolated valley whose population had gradually lost their sight. As generation followed generation, their bodies transformed, eyeballs degenerated back into their sockets and eyelids permanently closing as they radically adapted to life without vision. In the end, the residents of the Country of the Blind thrived in their profound isolation and state of extraordinary otherness; no sight was no loss whatsoever for they had learned to encounter the world through an array of extra-visual sensory arrangements, including extra-sensitive hearing and fingertips. Significantly, darkness – not only a relative absence of sunlight, but also the material presence of a distinct environmental condition – pervades Wells’ haunting tale; much of it occurs in

remote shadows cast by looming mountaintops: 'after a time the rising sun ceased to strike along the gorge, the voices of the singing birds died away, and the air grew cold and dark.' This gloomy and secluded place was the setting for ghastly transformation. For Wells, radical difference forged of degeneration had roots in an extreme and lonely environment, one that was cut-off from a 'normal', implicitly enlightened – in multiple senses of the word - world.¹

The suggestive motifs of isolation, darkness, radical difference, and transformation through degeneration at the heart of 'The Country of the Blind' were thoroughly entwined, and they were central motifs in a disturbing declensionist discourse that gathered force in Europe and North America from the middle of the nineteenth century, climaxing in the decades surrounding the *fin de siècle*. Visions of isolation, degeneracy, and decline are threaded across the literature of the age, including the various degenerations present in H. G. Wells' *The Time Machine* (1895), the travels of Oscar Wilde's Dorian Grey into a monstrous and degenerate metropolitan underworld (1890), George Gissing's tragic, murky London netherworld (1889), and Joseph Conrad's emergent 'abomination' in *Heart of Darkness* (1899).² In some instances, the total darkness of the subterranean world features as the setting of monstrous encounters with degenerate beings. In Jules Verne's 1864 *Journey to the Centre of the Earth*, German Professor, Otto Liedenbrock, and his companions encounter fish without eyes and evidence of a primeval race of giants as they journey through the blackness towards the Earth's core.³ Later, in horror writer H. P. Lovecraft's 1918 'The Beast in the Cave', a traveller becomes hopelessly lost in the darkness of the world-famous Mammoth Cave in Kentucky. There he finds himself stalked by a horrifyingly degenerate beast: 'From the tips of the fingers or toes, long rat-like claws extended. The hands or feet were not prehensile, a fact that I ascribed to the long residence in the cave which, as I before mentioned, seemed evident from the all-pervading and almost unearthly whiteness so characteristic of the whole anatomy.'⁴ All of these narratives share what is essentially the same logic: isolated, and extreme environments can be the setting for the emergence of radical and often monstrous

difference. Moreover, the darkness of some of these environments was not only the scene of the action, but also the driver of transformation.

Evidently, the fringes of the world hosted creatures that dwelt at the edges of the cultural imagination. The nightmares at the heart of these fantasies were, however, not confined to purely fictional realms. During the same period, some extraordinary dark-dwelling beings occupied the scientific imagination, too. An 1891 article in the *Indianapolis Journal* reflected that 'There are many animals in the world which pass all their lives in darkness, never seeing a ray of light'. Some of them, it noted, are creatures without eyes that emerged within and which live in the absolute darkness deep in the bowels of the Earth. One of the most interesting examples of physical transformation, the article elaborated, 'is blindness associated with life in the dark ... [The blind fish of Mammoth Cave, Kentucky] is destitute of external eyes. Although the eyes with the optic nerve are quite rudimentary, the optic lobes are as much developed as in fishes with perfect eyes ... They move very slowly through the water ... the ghostly white skin of the fish readily revealing themselves.'⁵ These were creatures that seemed to have degenerated from a supposed state of perfection in darkness, and they become objects of intense fascination across the nineteenth and twentieth centuries.⁶ By the latter half of the nineteenth century, the cave and its various eyeless inhabitants had gained an international reputation. The British periodical *Once a Week* claimed in 1871 that 'There are probably no readers of these pages who have not heard more or less of the Mammoth Cave of Kentucky ... [which may be regarded] as the most complete zoological garden in the world for eyeless animals.'⁷ Thus, while Lovecraft's unearthly cave creature is among the most extreme manifestation of difference born of total darkness, it may also be among the most disturbing, for, as noted in such newspaper

articles, Kentucky's Mammoth Cave contained its own real-life extremophiles whose bodies had apparently been radically transformed through isolation across eons in the darkness.

This paper offers a distinct contribution to several bodies of scholarship by historicising the supposed capacity of darkness to transform, and perhaps monstrously distort, bodies and minds. It does so by focusing on a single – though expansive – dark environment where several discourses of dark degeneration converged across the mid-late nineteenth century. Orbiting Kentucky's immense Mammoth Cave, this paper interrogates conceptualisations of the physical effects of deep darkness on the bodies consumed by it. The cave was the stage for several allied discourses of dark degeneracy that conjured images of corporeal fragility and the disintegration of particular bodies and minds via exposure to the cave's all-encompassing darkness. This examination of various forms of dark degeneracy highlights one manifestation of an intensifying nineteenth-century focus on the *how* of natural processes and a growing sense of the transformative significance of the apparent cohesion of malleable bodies with their wider environments.

This was a period during which knowledge of the world's environments, cultures, and organisms was expanding and deepening at the same time as industry and urbanisation increasingly reconstituted the fabric of society. This cultural milieu spawned profound biological and social questions about the emergence, development, and future of life, culture, and civilisation, and which significantly disrupted a pervasive faith in progress, the seamless and relentless advance from simplicity to complexity.⁸ Over the course of the nineteenth century, the natural world offered a building body of evidence that 'improvement' in this way was not inevitable; naturalists and natural philosophers became increasingly aware of creatures – such as the blind cave fish – whose 'extreme' and 'backward' forms seemed to contravene the elegant and monolithic biosocial laws of progress. By the end of the century, it had become clear that evolution could chart a 'backwards', degenerative course.

The spectre of decline has haunted societies for centuries, but fears of degeneration – of the decline, fragmentation and distortion of bodies, minds, societies, and cultures - intensified in both Europe and North America across the second half of the nineteenth century and remained potent until at least the interwar period. If ‘progress’ was the watchword of the nineteenth and early twentieth centuries, degeneration was the diffuse phenomenon that haunted its various cultures.⁹

Degeneration was a compelling concept, not least because of the post-enlightenment positivist faith in progress that had characterised modernity up until that point. The likes of Hegel, Marx, and Spencer had each propagated the monolithic and essentialising view that the path of the human journey (in particular) was one of perpetual improvement.¹⁰ The sheer speed of ‘improvement’, however, generated a gathering anxiety about the poisoned fruits of progress by the decades approaching the turn of the twentieth century. This concern reached its discursive extreme in Max Nordau’s 1893 *Degeneration*, which – influenced by the work of criminologist, phrenologist, and physician Cesare Lombroso - argued that the intense pressures of modernity had produced artists with the same degenerate traits as criminals. While this work was received generally negatively on both sides of the Atlantic, its emergence and extremity were symptoms of a latent sense of decline borne of the trappings of modernity.¹¹ The evidence for this decline transcended the biological and social realms, and Daniel Pick skilfully illustrates the diverse, slippery character of the concept, identifying ‘a fantastic kaleidoscope of concerns and objects through the second half of the century.’¹² Its dispersive nature meant that ‘it provided a context for the interpretation of situations, and a text for speculation.’¹³ In other words, its roots and echoes can be discerned across copious interrelated contexts. A complex discourse relating to dark environments presents one such context.

Over the past several decades, there has been sustained scholarly interest in degeneration as a complex cluster of ideas.¹⁴ When Daniel Pick published his *Faces of Degeneration* in 1989, he observed that historians and literary critics had paid relatively little attention to the idea, instead choosing to focus on the notion of progress. When degeneration was a focus of analysis, it tended to

be limited to the contexts of psychiatry, or the apparently atavistic resurgence of ‘primitive’ characteristics in the descent of European civilisation under Nazism.¹⁵ While these foci remain conspicuous in more recent scholarship, the concept’s historical contours and textures have since diversified. Historians and literary critics have, for instance, examined the gendered character of degenerative discourse through the intricate prism of the connections between sex, gender, mental illness, lifestyle, and degeneracy.¹⁶ Perhaps most significantly, scholars have turned to the currents underpinning racial science and racial determinist thought, exposing an intellectual milieu that identified the supposedly degenerative effects of tropicality upon the fragile bodies and minds of the white colonist.¹⁷ At the same time, research has indicated that it was imagined that Black Africans were best suited to the tropics and that degeneration would occur if they moved into the temperate zones. Indeed, such findings reveal that issues of race – and more broadly of classification, mutability, and inheritance – were at the heart of what was a systemically racist field of biological science that transcended the human and animal realms between the late eighteenth and early twentieth centuries.¹⁸

Significantly, darkness lurks throughout these works and across the discourses they identify, as a potent motif, a symbol of the supposedly backwards, the primeval, or as the stage on which degenerative dramas played out. In Arthur Herman’s view, for instance, ‘A powerful image came to haunt the liberal imagination: that inside every man lay a sleeping beast that might, if conditions went awry, suddenly spring out of its lair into the light of day.’¹⁹ And yet, the literature and scientific schema of the period also frequently cast islands of darkness as much more than passive components of the textured cultural landscapes of transformation. The apparent significance of secluded darkness as a driver of perplexing, deviant, and disturbing transformation has escaped historical attention.

Darkness has recently emerged as a focus of social and cultural historical interest. John A. Jackle was on point in his 2001 claim that places – past and present – have predominantly been considered

from the perspective of the light of day.²⁰ Over the past two decades, historians have heeded Jackle's call to interrogate the shadows. Nina Edwards' *Cultural History of Darkness* and A. Roger Ekirch's *At Day's Close*, are two principal examples of studies which trace the histories of shaded socio-political regimes, from criminality, leisure, and sex through to the world of nocturnal work.²¹ Equally, historical geographers have pointed towards the contemporary significance of illumination in countless combinations as significant conditions which shaped human societies, their fears, and desires.²² Across this scholarship, though, darkness has been paid little attention in an explicitly scientific context, as an environmental condition and natural phenomenon capable of driving transformation. Historians of science need to consider darkness as a physical phenomenon that has frequently been thought integral to natural processes across human and more-than-human realms. That said, some scholars have pointed to the effects of sunlight on bodies, particularly in the context of the treatment of consumption and the development of heliotherapy across North America and Europe.²³ Meanwhile, medical historian Daniel Freund pointed to a gathering anxiety about darkness in American cities and among urban reformers towards the end of the nineteenth century.²⁴ Despite substantial focus on the physical effects of light, however, there is little direct examination of historical scientific discourse surrounding darkness as *a distinct presence* in such contexts.

Darkness - and the relationships between bodies and darkness in particular – was frequently considered as a driver of change across several currents of thought that operated on diverse scales. To illustrate this, I focus on three historical subterranean phenomena rooted in Kentucky's Mammoth Cave: Predominantly, I concentrate on the history of the natural history of extremophile species that have adapted to true darkness. Scientific discourses relating to the cave's denizens frequently evoked visions of otherness rooted in notions of freakery and degeneration brought about by isolation and immersion in absolute darkness, and the shape of these theories flexed over the course of the period leading up to around 1900. I then consider episodes of the supposed transformation of human bodies and minds warped by voluntary and involuntary immersion in darkness, suggesting that there was an important supposed difference between the ways in which

different bodies were thought to engage with the subterranean world. Taking these contexts together, it is clear that the deep darkness of the subterranean was often seen to have both generative and degenerative effects, from its rapid impacts on individual bodies to its more gradual influence on species-level mutation. Published materials, from newspaper articles emanating from across North America and the United Kingdom, scientific papers, cave guidebooks and travelogues give insight not only into the ways in which the cave and its dark environment were packaged for wider consumption, but also into the scientific schools of thought which wrestled with the role of darkness in the course of subterranean degenerations. Together, these materials permit access to multiple interlocking discourses of dark degeneracy across the period. Several schools of thought – scholarly as well as more popular discourses - implicated the presence of darkness in a range of physical processes which drove radical transformation across several registers.

A SUBTERRANEAN WONDERLAND

The Mammoth Cave region of Kentucky has a long but mostly buried history of human occupation. Archaeological evidence points to almost continuous inhabitation by indigenous North Americans across the period between about 4,000 and 2,000 years ago. Following the cave's rediscovery by white frontiersmen moving westwards from Mississippi in the final years of the eighteenth century, the cave was deployed as a source of potassium nitrate during the War of 1812, before transforming into a monumental 'star' of the North American continent. Over the decades that ensued, the Mammoth Cave system became renowned for its sheer enormity; the extent of its underground passageways – as represented in several maps produced across the past several centuries (Fig. 1) - and the magnitude of its geological features, which ranged from giant domes and deep pits to vast underground rivers that were large enough to be traversed by steamers.

Figure 1. Edmund F. Lee and Doolittle & Munson, Map of the Mammoth Cave (Cincinnati, 1835).
<https://www.loc.gov/item/2006626050>

An immense karst cave system among many that stretch into the Appalachian Mountains, the Mammoth Cave system today extends for more than 350 miles though, in reality, it is merely a single segment of a vast trans-Appalachian subterranean world, most of which remains uncharted.

As Alyssa Diane Warrick illustrates in her extensive history of Mammoth Cave, just like similarly gargantuan features of the North American landscape, the cave increasingly became a source of intense American pride and national and international curiosity across the period of its commercial heyday in the second half of the nineteenth and the early decades of the twentieth centuries. Indeed, the cave was intensively marketed – by both successive and competing owners - in order to lure throngs of visitors to stalk its darkly sublime labyrinth, many of whom were drawn to the cave by the lure of an otherworldly underground spectacle.²⁵ An 1845 description by British traveller Alexander Clark Bullitt neatly conveys the otherworldly imaginings of this dark domain: ‘the lamps in the canoe glare like fiery eye-balls and the passengers sitting there so hushed and motionless look like shadows. The scene is so strangely funereal and spectral.’²⁶

In recent years, scholars have recognised that caves – like any other feature of the landscape - are nature/culture hybrids, where ideologies, aspirations and neuroses are inscribed onto a natural world that operates as a potent bearer of meaning.²⁷ Importantly, nineteenth-century writers principally imagined monumental cave systems as isolated locales of a dark and colossal sublime that was *supposed* to be emotionally transformative. William B. Jones’ 1844 guide to Mammoth Cave describes the cave as ‘dark and dismal ... nothing can be beheld and admired but by the aid of artificial light, yet the very darkness renders the scene the more awfully sublime.’²⁸ Guidebooks and newspaper articles relating visits to the cave drew attention to the otherworldly and inherently transformative character of the lonely darkscapes concealed beneath the skin of the earth, while routinely pointing to the ‘oppressive’ nature of the darkness beneath.²⁹ Caves such as Mammoth Cave were places where thick darkness entwined with immense scale to evoke fear, fascination, and awe in equal measure.³⁰ Indeed, the names ascribed to key features of the cave emphasised its

supposed power to evoke intensely emotional visitor responses: the enchantments of the Star Chamber, where balsam afforded the cave's ceiling the look of a night's sky brimming with countless celestial bodies (Fig. 2), the awful Giant's Coffin, and the infamous and dreadful Bottomless Pit, which prompted an evocative 1856 description in *Scientific American*: 'The Bottomless Pit in the Mammoth Cave is suspected by many to run through the whole diameter of the earth ... he looks below, and nothing there meets his glance save darkness as thick as lampblack ... he hears a wild, mournful melody of water, and the wailing of the brook.'³¹ Critically, then, the deep karst environment of the Deep South subterranean was marketed and represented as a place of profound emotive transformation.

Figure 2. 'The Star Chamber', in Horace Martin, Pictorial guide to the Mammoth Cave, Kentucky (New York, 1851) Courtesy, American Antiquarian Society.

The transformations that were supposed to take place in the remote underground were often intimately associated with time itself, and this was part of the attraction's appeal. Particularly from the eighteenth century, caves were historically constructed as corridors leading downwards and backwards into deep time, a shrouded and essentially primeval domain.³² This combination of cultural constructs led some to portray caves like Mammoth Cave as spatial-temporal annexes, islands of deepest gloom.³³ The remote and emotional aspects of the earth's interior is significant, for it was in these places cut off from the rays of the sun that darkness of the deepest and most primeval sort was considered to do much more than simply inspire fleeting emotional responses. Indeed, caves were of substantial interest to naturalists precisely because they were viewed as *islands*, and this curiosity generated an array of discourses relating to the natural history of Mammoth Cave, focusing on extremophile species that could be found adrift there. Deep darkness was frequently imagined as driving change in the structure and behaviour of subterranean beings. This was a darkness that appeared, to some, to have considerable agency; powerful enough to drive

the course of life, from adaptive degeneration at one end of the scale to wholesale destruction at the other.

EVOLUTION AND THE PROBLEM OF DEGENERACY

As natural philosophers, explorers, and tourists ventured deeper into the Mammoth Cave system across the middle decades of the nineteenth century, it became obvious that it was home to a range of species, including fish, crickets, rats, bats, and crayfish. Frequently imagined as empty, dead spaces, cave systems are lively ecosystems, and the richness of the ecosystem in and around Mammoth Cave was eventually recognised when it was incorporated as part of the Mammoth Cave National Park in 1941.³⁴ Some of the creatures that dwell in the darkness of the subterranean, however, have over eons developed adaptations to life without light. Across the late eighteenth and early nineteenth centuries, cave scientists had begun to identify several seemingly anomalous, ‘primitive’ species – such as eyeless spiders and the otherworldly blind salamander – well beyond Mammoth Cave, in other Appalachian systems, caves in Cuba and, famously, in Postojna, Slovenia.³⁵ Initially presented as freakish curiosities, those discovered at Mammoth Cave provoked a sense that the deep subterranean darkness was the epitome of isolation in both space and time. Amongst the litany of strange subterranean beings, one attracted the focused attention of naturalists and cave tourists. In the waters of Mammoth Cave – the rivers Roaring, Echo and Styx – could be found eyeless fish (*Amblyopsis spelaeus*) (Fig. 3), which had adapted in radical and perplexing ways to life in the darkness.³⁶

Figure 3. Frank. H. Stockton, *Roundabout Rambles in Lands of Fact and Fantasy* (New York: Charles Scribener’s Sons, 1910), p. 36.

Across the eighteenth and early nineteenth centuries, the natural phenomena of the world had been increasingly classified; anthropogenic order imposed upon the immense chaos of nature. But the question of how to interpret the oddities and the outliers remained vexed.³⁷ Thus, the eyeless fish of Mammoth Cave were the subject of intense popular and scientific speculation after their discovery.

Numerous early reports were initially marked with a sense of the spectacular, the esteemed, and the freakish. One mid-century report articulated the natural wonders to be found across the US, gloating that ‘the greatest cave in the world is the Mammoth Cave in Kentucky, where one can make a voyage on the waters of a subterranean river, and catch fish without eyes.’³⁸ About four-to-five inches in length and typically of a whitish hue, the fish were swiftly imagined as an epitome of physical and sensory otherness, as ‘star attractions’ within one of America’s major tourist destinations. Indeed, the fish featured in one of the earliest descriptions of the cave, published in 1840: Transylvania University’s Reverend Robert Davidson described ‘a stream of water twenty feet wide and they said as many deep ... we were informed that a species of white fish were found here without eyes, and the keeper of the hotel assured us that he himself had seen them, but that their other senses were so acute, the slightest touch of water overhead was sufficient to alarm them and make them dart off like lightning ... we were not favoured with a sight of these natural curiosities.’³⁹ Almost every published guidebook across the middle of the nineteenth century – both those published as standalone texts and those that appeared in excerpted form in newspapers – feature the fish as freakish curios in a journey through the Kentuckian underground.⁴⁰ Indeed, popular texts, in particular, accentuated the otherworldly and bizarre. Some reports refer to ‘those anomalous fishes [that] twirl in the waters of the deep and dark ... in the water by torchlight [they] look like white phantoms.’⁴¹

Beyond sensational descriptions, naturalists soon sought to understand the creatures and their place in the story of life on earth. They were first scientifically described in 1842 by James Ellsworth DeKay in his *Natural History of New York*, where he recounted the features of a specimen of poor condition in New York’s Cabinet of the Lyceum of Natural History. The same year a specimen was presented by W. T. Craige, M.D. to the Academy of Natural Sciences of Philadelphia.⁴² Meanwhile, specimens – both alive and dead – were sent for examination as far afield as Paris in the 1840s.⁴³ The extraordinary character of the fish and related cave fauna meant that Mammoth Cave became, according to Katie Algeo, a scientific field site for the study of dark adaptations. Biologists, among

many others, flocked to the cave's living laboratory.⁴⁴ While the likes of Benjamin Silliman, Edward Drinker Cope, Jefferies Wyman, Louis Agassiz, and Charles Darwin each commented on the blind cave fish, key figures eventually emerged after the Civil War (which disrupted field research across the South) as specialists in the study of cave fauna. Frederic Ward Putnam, of Salem's Peabody Academy of Science, worked as a special assistant on the Kentucky State Geological Survey in the early 1870s, during which time he studied the biospeleology of Mammoth Cave, obtaining a large personal specimen collection in the process. Alphaeus Spring Packard was associated with the Kentucky State Geological Survey in 1874, he too conducting extensive studies of the cave life of the region.⁴⁵ Putnam and Packard eventually published together, noting in the preface to their combined work that 'no thorough zoological exploration of the cave has yet been undertaken.'⁴⁶ In the process, the fish transformed from 'freak' of nature into perplexing examples of adaptation to extreme environments. Indeed, in 1872, a group of naturalists visited the cave together to explore its biospeleology (as well as its geology, for geology, just as it had in the United Kingdom, where its so-called Golden Age extended from 1790 to the mid-nineteenth century, was enjoying much popularity⁴⁷) immediately after the culmination of the August 1871 meeting of the American Association for the Advancement of Science.⁴⁸

It is evident from Putnam's 1872 paper that by the early 1870s, there was a vibrant community of naturalists stretching across the United States and Europe, all with their own blind cave fish specimens, and all interrogating the creature's anatomy to understand the mechanisms through which it inhabited its gloomy world.⁴⁹ Key among the questions that preoccupied these naturalists was the significance of darkness in *producing* radically adapted bodies. Certainly, as part of a developing interest in the fauna of the subterranean across Europe and North America, superficial classificatory structures were established during the same period, which pointed to a fundamental connection between subterranean darkness and the bodies which inhabited it. From the middle of the century, naturalists such as J. M. C. Schiödte identified regions marking the transition from the light of the outside world to the deep darkness of the Earth's innards via a twilight transitional

zone.⁵⁰ Early taxonomies positioned darkness as a central subterranean environmental determinant of classification, ignoring more complex ecological relationships between cave fauna and the wider karst environment. Schiödte classified cave creatures as either 'shade' or 'twilight' fauna while, according to the system established by Schiner in 1854, cave fauna could be classified as 'trogloxenes' - chance guests/strays that did not habitually reside in darkness - or 'troglophiles' - which prefer subterranean realms, but which also occur outside - or, lastly, 'troglobionts', which occur exclusively underground and whose bodies are highly modified for and by life in darkness.⁵¹ Such classifications clearly position subterranean darkness as the single most important factor in the zonation of cave environments, but they did not say much about the creative influence of subterranean darkness itself.⁵²

Over several decades, the deterministic influence of darkness on these subterranean bodies underpinned a small constellation of key questions which clustered around deciphering the origin and mechanisms of the degeneration of the eye, that apex symbol of complexity and enlightenment in the Western world.⁵³ Exactly what role did darkness play in driving the forces of degeneration in subterranean species? This was the question that consumed a select community of naturalists, and it is one which continues to perplex life scientists in the twenty-first century.⁵⁴ In the decades approaching the turn of the century, there were multiple hypotheses, some of which ran in parallel, making for something of a conceptual miscellany within the natural sciences. For example, while his view stands in relative isolation in the context of the wider discussion, the Reverend Robert Davidson, who published an early account of the eyeless fish in 1840, identified no direct role at all for darkness in their emergence, instead supposing that they had been blinded by a sudden exposure to sunlight.⁵⁵ Davidson's hypothesis reflects a view which was coded by creationism, and which supposed that animals were designed with the powers of sight and that blindness was a morbid deviation from the norm. The eyelessness of some species of subterranean fauna provided a major headache for naturalists and, in important respects, this had a lot to do with a generally pervasive ocularcentrism in the Western world. During the period, sight was revered, not only

among naturalists, but also theologians, who together identified the eye as the organ of enlightenment, as evidence of the masterful hand of the creator, and as a primary evolutionary exemplar of the natural tendency for complexity to emerge from simplicity. As eighteenth-century English philosopher William Paley observed, the fingerprints of a divine designer seemed to lie all over the eye.⁵⁶ Vision was conceptualised as the preeminent means through which the individual subject acquired knowledge of the world (see visual figures of thought, such as Aristotle's Wax Tablet and Plato's Cave), and this subsequently led to complementary visions of sightlessness.⁵⁷

While Robert Davidson's specific hypothesis stood at one extreme of the conceptual spectrum, there nonetheless emerged two broad positions about the importance of darkness as a driver of subterranean transformation. This is neatly captured in an 1879 article in *Chambers' Journal*, which explicitly asked whether eyeless fish were 'created without eyes, in adaptation to dark underground rivers, or have the eyes disappeared in the course of ages to suit new conditions?'⁵⁸ In effect, these two positions portray a much broader debate within the natural sciences about the connection between living beings, their wider environments, and the passing of time.

The initially dominant position was coded by creationist views that species were formed in a single moment of genesis and were essentially immutable. Prominent naturalist Louis Agassiz was one among many naturalists who advocated for an essential stasis in the natural world. His anti-evolutionist position was expansive and closely linked to a vehement racism in his conviction that human races were created separately, and that species and races were designed for specific environments. When they left those environments, they were doomed to degeneration.⁵⁹ The identification of non-blind cave fauna in the decades following the 1840s seemed to support the creationist view of species immutability. Cave naturalist F. W. Putnam pointed to multiple fish living in the rivers of Mammoth Cave, including chologaster, with its apparently fully functional eyes, despite inhabiting a subterranean darkness that was just as total as its eyeless neighbours.⁶⁰ Indeed, Putnam pointed more generally to the diversity of variations among subterranean fish, suggesting,

following an Aristotelian line of argument, that since species are immutable, remaining fixed and unchanging from the moment of their Creation, the blind fish were simply made that way. The implication was that darkness did not itself cause transformation but, rather, that pre-created and stable species just happened to find themselves in dark environments via the movements of the earth itself.⁶¹ While this view lost much credence over the course of the period, it did not disappear entirely: a 1918 report in the *Harrisburg Telegraph* suggested – possibly tongue-in-cheek - that these ‘marvels’ of nature had been generated by ‘the all wise creator’ in retirement. They were, the article posited, an insane afterthought in which the rules of a rational creation had been subverted.⁶²

Beyond the frontiers of this inert creationist perspective, the possibility of evolution - or the essential mutability of natural forms - had become well-established, though not necessarily widely accepted as fact, by the mid-nineteenth century.⁶³ Comparative anatomical analyses of subterranean populations across the ‘Old’ and ‘New’ Worlds had found that such fauna was often strikingly similar to those living in surrounding environments, except for the vital sensory adaptations which allowed them to survive and thrive in the darkness. After the middle of the nineteenth century, it was seemed abundantly clear that cave fauna must have migrated into the darkness over many generations, before somehow degenerating, proving that species were not immutable and that they were not made – *from scratch* - underground.⁶⁴

What remained at stake, however, was the *process* by which development was driven, and it was in this regard that the problem of degeneracy emerged as a supposed force of radical change.⁶⁵ Two principal evolutionary hypotheses took centre stage, and in each of them, darkness was awarded various degrees of significance among a constellation of evolutionary drivers. Importantly, the notion of degenerative transformation had long been entangled with wider environmental contexts. Eighteenth-century Parisian naturalist, Georges-Louis Leclerc, Comte De Buffon, observed that animals appeared to transform once having moved from one milieu to another to which their forms were not ideally suited, while geologist Charles Lyell held the view that ‘Each race of man has its

place, like the inferior animals.⁶⁶ Such a perspective thoroughly entangled body and natural world, privileging the power of environmental contexts in seeding and propagating material change.

This view was developed and strengthened across the nineteenth century. Naturalist Jean-Baptiste Lamarck's 1809 *Zoological Philosophy* presented evidence that energetic environmental stressors consistently shape the transformation of equally dynamic living beings. This Lamarckian hypothesis was of harmonious transformation towards a state of perfect balance; a fundamentally stable natural world in which living things were imbued with an innate drive to responsively adapt to the world around them. Frequently taken as an implicit recognition of divine influence on the material world, Lamarckian natural philosophy proved influential across the nineteenth century. Indeed, it remained popular even after the emergence of Darwin's hypothesis of evolution by natural selection from the late 1850s.⁶⁷ Diverging from the Lamarckian hypothesis, the Darwinian view saw the environment as far less deterministic as a driver of change. Inherently violent, the Darwinian mechanism emphasised a perpetual struggle for existence which served as the driver of selection and therefore progressive species adaptation. Indeed, evolution via the Darwinian mechanism was understood to take place in two stages. Firstly, there were an immense multitude of random mutations that could generate almost infinite variety. The second part – the most crucial – was that some of these mutations might allow animals to better survive and thrive in their environments. These mutations would therefore be propagated, producing organisms better adapted to their environment, leading to gradual speciation over the course of time.⁶⁸ Nonetheless, both philosophies observed in nature a dynamism and profound complexity, rather than stasis, and the two views essentially ran in parallel across the period.⁶⁹

According to the disciples of Lamarck - the neo-Lamarckians - darkness had considerable agency in driving degeneration in subterranean contexts. Palaeontologist and comparative anatomist Edward Drinker Cope, for instance, argued that while evolution by natural selection might account for the perpetuation of advantageous traits, this mechanism could not explain the origin of those traits in

the first place. Reasoning that the cause of variation – in this case the disappearance of the eye - must lie elsewhere, he postulated that the disuse of the eye in the absolute darkness in which the fish found itself stimulated its gradual degeneration. As a prominent neo-Lamarckian, Cope's hypotheses influenced key cave naturalists, such as Alpheus Hyatt II and Alpheus Spring Packard, both of whom had more to say than he on the subject.⁷⁰ Packard, in particular, argued that cave fish adaptations could only be explained through the constant disuse of the eyes in the dark and that its disappearance must have occurred *suddenly* (by which he meant several thousand generations).⁷¹ In short, neo-Lamarckians suggested that it was possible for dark environments to directly exert degenerative pressures, stimulating the reduction of complexity, transforming life-forms in the process, and this view was influential until early in the twentieth century.

While Darwin's evolutionary mechanism placed less emphasis on environmental drivers, it would be erroneous to suggest that the Lamarckian and Darwinian positions were antithetical. In many ways Darwin acknowledged elements of Lamarckian evolution by recognizing that the environment played an important role in evolutionary processes. However, he argued that it was natural selection – competition between diverse adaptations - that allowed for the effects of environment to be transmitted across the generations.⁷² In the Darwinian view, then, it was the randomly emergent fit between advantageously adapted body and its wider environment which was the driver of change. And yet, the problem of degeneracy was a significant sticking point for Darwin's theories, particularly in relation to blindness; he could not fathom why it would be *advantageous* for an organism to lose its eyes. Nonetheless, he explained the sightlessness of blind species – from moles whose eyes had been covered by skin and fur, to the cave fauna of Kentucky and Carniola - through a combination of theories relating to use, disuse, and natural selection, emphasising the importance of isolation in the dark and suggesting that as on the most remote mountaintop and the most secluded oceanic outpost, isolation was a key ingredient of degenerative speciation in subterranean islands of darkness.⁷³ Writing in 1872, Darwin's consternation remained in evidence as he confessed that 'it is difficult to imagine that eyes, though useless, could in any way be injurious to animals living

in darkness.⁷⁴ Across the latter decades of the century no clear consensus view emerged as Darwinian scholars tackled the problem of evolution by degeneration head on. E. Ray Lankester was one such scholar, focusing his attention on subterranean darkness, attempting to eliminate the generative influence of darkness altogether, and postulating that darkness did not produce blindness but rather that caves served as ecological traps for the already visually 'defective'. In his view, published in 1893, mutants with 'distorted or defective eyes' were swept, along with their sighted kin, into the underworld. Those with functional eyes could follow the faint light to the surface, while those who could not see were condemned to remain trapped, 'until only a pure race of eyeless or blind animals would be left'.⁷⁵

Nonetheless, by the latter decades of the nineteenth century, the fact of progressive degeneration in eyeless cave fauna had been adopted as the consensus view across the community of naturalists working on the subject, and while many acknowledged the direct impact of darkness on the transmutation of sensory configurations, there remained profound questions about the mechanisms by which this was possible.⁷⁶ The mechanisms of dark degeneration were tested across several experiments, which attempted to initiate or reverse atrophy. One such experiment took place in Europe in the early 1880s, when several mice were successively bred in dark conditions to ascertain how long it might take for evolutionary processes to become degenerative. The mice did not, however, appear to have lost any visual capacity in the process.⁷⁷ In some cases, the blindness of cave fauna was considered merely a *temporary* adaptation to the dark. Indeed, one unnamed naturalist reflected in 1879 on the coming of electric lighting to the cave towards the final decades of the nineteenth century: 'what developments, if any, will be made upon the blind fish ... now that light is to be cast upon them ... ?'⁷⁸ Several experiments attempted to recover visual function, implying that evolutionary processes were able to function both 'forwards' and 'backwards' as living forms transmuted over the course of time. Benjamin Silliman allegedly conducted experiments on cave rats captured near the mouth of Mammoth Cave, in which exposure to graduated light over the course of a month generated a dim perception of objects among the experimental subjects, while

the eyes of four blind fish destined for display at the Dublin Zoo in 1870 had apparently begun to regenerate over the course of their trans-Atlantic voyage.⁷⁹

An allied research question focused on identifying the so-called 'stigmata of degeneration', the physical evidence of 'backwards' transformation. Carl H. Eigenmann rendered microscopic sections of the rudimentary eyes of cave fish, while simultaneously locating degenerated cellular layers present in 'normal' eyes. In his view, the key to understanding the origins of degeneration lay in the eye itself.⁸⁰ Indeed, by the turn of the century, rudimentary eyes were considered concrete evidence of the degeneration of blind cave fish.⁸¹ He later identified the remnants of pigment cells - protection from the sun - in the kin of the blind fish, and this was deployed as evidence of the ancestors of blind fish living in the light of day.⁸² Importantly, despite having lost their vision, it was evident that the blind cave fish and associated subterranean fauna were not considered, in this evolutionary schema, as wholly lacking.⁸³ Moreover, across the nineteenth century, it became clearer that such creatures had not only experienced degeneration but also constructive extra-visual adaptation to their environments, and this pointed to the wider transformative effects of darkness on these specialised forms. Theodor Tellkamp, member of the New York Lyceum of Natural History, first proposed the presence of folds on the head of the fish in the 1840s that, he surmised, might serve as organs of touch.⁸⁴ An interest in touch in the context of blindness was longstanding in Western cultures, as exemplified by an intense interest in the life of deaf, dumb and blind Laura Bridgman in mid nineteenth-century America.⁸⁵ At an 1873 debate on the subject Edward Drinker Cope described the blind fish that he had encountered in the Wyandotte Cave, emphasising, instead, the fish's auditory powers: 'They are unconscious of the presence of the enemy, except through the sense of hearing. This sense is, however, evidently very acute, for at any noise they turn suddenly downward, and hide beneath stones.' Other participants, including eminent pisciculturalist Seth Green, argued strongly that fish were only able to hear through vibration.⁸⁶ At an 1897 meeting of the British Association for the Advancement of Science, held in Toronto, Eigenmann noted that the most abundant blind fish had a head that was covered by cilia, or 'feelers': 'by means of its sensitive

feelers, it can recognise any motion about it in the water, but no amount of noise attracts its attention.⁸⁷

Despite the recognition of extra-visual adaptations, it proved difficult to move beyond trust in the equation of vision with complexity, perfection, precise knowledge, and fruitful interaction with the world. In several cases, and despite a recognition that lack of vision was 'compensated for' by a 'quickenings' of other senses, eyeless fish were depicted as the 'poor' victims of dark degenerative forces. These denizens of darkness lived in 'tadpolitic' condition, in the very doldrums of creation.⁸⁸ Such a view is unsurprising given prevalent views on the 'poor' lives of visually impaired people across the period and the prevailing cultural position of the eye.

The complex, strengthening and often profoundly perplexed discourse of degeneracy is important across these contexts. Despite the generation of extra-visual sensory apparatus, the 'degeneration' of eyes was widely interpreted as a potent symbol of the movement from complexity to simplicity, from higher forms to supposedly lower forms of life, even for those who rejected the Creationist paradigm.⁸⁹ Across numerous discourses of degeneration, the increasing influence of evolutionary theory – particularly after the 1859 publication of Darwin's *Origin of Species* - meant that it became increasingly clear that the degenerative tendency had hereditary dimensions; that sex could transmit the essence of 'backwardness'. This was disturbing in the extreme for it meant that the process of decline could be easily accelerated, spreading endemically within species, societies, and cultures.⁹⁰ In effect, darkness was increasingly seen as part of the process through which nature could 'turn back the clock', returning a living being to a supposedly less sophisticated state. Indeed, tropes of backwardness tended to dominate degenerative discourse. Anne Robert Jacques Turgot, for instance, interpreted 'less developed' human populations as remnants of humanity in an earlier stage of development. They had, he surmised, been held back by isolation. Cesare Lombroso's criminal science, which built on Bènedict Augustin Morel's earlier theories of degeneracy, meanwhile, was founded upon the evolutionary notion of a return to the primitive, and there is a

strong correlation between the idea of degeneration and the broadening of social and scientific commentary around the generation and key characteristics of criminality.⁹¹

Significantly, however, natural science had evidenced that degenerative transformation at a species level unfolded across eons, and this separated these degenerative discourses from those pertaining to social degeneration at the *fin de siècle*. Significantly, however, mid-late nineteenth-century popular discourse pointed not only to Mammoth Cave's more-than-human degenerates, but also to its human victims of a horrifying kind of dark degeneration where the collapse of bodies and minds was observed to be both terrifyingly swift and monstrously profound. Dark degeneration, then, was broadly envisaged as operating across multiple temporalities and several bodily forms.

DARK DEGENERATION IN THE BLINK OF AN EYE

The eyeless state of the cave's fish and wider fauna reflected, or at least diffracted, wider engagements with the idea of degeneracy across the second half of the nineteenth century. After all, degeneration was never a fixed theory. It was extraordinarily flexible and fluid in its tenets and applications.⁹² One 1896 article, for instance, cited the example of the American nostril: 'There is a well-founded belief among men of science that the American nostril is becoming smaller and smaller with each generation'. Citing the fate of the eyes of the blind fish, and those of the common ground mole, the article concluded that 'The question here presents itself to the physiologist whether in future ages the function of the human nose will not be a mere historical tradition.'⁹³ This was an historical moment in which degeneracy loomed large in the cultural and scientific imaginations, and it is clear that models of evolutionary degeneracy transcended the human and more-than-human realms. Schiebinger shows, for instance, how racial and sexual differences among peoples were explained by way of the degenerative impact of environments upon bodies and the communication of acquired traits across generations.⁹⁴ E. Ray Lankester explicitly referenced these fears at the culmination of his comment on degeneracy in relation to Darwinian theory, arguing that degeneracy could occur on both species and individual levels. Indeed, the *fin de siècle* sense of decline was

palpable in his ruminations – pointing to the indigenous Fuegians, Bushmen and Australians - about whether all people are doomed to ‘degenerate ... tending to the condition of intellectual Barnacles [sic]’.⁹⁵

At Mammoth Cave, discourses encircling and emanating from the lives of the eyeless fauna related to wider scientific and cultural concerns about the binary life-generating capacities of sunlight and the transformative forces exerted by darkness, and these occasionally extended into the human realm. An 1857 report in the *New York Herald*, for instance, drew a direct correlation between the impact of darkness on subterranean fish, the influence of sunlight on animals and plants, and the apparent impact of both on ‘the human frame’.⁹⁶ The life-giving forces of sunlight stood in direct contrast to the supposedly degenerative effects of its absence. Biological research increasingly seemed to prove this point: an 1879 experiment suggested that tadpoles could not develop into frogs if they were not exposed to sunlight; ‘Could we say anything more emphatic of the advantages of sunlight as concerns health and development?’ asked one writer in an edition of *Chambers’ Journal*, published that year. Moreover, it asked, presumably pointing to the role of equines in the industrial pits, ‘what cruelties are committed in keeping horses and other domestic animals in whole or semi-darkness!’. Deprived of sunlight and ensconced in darkness, such beings were fated to ‘grow up in an imperfect, tadpolic condition.’⁹⁷

Several discourses surrounding Mammoth Cave suggest that subterranean darkness was not infrequently viewed as a source of human degeneration towards a primitive and conceivably monstrous state. Certainly, several nineteenth-century discourses relating to mine workers reflect a fear of the degenerative impact of the darkness beneath: Peter Gaskell’s 1833 *The Manufacturing Population of England* conjured hybrid images of human-moles: ‘crowd[s] of beings that emerge from their dwellings every morning ... filthy ... squalid.’ Several additional nineteenth-century social commentators framed miners within this degenerate human-animal paradigm.⁹⁸ It ought to be noted, however, that dialogues surrounding miners’ bodies were complicated. As Stephanie Ward

argues, images of declining, broken, even warped miners' bodies were in tension with more positive – hypermasculine – images across a variety of discourses.⁹⁹

The perceived life-inhibiting, disturbingly degenerative effects of darkness are evident in several nineteenth-century episodes in Mammoth Cave's history that signal the presence of multiple degenerative mechanisms that ran parallel to those concerning the evolutionary discourses orbiting the subterranean eyeless fauna. In the early 1840s, the cave had not fully transitioned into a tourist destination and, for a short period, its chambers were put to work in the name of offering convalescence to those afflicted by consumption. Sanatoria for the treatment of consumptives proliferated in Europe and North America, particularly across the second half of the nineteenth century, when a plethora of spaces emerged as sites of therapeutic experimentation. These spaces epitomised, in large part, the intensified sense that bodies and their environments needed to engage in generative entanglement.¹⁰⁰ The Mammoth Cave sanatorium, however, stands apart in its provision of a dark therapeutic environment, and there was some logic underpinning this decision. Not least, it seemed that the underground environment prevented organic decomposition. An 1841 report claimed that 'lamps burn with more brilliancy within [the cave]' and this was joined by the presence of the preserved remnants of indigenous life, including mummified bodies and decades-old corn-on-the-cobs in suggesting that there was something life-preserving about subterranean conditions. The cave's reliably cool temperature of 54 degrees Fahrenheit was understood to be an important element of these potentially favorable conditions; William A. McDowell, Louisville physician, identified such circumstances as essential to the cure of pulmonary consumption in the early 1840s.¹⁰¹ Moreover, reports suggested that oxen thrived in an underground environment, becoming 'fat' in the process.¹⁰² The cave was viewed by some, therefore, as vibrant, despite the gloom, and perhaps imbued – in some contexts – with life-*enhancing* attributes, and this stance remained in circulation across the ensuing decades. W. Stump Forwood – author of an 1870 cave guidebook – reported that enslaved people working saltpetre in the cave during the War of 1812 spent up to a year underground, before emerging in lustrous health.¹⁰³

The apparently generative cave environment, and an association with William A. McDonnell, persuaded the cave's proprietor, Louisville physician John Croghan, to encourage consumptives into his subterranean sanatorium in 1842. An initial experiment had apparently succeeded; one William J. Mitchell lived in the cave while in the final stages of his illness, where he established living quarters near the Star Chamber. Emerging from the cave two months later, his health was ostensibly restored to such a degree that he would 'rather live in a cave than elsewhere.'¹⁰⁴ It is likely that the report reflects little more than an attempted marketing stunt, for soon after publication, the curative properties of the cave environment were bluntly discredited. Of at least thirteen consumptives that inhabited the cave in 1843 – where they attempted to cultivate plants, and lit fires to keep themselves warm, thereby spoiling the supposedly 'pure' air of the underground - seven died, at least four doing so in the cave itself.¹⁰⁵

Initial medical assessments of the failed experiment at Mammoth Cave tended toward arguing that the air of the cave might only be beneficial if combined with the generative influence of sunlight. Indeed, a common trope across publications relating to the cave was the specific features of the subterranean atmosphere. Countless reports pointed to the heightened sense of smell generated by time spent touring the subterranean darkness and, upon leaving the cave, visitors frequently reported a hypersensitive sense of smell.¹⁰⁶ Henry Ling Taylor wrote to *Science* in 1893, recalling a conversation with his father, C. Fayette Taylor, that 'the sense of smell was intensified to such an extraordinary degree that most common objects, such as trees, plants, animals and even people had strong individual odors, mostly unpleasant; about half the party were strongly nauseated and vomited.'¹⁰⁷ Others proposed that the fatal error had been the length of the patients' stay in the cave. Nonetheless, in both cases the implication was that exposure to dark conditions had stimulated a terminal physical decline.¹⁰⁸ Such conclusions were early manifestations of a view which would eventually lead to the development of heliotherapy; certainly, by 1880, it was known that sunlight was critical to the treatment of rickets - a disease of darkness - and by the early decades of the twentieth century, sunlight had been identified as a prime mover in the treatment of tubercular

disease.¹⁰⁹ British physiologist Leonard Hill cautioned in his 1925 treatise *Sunshine and Open Air*, that alpine sanatoria should, under no circumstances, be overshadowed by mountain peaks, while noting that smoke, fog and an indoor lifestyle only serve to exasperate the consumptive's condition. He also pointed to the notion that those who dwell in darkness – from pit ponies to night workers – are only able to avoid the detrimental effects of the darkness itself by ensuring that their diet was vitamin-rich.¹¹⁰

The recognition of the medically detrimental physical effects of exposure to darkness are only one aspect of the response to this unfortunate episode. More disturbing narratives emerged several decades later, coinciding with the intensification of wider degenerative discourses across connected scientific and social contexts. Several texts, on both sides of the Atlantic, enshrined the episode within a frame skewed by gothic fears of physical decline and destruction, referring to the cave's consumptives as 'creatures' lurking beyond the light of the sun, whose eyes became sunken and their faces bloodless.¹¹¹ In Stump Forwood's 1870 guidebook, the enslaved guide, Alfred, relates the story of the consumptives in the cave, claiming to have waited on the residents, who dwelt across five months in stone and frame cottages sited within the Gothic Arcade. According to his supposed account, all fifteen consumptives eventually died, but not before they had transformed into an otherworldly 'company of lank, cadaverous invalids wandering about in the awful gloom and silence, broken only by their hollow coughs – doubly hollow and sepulchral there.' Those who lingered in the cave for three or four months were remade by the oppressions of darkness. Stump Forwood elaborated, and in so doing, drew parallels between these people and the cave fauna they lived alongside: 'The face was entirely bloodless, eyes sunken, and pupils dilated to such a degree that the iris ceased to be visible'. Nearby, the consumptives had planted trees which also gave up the ghost, withering and dying.¹¹² Journalist and world traveller, Thomas W. Knox later described the residents of the cave in similarly appalling terms: 'their faces became livid; the pupils of their eyes expanded, and darkened until the iris was visible, having the appearance of two spots burning above a deathly palor ... they were tottering on the brink of the grave.'¹¹³ In this regard, the cave assumed the

discursive character of a lifeless, even haunted, domain devoid of life-giving properties, while the apparent physical degeneration of human bodies, which resulted in translucent skin and degenerated eyes - the 'stigmata of degeneracy' – rendered these people profoundly less-than-human. Significantly, too, and unlike those affecting nonhuman cave fauna, the forces of degeneration in this case acted with disturbing rapidity. It was clear that dark degeneration could unfurl with both speed and catastrophic consequences.

The rapid onset of dark degeneration was additionally detected beyond the context of the body itself. While Stump Forwood raised the possibility that the silence and darkness of the subterranean world might be useful in the treatment of 'excitement of the mind', sudden Immersion in darkness was more often observed to act profoundly and detrimentally upon the stability of the psyche.¹¹⁴

One such episode in 1854 was related by S. Stocking of Binghamton, whose son became separated from his subterranean tour party. Scuttling from avenue to avenue in a desperate attempt to retrace his steps, he supposedly encountered human skeletons, which he presumed to be the corpses of those who had previously been consumed by the darkness. Eventually, he succumbed to 'deep melancholy', and 'despair, with all its horrors, settled down upon the mind' before an enslaved guide found him and brought him to safety.¹¹⁵ A later 1898 report detailed the findings of 'a scientific gentleman', who found his senses dulled and his mind rendered profoundly fragile. This explains, he supposed 'the fact why persons lost in the cave for one, two or three days have always been found, when rescued, in a state of temporary insanity. The mind and ... senses gradually become weakened or paralysed.'¹¹⁶ A report of the same year, for instance, suggested that when a man become lost in the cave 'he [became] a raving maniac and remained so'.¹¹⁷

Subterranean darkness, then, could thought capable of exposing inherent vulnerabilities in body and mind. Significantly, however, these reports of tourists' descent into lunacy sit at odds with discourses which seem to troublingly position black cave guides as ideally suited to underground conditions, raising questions about the racial dimensions of dark degeneracy, especially when the

condition of enslavement was, in other contexts, viewed as ripe for degeneration.¹¹⁸ It was black slaves put to work in Mammoth Cave who spent long periods underground, frequently opening up new passages by contorting their bodies to pass under the low ceilings of the cave's underground river systems, traversing tight passages, like Fat Man's Misery, who crawled on their bellies to unlock new subterranean chambers, and who were portrayed as at one with the subterranean darkness. It was black guides, too, who led white travellers into the underworld, and who came to their rescue if they become lost in the labyrinth beneath.¹¹⁹ Essentially portrayed as capable of 'becoming animal' in the darkness – apparently thriving in the shadows in the same way as some depicted animals toiling beneath the earth - enslaved people were earlier reported as having flourished in the darkness when mining for saltpetre during the War of 1812.¹²⁰ The implication is that particular 'kinds' of body were better suited than others to the extreme conditions of the underground, and that some were more prone to the degenerative effects of darkness than others. The cohesion between body and environment was apparently framed by the cultural status of the body in question.

CONCLUSION

The nineteenth- and early twentieth-century scientific and popular discussion around life, light and transformation in the depths of Mammoth Cave is an important case study of the shape of dark degenerative discourse. It raises the question of the extent to which darkness was viewed as a significant degenerative determinant across human and more-than-human realms and across multiple registers, from the long-acting force that might eventually generate new species, to the swift and cataclysmic degeneration of certain individual bodies and minds. The precise character of the perceived influence of darkness on bodily forms emerged over several decades, taking multiple forms that reveal dynamic understandings of the significance of the cohesion between bodies and environments in driving transformative mechanisms. Subterranean environments have historically been crucial spaces for life scientists in this regard. A 1929 publication referred to New Mexico's

Carlsbad Caverns as ‘a subterranean marvel ... a vast laboratory [where] nature produces the unexpected and seemingly impossible.’¹²¹ Indeed, the Romanian Movile Cave, only discovered in 1986, continues to lure scientists hoping to mine ‘biological treasure from the Stygian darkness.’¹²² Astonishingly, the evolutionary mechanisms underpinning the emergence of supposedly ‘degenerate’ cave life remains poorly understood. Life scientist Lauren Sumner-Rooney recently published a paper which encapsulates the lack of clarity of the evolutionary pathways taken by eyeless creatures, even in the context of a resurgence of interest during the second half of the twentieth century.¹²³ A mid-century hypothesis, for instance, argued that caves were ‘terminal wards’ for dying species; stable environmental conditions where end-of-the-line species gather in the shadows to disappear.¹²⁴ This theory has been debunked by biospeleologists such as Thomas Barr who suggested, instead, that cave fauna were originally refugees from the extreme climatic changes of the Pleistocene.¹²⁵

In considering the perceived impacts of darkness on subterranean bodies, these cases focusing on Kentucky’s Mammoth Cave together raise important questions about which bodies were able to cohere with the primitive and perpetual subterranean night. The supposed degeneracy that drove species change was also identified across thoroughly human contexts and was particularly disturbing in its speed and severity, reflecting not only a profound recognition of the fragility of the human condition and its vulnerability to terminal decline when immersed in conditions for which it was not ideally suited, but also the apparently raced sense that some human forms were better suited to dark conditions than others. In so doing, discourses of dark degeneracy illuminate a key point of contention that infused biological and social biological discourses during the period: the degree of entanglement between body and environment and, therefore, the extent to which environmental conditions can ‘improve’ or ‘degenerate’ individuals and the wider collective – species and societies – over the course of time. In important respects, then, we find, in the context of dark degenerations, some of the roots of the nature-nurture debate around development that continues to rage in the

twenty-first century, and more work is required to trace the presence of darkness – in all its forms – across such discourses.

These contrasting but connected illustrations of the supposed presence of dark degeneracy raise significant historical questions. Where else might historians locate the supposedly degenerative forces of darkness, not only across the history of science but also in wider societal and cultural currents? Sebastian Faulks' 1993 war novel, *Birdsong*, for example, raises the spectre of degeneracy amongst the pervading gloom of the trenches of World War One's Western front, while discourses around poverty and living conditions might require re-examination to precisely locate the position(s) of darkness in shaping social discourse, not least at the intersections of race, gender, and (dis)ability.¹²⁶ Indeed, while it is clear that the Romantics and transcendentalists depicted a terrifying darkness in the industrialising worlds that increasingly enveloped them – William Blake's 'dark satanic mills' – the wider place of darkness in scientific, social and cultural relations in these contexts remains underexplored.¹²⁷ Jack London's descent into the 'abyss', where he finds himself among people degenerate in both body and mind is one illustration of the supposedly degenerative impacts of urban darkness. Indeed, the motif of the monstrously dark abyss has also been conjured in other times and places.¹²⁸ Attention to the complex character of darkness in its interactions with other environmental and bodily contexts might facilitate a deeper and more nuanced understanding of diverse historical and contemporary assumptions about the extents to which bodies and their wider environments entangle and shape each other.

¹ H. G. Wells, 'The Country of the Blind', *The Strand* (1904).

² H. G. Wells, *The Time Machine* (New York, 1895); Oscar Wilde, *The Picture of Dorian Grey* (London, 1891); George Gissing, *The Nether World* (Oxford: OUP, 1992); Joseph Conrad, *Heart of Darkness* (London: Penguin Books, 1902). For more on degeneration in literature at the *fin de siècle*, see Daniel Pick, *Faces of Degeneration: A European Disorder, c. 1848-c.1918* (Cambridge: Cambridge Univ. Press, 1989), pp. 155-65.

³ Jules Verne, *A Journey to the Centre of the Earth* (Boston: H. L. Shepherd & Co. 1874), 127, 155-6.

⁴ H. P. Lovecraft, 'The Beast in the Cave', in *Collected Fiction: a variorum edition*, ed. By S. T. Joshi (New York, Hippocampus Press, 2017).

⁵ *The Indianapolis Journal* (11 October 1891).

⁶ For a clear delineation of the history of hypogean fish research, see Aldemaro Romero, 'Scientists Prefer them Blind: The History of Hypogean Fish Research', *Environmental Biology of Fishes*, 2001, 62: 43-71.

⁷ 'Eyes and No Eyes', *Once a Week* (2 December 1871), p. 205.

⁸ For scholarship on the expansion of the natural sciences see for example, John M. Mackenzie, *The Empire of Nature: Hunting, Conservation and British Imperialism* (Manchester: Manchester Univ. Press, 1997). Mid-nineteenth-century polymath Herbert Spencer defined 'progress' as the relentless advance from simplicity to complexity: Herbert Spencer, 'Progress: Its Law and Cause', *Westminster Review* (1857).

⁹ For classic histories of the idea of progress, see John Bagnell Bury, *The Idea of Progress: An Inquiry into its Origin and Growth* (London: Macmillan and Co. Ltd. 1921); Frederick J. Teggart, *Theory and Processes of History* (Berkeley: Univ. of California Press, 1977); Charles van Doren, *The Idea of Progress* (New York: F. A. Praeger, 1967).

¹⁰ Robert Nisbet, *A History of the Idea of Progress* (New York: Basic Books, 1980). As Eksteins puts it, '...the Faustian notion of "becoming" rather than "being" became the central logic of the century.' Modris Eksteins, 'History and Degeneration: Of Birds and Cages', in *Degeneration: The Dark Side of Progress* ed. By H. Edward Chambers and Sander L. Gilman (Columbia Univ. Press, 1985), p. 3.

¹¹ Jarko Jalava, 'The Modern Degenerate: Nineteenth-Century Degeneration Theory and Modern Psychopathy Research', *Theory and Psychology*, 2006, 16: 416-432, p.417. For a delineation of Nordau's arguments and their reception, see Linda L. Maik, 'Nordau's Degeneration: The American Controversy', *Journal of the History of Ideas*, 1989, 50: 607-623.

¹² Pick, *Faces of Degeneration*, pp. 2-3, 15.

¹³ H. Edward Chambers and Sander L. Gilman, 'Introduction', in *Degeneration: The Dark Side of Progress*, ed. by H. Edward Chambers and Sander L. Gilman (Columbia Univ. Press, 1985), p. ix.

¹⁴ See Pick, *Faces of Degeneration*; Chambers and Gilman (eds.), *Degeneration*; Marja Märmänmaa and Christopher Nissen, *Decadence, Degeneration, and the End* (Basingstoke: Palgrave Macmillan, 2014); David Weir, *Decadence and the Making of Modernism* (Amherst: Univ. of Massachusetts Press, 1995); Arthur Herman, *The Idea of Decline in Western History* (New York: The Free Press, 1997); Elof Axel Carlson, *The Unfit: A History of a Bad Idea* (Cold Spring Harbour Laboratory Press, 2001), pp. 39-57.

¹⁵ Pick, *Faces of Degeneration*, p. 6; See also Herman, *Idea of Decline*, 114.

¹⁶ See Judith R. Walkowitz, *Prostitution and Victorian Society: Women, Class, and the State* (Cambridge: Cambridge Univ. Press, 1980), pp. 36-37; Lisa Appignanesi, *Mad, Bad, and Sad: A History of Women and Mind Doctors* (London: Virago, 2008); Amy Milne-Smith, 'Work and Madness: Overworked Men and Fears of Degeneration, 1860s-1910s', *Journal Victorian Culture*, (2019), 24: 159-178; Hilary Marland, *Dangerous Motherhood: Insanity and Childbirth in Victorian Britain* (Houndmills: Palgrave Macmillan, 2004). For more on discourses of madness in the nineteenth century, see Helen Goodman, "'Madness and Masculinity": Male Patients in London Asylums and Victorian Culture', in *Insanity and the Lunatic Asylum in the Nineteenth Century*, ed. by Thomas Knowles and Serena Trowbridge (Abingdon: Routledge, 2016), pp. 149-66.

¹⁷ See, for instance, Richard Eves, 'Going troppo: images of white savagery, degeneration and race in turn-of-the-century colonial fictions of the Pacific', *History and Anthropology*, 1999, 11: 351-385 and Waltraud Ernst and Bernard Harris (eds.) *Race, Science and Medicine, 1700-1960* (London: Routledge, 1999). For a classic analysis of the significance of the medical experience of Europeans in the tropics to the concerns of racial biology, see Philip D. Curtin, *The Image of Africa: British Ideas and Action, 1780-1850* (Madison: Univ. of Wisconsin Press, 1964), 1, 83-84.

¹⁸ Nancy Stepan, 'Biological Degeneration: Races and Proper Places', in *Degeneration: The Dark Side of Progress* ed. By H. Edward Chambers and Sander L. Gilman (Columbia Univ. Press, 1985), pp. 98-120. Recent scholarship has illustrated that fears of racial degeneration were fairly pervasive in the 1880s and 1890s: Christopher Prior, *Edwardian England and the Idea of Racial Decline: An Empire's Future* (London: Palgrave Macmillan, 2014), p. 17; Robert J. C. Young, *Colonial Desire: Hybridity in Theory, Culture and Race* (London: Routledge, 1995).

¹⁹ Herman, *Idea of Decline*, p. 115.

²⁰ John A. Jackle, *City Lights: Illuminating the American Night* (Baltimore, 2001), p. vii.

²¹ Nina Edwards: *A Cultural History* (London: Reaktion Books, 2018); A Roger Ekirch, *At Day's Close: A History of Night-time* (London: W. W. Norton & Co. 2005).

²² See C. Koslofsky, *Evening's Empire: A History of Night in Early Modern Europe* (Cambridge: CUP, 2001); Tim Edensor, 'Introduction to Geographies of Darkness', *Cultural Geographies*, 2015, 22: 559-65; Tim Edensor, 'The Gloomy City: Rethinking the relationship between light and dark', *Urban Studies*, 2015, 52: 422-38.

²³ Simon Carter, *Rise and Shine, Sunlight, Technology and Health* (Oxford: Berg, 2007).

- ²⁴ Daniel Freund, *American Sunshine: Diseases of Darkness and the Quest for Natural Light* (Chicago: Univ. of Chicago Press, 2012), Chapter 1.
- ²⁵ Alyssa Diane Warrick, "'Deep" South: Mammoth Cave, Kentucky, and Environmental Knowledge, 1800-1974 (unpublished Ph.D. dissertation, Mississippi State Univ., 2017). Also see Katie Algeo, 'Mammoth Cave and the Making of Place', *Southeastern Geographer*, 2004, 44: 27-47; Katie Algeo, 'Underground Tourists/Tourists Underground: African American Tourism to Mammoth Cave', *Tourism Geographies*, 2013, 15: 380-404.
- ²⁶ Alexander Clark Bullitt, *Rambles in the Mammoth Cave during the Year 1844, by a Visitor* (Louisville, 1845), p. 80.
- ²⁷ Michael Shortland, 'Darkness Visible: Underground Culture in the Golden Age of Geology', *History of Science*, 1994, 32: 1-61, p. 4.
- ²⁸ William B. Jones, *Wonderful Curiosity: or a correct narrative of the celebrated Mammoth Cave of Kentucky; with incidents and anecdotes* (Russellville, KY: Smith and Rhea, 1844), p. 8.
- ²⁹ See, for instance, 'Isaac Idler's Rambles: V. Two Days Underground', *New York Times* (12 February 1871).
- ³⁰ On the connection between Romanticism and the subterranean, see D. R. Dean, *Tennyson and Geology* (Lincoln, 1985).
- ³¹ 'Bottomless Pit in the Mammoth Cave', *Scientific American*, 1856, 12.16: p. 121.
- ³² Shortland, 'Darkness Visible', p. 5. For more on this element of the underground, see Liza Piper, 'Subterranean Bodies: Mining the Large Lakes of North-West Canada, 1921-1960', *Environment and History*, 2007, 13: 155-86.
- ³³ 'Mammoth Cave', *Scientific American*, 1845, 1.3.
- ³⁴ Considering its immensely rich biodiversity, the park is today a UNESCO World Heritage site, and an International Biosphere Reserve (awarded 1981 and 1990, respectively).
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- ³⁶ There are multiple reports of people finding eyeless fish elsewhere. See, for instance: 'A Fish Story', *The Daily Dispatch* (13 June 1854).
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- ³⁸ *Shepherdstown Register* (25 April 1857).
- ³⁹ Rev. Robert Davidson, *An Excursion to the Mammoth Cave and the Barrens of Kentucky, with some notices of the early settlement of the state* (Lexington, 1840), p. 55.
- ⁴⁰ See, for instance, *A Description of the Mammoth Cave of Kentucky, The Niagara River and Falls, and the Falls in Summer and Winter; The Prairies, of Life in the West; The Fairmount Waterworks; and Scenes on the Schuplkill, etc. etc. to Illustrate Brewer's Panorama* (Boston, 1850); Carter Hovey, *Guidebook to the Mammoth Cave of Kentucky: historical, scientific and descriptive* (Cincinnati, 1884); Horace Martin, *Pictorial Guide to the Mammoth Cave, Kentucky* (New York, 1851); W. Stump Forwood, *An Historical and Descriptive Narrative of the Mammoth Cave of Kentucky* (Philadelphia, 1870).
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- ⁴² James DeKay, *Natural History of New York, Fishes* (New York, 1842), 187; *Proceedings of the Academy of Natural Sciences of Philadelphia*, 1842, 1: p. 175.
- ⁴³ *Alexandria Gazette* (22 August 1842); *The Columbia Democrat* (11 January 1844).
- ⁴⁴ Algeo, 'Mammoth Cave', 38; Also see Thomas C. Barr, 'Ecological Studies in the Mammoth Cave System of Kentucky', *Speleology* III, 1965: 147-204, pp. 150-152. On scientific field sites, see Adi Ophir and Steven Shapin, 'The Place of Knowledge: A Methodological Survey', *Science in Context*, 1991, 4: 3-21 and Daniel Pickstone, *Ways of Knowing: A New History of Science, Technology and Medicine* (Manchester: Manchester Univ. Press, 2001).
- ⁴⁵ T. D. A. Cokerell, *Biographical Memoir of Alpheus Spring Packard, 1839-1905* (Washington, D. C. 1920).
- ⁴⁶ A. S. Packard Jr and F. W. Putnam, *The Mammoth Cave and its Inhabitants, or descriptions of the fishes, insects and crustaceans found in the cave* (Salem, MA 1872). Another such specialist was Carl H. Eigenmann, who conducted deep studies of subterranean fish across the later years of the nineteenth century.

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- ⁴⁸ Packard and Putnam, *Mammoth Cave*, p.5.
- ⁴⁹ F. W. Putnam, ‘The Blind Fishes of the Mammoth Cave and their Allies’, *The American Naturalist*, 1872, 6: 27-29.
- ⁵⁰ J.C. Schiödte, ‘Specimen faunae subterraneae’, *Transactions of the Royal Entomological Society of London*, 1851, 6: 134-157.
- ⁵¹ The major criticism of the classic classificatory system is the poor definition of the three categories, and the dualistic nature of the middle stage – troglophile. The system was characterised by increasing ecological adaptation to the subterranean environment, coupled with an increasingly morphological specialisation. See B. Sket, ‘Can we agree on an ecological classification of subterranean animals?’, *Journal of Natural History*, 2008, 42: 1551-52. This classic terminology is still very much in use, though there is much variation across the scientific world in terms of the classificatory system that is accepted.
- ⁵² F. G. Howarth, ‘Ecology of cave arthropods’, *Annual Review of Entomology*, 1983, 28: 365-89; Max Moseley, ‘Are all caves ecotones?’ *Cave and Karst Science*, 2009, 36: pp. 55-56.
- ⁵³ For more on the power of vision, see Donna Haraway, ‘Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective’, *Feminist Studies*, 1988, 14: 575-99.
- ⁵⁴ Tanja Pipan and David C. Culver, ‘Convergence and divergence in the subterranean realm: a reassessment’, *Biological Journal of the Linnean Society*, 2012, 107: 1-14.
- ⁵⁵ Davidson, *Mammoth Cave*, p. 55. Also see *Bloomington Herald* (29 October 1841).
- ⁵⁶ On Paley, see William C. Gillespie, ‘Divine Design and the Industrial Revolution: William Paley’s Abortive Reform of Natural Theology’, *ISIS*, 1990, 81: 214-29. English Platonist Henry More was probably the first to identify the eye as the best evidence of divine design. See Jessica Riskin, ‘The Divine Optician’, *American Historical Review*, 2011, 116: 352-70.
- ⁵⁷ For a history of vision in Western thought, see Martin Jay, *Downcast Eyes: The Denigration of Vision in Twentieth Century French Thought* (Berkeley: Univ. of California Press, 1994). Also see Jonathan Porter, *Discourses of Vision in Nineteenth Century Britain* (Basingstoke: Palgrave Macmillan, 2018) and Mark M. Smith, *Sensory History* (Oxford: Berg, 2007), pp. 19-40. For an overview of attitudes towards vision impairment, see Mark Patterson, *Seeing with the Hands: Blindness, Vision and Touch after Descartes* (Edinburgh: Edinburgh Univ. Press, 2016); Heather Tilley, *Blindness and Writing: From Wordsworth to Gissing* (Cambridge: CUP, 2018).
- ⁵⁸ William Chambers, ‘Seeming Oddities in Nature’, *Chambers Journal*, 19 April 1879, 799: 243.
- ⁵⁹ Louis Agassiz, ‘Sketch of the Natural Provinces of the Animal World and their Relation to the Different Types of Man’, in Josiah Clark Nott *et al.* *Types of Mankind* (Philadelphia: Lippincott, Grambo & Co, 1854), lviii-lxxvi. For an illustration of the array of scholars who advocated for the immutability of species, see J. David Archibald, *Origins of Darwin’s Evolution: Solving the Species Puzzle Through Time and Place* (New York: Columbia Univ. Press, 2019), pp. 59-74.
- ⁶⁰ It is likely that Theodor Tellkamp first identified chologaster, originally simply calling it ‘mud fish’: Putnam, ‘Blind Fishes of the Mammoth Cave’, 27-29.
- ⁶¹ *Ibid.*
- ⁶² *Harrisburg Telegraph* (15 June 1918).
- ⁶³ Rudwick, *Bursting the Limits of Time*, p. 245.
- ⁶⁴ Charles Darwin, *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life 1st ed.* (London: John Murray, 1859), pp. 150-51.
- ⁶⁵ For a classic exploration of the history of the idea of evolution, see Peter J. Bowler, *Evolution, The History of an Idea* (Berkeley: Univ. of California Press, 1984).
- ⁶⁶ George Louis Leclerc, comte de Buffon, *Histoire naturelle, générale et particulière, avec la description du Cabinet du Roi* (Paris : l’Imprimerie Royale, 1749-1766). On Lyell, see Leonard G. Wilson, ed., *Sir Charles Lyell’s Scientific Journals on the Species Question* (New Haven and London: Yale Univ. Press, 1970), p. 347.
- ⁶⁷ Rudwick, *Bursting the Limits of Time*, pp. 388-89, 566-67; L. J. Jordanova, *Lamarck* (Oxford: OUP, 1984), p. 8, 80-81.
- ⁶⁸ Darwin, *Origin of Species*.
- ⁶⁹ Jordanova, *Lamarck*, 106-109.
- ⁷⁰ J. S. Kingsley, ‘Edward Drinker Cope’, *The American Naturalist*, 1897, 31: pp. 414-19.

- ⁷¹ A. S. Packard, in Packard and Putnam, 'Mammoth Cave', p. 26.
- ⁷² Diane B. Paul and James Moore, 'The Darwinian Context: Evolution and Inheritance', in *The Oxford Handbook of the History of Eugenics*, ed. by Alison Bashford and Philippa Levine (Oxford: Oxford Univ. Press, 2018), p. 34.
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- ⁷⁴ William R. Jeffrey, Allan G. Strickler and Yoshiyuki Yamamoto, 'To See or Not to see: Evolution of Eye Degeneration in Mexican Blind Cavefish', *Integrated Comparative Biology*, 2003, 43: 531-41.
- ⁷⁵ E. Ray Lankester, 'Blind Animals in Caves', *Nature*, 1893, 1217: p.389.
- ⁷⁶ 'Effect of Continuous Darkness on Animals', *The Globe* (4 July 1896).
- ⁷⁷ 'Scientific Miscellany', *The Donaldsville Chief* (27 January 1883).
- ⁷⁸ *Weekly Trinity Journal* (15 November 1879).
- ⁷⁹ Darwin, *Origin of Species*, 150; 'Piscatory and Scientific', *Courier Journal* (7 October 1870); 'Misc.' *The London Journal*, 1 December 1870, 5: p. 303; *Nashville Union and American* (5 November 1870).
- ⁸⁰ 'Letters to George Boulenger from Carl H. Eigenmann, 1888-1899', Natural History Museum Archives (DF ZOO/235/1/1/1/225); *Evening Star* (30 September 1897).
- ⁸¹ *New York Weekly* (March 1901).
- ⁸² *Evening Star* (30 September 1897).
- ⁸³ It is worth noting that sight loss was infrequently associated with degeneracy. However, Max Nordau did attribute the erratic artistic productions of *fin de siècle* artists to nystagmus, a condition that causes the eyeball to tremble: Nordau, *Degeneration*, p. 27.
- ⁸⁴ T. G. Tellkamp, 'Memoirs on the blind-fishes and some other animals living in the Mammoth Cave in Kentucky', *New York Journal of Medical and Collateral Sciences*, 1845, 5: 84-93.
- ⁸⁵ Elizabeth Gitter, *The Imprisoned Guest: Samuel Howe and Laura Bridgman, the Original Deaf-Blind Girl* (New York: Farrar, Strauss and Giroux, 2001). Later discourse began to refer to a 'sixth sense', or a 'sense of obstacles'. See Émile Javal, *The Blind Man's World* (London: George Pullman & Sons, 1904), pp. 105-15.
- ⁸⁶ 'Can Fish Hear?', *The Columbia Herald* (21 February 1873). Also see Stump Forwood, *Mammoth Cave*, pp. 86-87.
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- ⁸⁸ 'Seeming Oddities in Nature', *Chambers Journal*, 19 April 1879: p. 799.
- ⁸⁹ See, for instance, E. Ray Lankester, *Degeneration: A Chapter in Darwinism* (London: John Murray, 1880).
- ⁹⁰ Pick, *Faces of Degeneration*, p. 21.
- ⁹¹ *Ibid*, p. 126. See also Jalava, 'Modern Degenerate', p. 419.
- ⁹² Pick, *Faces of Degeneration*, pp. 7, 15.
- ⁹³ *East Oregonian: E.O* (28 August 1917).
- ⁹⁴ Schiebinger, *Anatomy of Difference*, esp. p. 393.
- ⁹⁵ Lankester, *Degeneration*, pp. 58-62.
- ⁹⁶ *The New York Herald* (20 May 1857).
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- ⁹⁸ Peter Gaskell, *The Manufacturing Population of England: Its Moral, Social, and Physical Conditions, and the Changes which have Arisen from the use of Steam Machinery* (London, 1833); John Burnett (ed.), *Useful Toil: Autobiographies of Working People from the 1820s to the 1920s* (London, 1974), 43; *St. Paul Daily Globe* (08 March 1896). For more on the 'beastly' characters of people underground, see Shortland, 'Darkness Visible', 29-32. For work on the underground sensory environment, see Rosalind C. Morris, 'The Miner's Ear', *Transition*, 2008, 98: 96-115.
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