FORUM

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Landfill Hills: Grappling with the Scale and Depth of Contemporary Waste Landscapes

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Abstract

This paper investigates a waste landscape in the Marston Vale, Bedfordshire, UK, consisting of a range of landfill hills. The hills originated as vast holes in the ground created by clay extraction, which presented suitable receptacles for the dumping of landfill waste. Although of much larger scale than evidence normally dealt with by archaeologists, these are treated here as archaeological features within an archaeological landscape. While other papers deal with important aspects of political ecology of waste landscapes, the present focus is on the upscaling of methods that is necessary to cope with such mega-scale contemporary waste landscapes, in order to make them more susceptible to archaeological analysis.

Introduction

A landscape, according to the *Collins English Dictionary*, is everything one can see when looking over an area of land. The waste landscape described in this paper – a series of landfilled quarries (now hills) in Marston Vale, Bedfordshire in the south Midlands of

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England – is somewhat larger than that, in the sense that there is no one viewpoint where it is possible to see its total surface area. To do that, it would be necessary to look down from above, perhaps by making use of the kind of disembodied viewpoint provided by satellite photos and GIS software such as Google Earth. But even then, the larger part of the landscape is buried and hidden from sight. Despite the fact that the word "landscape" is sometimes taken to refer to only visible surfaces of land, or surface appearances, this particular landscape cannot be apprehended or understood by considering only what the eye can see. There is more to it than that; there is a buried or hidden component. As with an iceberg, the larger part of the Marston Vale landscape lies below the surface. Like Timothy Morton's hyperobjects (Morton 2013) or Graham Harman's objects with inaccessible inner cores (Harman 2010), it is impossible to grasp it all at once, and only partial experiences or understandings of it are achievable.

It might be observed that all archaeological sites have this buried component, but the point here is that waste landscapes like Marston Vale have a very different ratio of visible surface traces to invisible sub-surface remains from that which we are accustomed to, with much greater depth to buried deposits than is normally encountered relative to the surface area of the site, even when the area covered is extensive.

As well as unseen depth, then, another problem to be grappled with is the sheer size of features and deposits, far exceeding the range of scales on which archaeologists usually work (Edgeworth 2010). But that should not daunt us or deter us from taking an archaeological approach. Archaeologists are adept at shifting between scales through their normal working practices (Yarrow 2006); moving onto different scales is a natural progression on what archaeologists already do. As material culture patterning in the Anthropocene manifests on ever larger and smaller scales, archaeologists need to up-scale and down-scale methods and approaches to fit the new forms of evidence.

Waste sites have many aspects to them, and can be approached from various viewpoints: from a political perspective, Stewart (2022) discusses their long-term environmental impact and toxic effects on future generations, while Nativ's (2022) aesthetic approach involves philosophical discussion of landfill as "buried culture", grounded in an excavation of an early twentieth-century landfill near Tel Aviv (see also Edgeworth 2023 for a recent excavation of a smaller landfill site). In a short paper, it is impossible to encompass them all. This paper inevitably leaves out important dimensions as it reflects mainly on issues to do with scale.

Driving Past

Once you learn to recognise landfill hills, the realisation dawns that they are all around you. Driving along the A421 heading southwest from Bedford through Marston Vale towards the M1 motorway, these very substantial landscape features appear on your left and on your right. Their low, rounded profiles and smooth contours have been designed to be unobtrusive, to pass unnoticed as if part of the natural landscape. The majority of motorists, focusing on the road ahead, may not notice them at all. But as soon as they are constituted as objects worthy of attention, it becomes impossible to un-see them. There are more of them than you might think. Although low-lying, with only their

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above-ground portions visible, their bulk still astounds. It can be quite a shock, when the sheer scale of the material residue that we ourselves have played a part in generating – rarely entering into the field of awareness or discourse once thrown away, but now gathered together into a single mass and presenting itself in the form of large landscape features – emerges into our consciousness for the first time.

Forty years ago, the hills did not exist. There were only holes – massive voids in the ground, between 20 and 50 m deep and sometimes over 1 km across, where clay was extracted as raw material for a thriving brick industry (Kennett 1978, 110–120). It has been estimated that the void space of all the quarries put together amounted to 100 million cubic metres. Now, the smoking factory chimneys have gone, and the quarrying has largely ceased. Some of the vast pits have been filled with water to make lakes for fishing and water sports. One has been left open for a waste incineration plant to be constructed inside it. The new Rookery South Energy Recovery Facility burns rubbish that cannot be recycled instead of burying it, producing electricity from the steam generated. The quarries that concern us here, however, are those that have been filled to the brim with compacted landfill, and then have had yet more material added to create hills. There is now a range of five or six hills, extending over an estimated area of roughly 800 ha and rising up to about 12 m high, where no hills existed before (Figure 1).

For anyone interested in exploring landscapes of the Anthropocene, this is definitely a place to visit. However, there are no guidebooks to inform you about its history, no guided walks or noticeboards. This is not a heritage site (although see Harrison 2021). As newly formed ground, it might even be said that there is no past, no archaeology and

FIGURE 1. Landfill hill at Brogborough, viewed from the A421 looking west. A small methane-processing plant is visible. Everything above the general lie of the land is sculpted from landfill. Below the highest point on the hill is about 50 m of compacted waste material.

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FIGURE 2. Gated entrance – now locked and barred – viewed from a side road looking south. Trucks carrying waste material once accessed the site here. Now the site is closed, with access barred.

no history, apart from what has been made in the last few decades. All that has been effectively obliterated, by the twin processes of gouging out and covering over. It does not attract attention. Any curious glances through passing car windows are deflected by the smoothly sculpted shape of the land and its nondescript character. Road signs point everywhere else, to anywhere but the hills themselves. If the message that comes across was on a road sign, it would say something like this: "Motorist, drive on! Speed on towards the motorway and the city! Nothing of interest here!"

This paper, though, resists the imperative to pass by and proceed on to other places. The car turns off the A421 into a side road and runs slowly along the side of one of the landfill hills. There is a high metal fence with spikes and barbed wire enclosing the hill, as an effective barrier against trespassers. A metal gate where trucks carrying landfill material used to enter is now firmly closed and locked (Figure 2).

Viewed through the bars and mesh of the gate, a number of vertical pipes with valves sticking up at intervals are visible, indicating that the ground here is in active but controlled interchange with the atmosphere, producing methane from decomposition of material in layers below. The hill blocks the view that would have extended from here over many miles of flat countryside to the Greensand Ridge on the horizon. This may change, however. The settling of land resulting from decomposition of waste layers far below the ground surface may mean that this and other landfill hills will gradually reduce in height over the next hundred years or so, perhaps unblocking the view and restoring the landscape of Marston Vale to its normal flatness.

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A Brief History of Lost Time

During the Jurassic period, over 145 million years ago, what is now South Bedfordshire was a warm shallow sea, inhabited by marine crocodiles, ichthyosaurs, plesiosaurs, ammonites, brachiopods and other now extinct creatures, the bones and shells and other organic remains of which sank and settled into the mud at the bottom, to become inclusions in layers of fossil-rich sediment (Martill and Hudson 1991). Particles of eroded rock washed down rivers from nearby land, contributing to the crumbly and soft texture of the blue-grey clay rock matrix now known as the Oxford Clay.

Fast forward to the late nineteenth century, when it was discovered that, with the use of hard presses and mechanised firing processes, this clay, previously thought to be of little use for anything, made very good bricks. A further advantage discovered later was that its high carbon content meant that, when heated, it provided some of the fuel for its own firing. Quarrying began in the form of small-scale operations at first, but as demands for bricks increased and earth-cutting machinery became more efficient, the pits got steadily bigger. From the 1920s to the 1990s, huge pits up to 1 km wide and 20–50 m deep were being opened up (Griffin 1984; Johnson 2021).

In removing the clay and everything above, the quarrying took out over 150 million years of stratigraphic evidence. From a stratigraphic point of view, the missing strata represent lost time. The cuts of the quarries are erosional surfaces which geologists would call ”unconformities”. The erosional agents in this instance were not geomorphological forces such as wind and rain, or ice and torrents of water, but human beings and their machines. The clay was dug out by drag-line excavator, scraping its massive metal bucket along the base and sides of the pit, creating the cuts of the quarries in the process (Figure 3).

The principal company extracting the clay and making the brick was called the London Brick Company – a name imprinted and fired into the form of millions of bricks. My grandfather worked there during the Great Depression, cycling the 12 km to and from Bedford every day on his bike as well as doing a full day’s work. As the name on the bricks suggests, the enterprise was primarily oriented around the needs of the capital city. Many of the bricks went to build houses in the expanding London suburbs from the 1930s onwards. Large parts of the material fabric of the suburban metropolis, it might be said, originated as clay extracted from these giant voids in the ground.

When the brickmaking industry went into decline from the 1970s, the question arose as to what to do with these massive holes in the landscape (Griffin 1984). To fill them with water was one answer, and some were indeed turned into lakes for recreation and water sports. Landfill was another solution which presented itself. A certain irony lies in the fact that many of the houses built of bricks made from the clay extracted from the Bedfordshire pits now started sending household waste back to the very place where all those bricks had come from. The vast pits served as convenient receptacles for a range of household, industrial and commercial waste, much of it exported out from major cities like London, including tens of thousands of bricks from demolition rubble. A further irony lies in the fact that some of those bricks, stamped with the name of the city of which they were briefly part, were returning to their place of origin, albeit now transformed from lumps of soft and crumbly rock onto hard artefacts of the twentieth

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FIGURE 3. Extraction of clay by drag-line excavator, 1930s–1940s, pit near Stewartby, Bedfordshire (Britain from Above, © Historic England).

century which – as well as going through the various processes of shaping and firing during brick manufacture – also have a "life history" (Holtorf 2002) from their time as part of the urban fabric of the metropolis.

In the event that future geologists wish to find a "trace fossil" of the twentieth century city, they would do well to look here, 40 miles away from London, as well as on the sites of the city itself. The term "trace fossil" refers here not just to the landfill deposit taken as a whole, though that is certainly one way of understanding it, but also to the millions of smaller trace fossils of human activity contained within, in the form of hand-made artefacts and mass-produced objects, of which bricks are just one example. For future archaeologists, a rich and complex material record is provided by the stratigraphic successions of fills within the cuts of the quarries. In some cases the quarries are further divided into "cells". which were associated with discrete episodes of deposition. Each layer can be dated by the assemblage of artefacts and environmental evidence – shedding light on many aspects of social life – for example, on the choices that were made by urban populations as to what to throw away at particular times (cf. Dawdy 2006).

To allow for settling of ground over the next hundred years or so, and also to put as much material into the available space as possible, compacted waste was mounded up well above ground level to form the hills we see today. By the early twenty-first century

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the pits were full, and the process of landfilling largely drew to a close. The hills were smoothed into a shape that looked as natural and unobtrusive as possible, capped with protective linings, covered with topsoil and grassed over. Some have recently been partly covered with solar panels for electricity generation.

With all the valuable clay extracted, then, a waste landscape had been created, but this was then transformed into another kind of landscape through the process of landfilling. The vast voids were filled in to become hills. Thus the connection that Denizen (2013) identifies between holes where material has been extracted on the one hand and places where material accumulates on the other can be found here in one place.

Picking up on the theme of this collection of essays, then, this is ground that has been "made". The slate has been wiped clean, so to speak, by the erasure, or removal by scraping away, of the ancient land that was there before. Almost an entire geological stratum was removed. Layers of Ice Age boulder clay above, and the relatively thin set of archaeological deposits representing thousands of years of human history above that, also had to be removed to get at the valuable clay. In the place of the geological and archaeological strata that were there before, new land was built up, layer by compacted layer, in its place. As far as the landfill hills are concerned, history re-starts with the cutting of the quarries and the backfilling of the pits with waste material.

Up-Scaling Methods to deal with Mega Archaeological Features

Getting to grips with the sheer scale of the waste landscape, in terms of its depth as well as its horizontal extent, is a challenge. Normally, of course, if we encountered a series of pits on a typical excavation, we would dig a section or profile through them. That would enable us to draw the stratigraphic patterns, which could be directly observed in the section we ourselves have cut. Here that is not possible, due to the mega scale of the features in question. But it is important to acknowledge that the landfilled quarries are in every sense archaeological features, albeit of larger size and more recent date than we are accustomed to. Just like rubbish pits of prehistoric, Roman or medieval periods, these features have cuts which act as basins of deposition for sequences of fills. The fills are not just a random jumble of material, however, but are highly stratified (see sections through landfill deposits in Nativ 2022 and Edgeworth 2023) with layering building up according to the geological law of superposition (Harris 1989). There is not much difference between a pit just 1 m wide and a pit 1 km wide, except the variation in size. Similar patterns of stratigraphic relationships recur at either scale. Both are inherently archaeological and susceptible to archaeological analysis. Consider the schematic section drawing shown in Figure 4. In the absence of a scale, does this drawing represent two small pits no more than a metre wide, as might be found on a typical archaeological site, or landfilled quarries a kilometre wide?

There is no single answer to this question. Without a scale, the cross-section could in principle apply to both, or to any size of feature in between. The example illustrates the fact that some of the stratigraphic patterns found in humanly modified ground are multi-scalar or, to put it another way, not scale-dependant. The same applies to methods used to record stratigraphic relationships, such as the Harris matrix (Harris 1989). It is the somewhat fractal quality of archaeological evidence (and methods used to make sense

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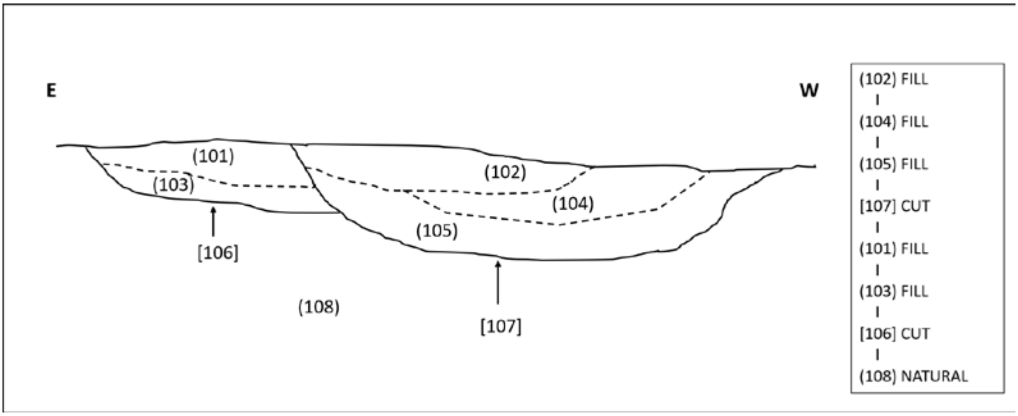

FIGURE 4. Schematic cross-section through intercutting pits, with corresponding Harris matrix on the right showing stratigraphic sequence but lacking any scale.

of it) that makes it possible to move easily between scales, to upscale or downscale as appropriate. To accommodate mega features such as modern landfilled quarries within an archaeological conceptual framework, we can in principle use exactly the same methods of stratigraphic analysis as we would in dealing with the highly detailed stratigraphy typically encountered in an archaeological trench (Lock and Molyneaux 2006; Edgeworth 2013).

It might well be asked how it is possible for the same drawing to apply to evidence on such different scales without – when moving to the larger scale – increasing the thickness of the lines. The answer is that the lines in the drawing indicate stratigraphic entities known as interfaces, that may have no thickness in themselves. An interface is like the Roman door-god Janus in that it has two faces, one looking in and one out – or, in the case of horizontal layers, one looking up and one looking down. It is where the upper face of one layer meets and touches the lower face of another. A cut is a type of interface that has been deliberately formed through intentional human action, often through the use of cutting tools or – in the case of the quarry cut – earthmoving machinery. Having no thickness in its own right, the interface can be represented in section by a thin line on any scale, like a vector line, no matter how big or how small the evidence being represented. Understanding this is the key to moving between scales, enabling extremely large (or extremely small) features to be to be treated in the same way as more human-scaled archaeological features.

Of all archaeological methods, the Harris matrix method is singled out here as being particularly important in helping us apprehend the vertical dimension of waste landscapes. In the ordering of stratigraphic entities such as cuts and fills into vertical and temporal sequence, we are reminded that waste landscapes have not only spatial depth to them but also time depth, despite being relatively modern compared to most archaeological sites.

As material culture patterning in the Anthropocene extends ever further into realms of the mega and the nano, it is incumbent upon archaeologists to follow it wherever it goes, and on whatever scale it manifests (Edgeworth 2010). With tools like the Harris matrix, archaeology has the means to do so. Edward Harris himself recently identified his

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method, which has been adopted by archaeologists throughout the world, as appropriate for making sense of Anthropocene stratigraphy (Harris 2014).

Figure 5 is a section compiled using surface maps, aerial photos, geological maps, records made by quarrying and landfilling companies and Google Earth, etc. This will not be as accurate as a geological map; it is more of a working drawing than a finished article. It was never intended as an end in itself, but more as a means of getting to grips with the sheer size of these landfill features, taking account of depth as well as surface manifestations – a tool for extending perception onto new scales of observation and analysis that were outside my archaeological comfort zone. As Marston Vale with its Oxford Clay deposits stretches in a south-southwest direction from close to the River Great Ouse in Bedford towards the Greensand Ridge – and in order to get the profile of as many of the landfilled quarries as possible – the section line was taken from St Paul's Church in Bedford town centre all the way through the vale to the deepest of the pits at Brogborough, with just one slight change of direction near the southern end. It is roughly 14 km in length, which is admittedly somewhat longer than most archaeological sections. As normal with geological maps, the vertical scale is exaggerated relative to the horizontal scale.

In drawing the profile, I realised that St Pauls Church steeple at one end of the section is roughly the same height *above* ground as the depth of the base of landfill *below* ground in the deepest part of Brogborough quarry at the other end. Now, whenever trying to convey the depth of landfill to others, I find it useful to make use of the steeple as a handy measure. As it is still not possible to walk upon the landfill hills, I sometimes ask people to imagine themselves standing on top of the artificial hill at Brogborough, with 50 m of compacted landfill directly beneath their feet, and then to imagine being at the top of the church steeple looking down at St Paul's Square far below. The distance from the top of the steeple to the ground is roughly the same as that from the top of the hill to the upper surface of the undisturbed natural layers at the base of the landfill.

Envisaging the Lower Bounding Surface

> Below the boundary are the fossil remains of plesiosaurs, ichthyosaurs, marine crocodiles and common fossils such as belemnites and Gryphaea shells. Above the boundary (in places artificially lined with stiff clay) are radio sets, nappies, glass bottles, tin cans, books, clothes, cinema tickets, electrical components, food packaging, plastic bags and biros, with the most common bones being those of domesticated animals such as factory-reared chickens. (Edgeworth *et al.* 2015, 43)

This passage comes from an article written with other members of the Anthropocene Working group about the lower bounding surface of the archaeosphere, using the base of landfilled quarries of Marston Vale as an example. A few months after publication of that paper, I received an email message from the French anthropologist and philosopher of science Bruno Latour (now sadly departed). He had read the paper and come across the above passage. He found the marked difference between objects above and below the boundary extraordinary: were there any photos that could illustrate the contrast described?

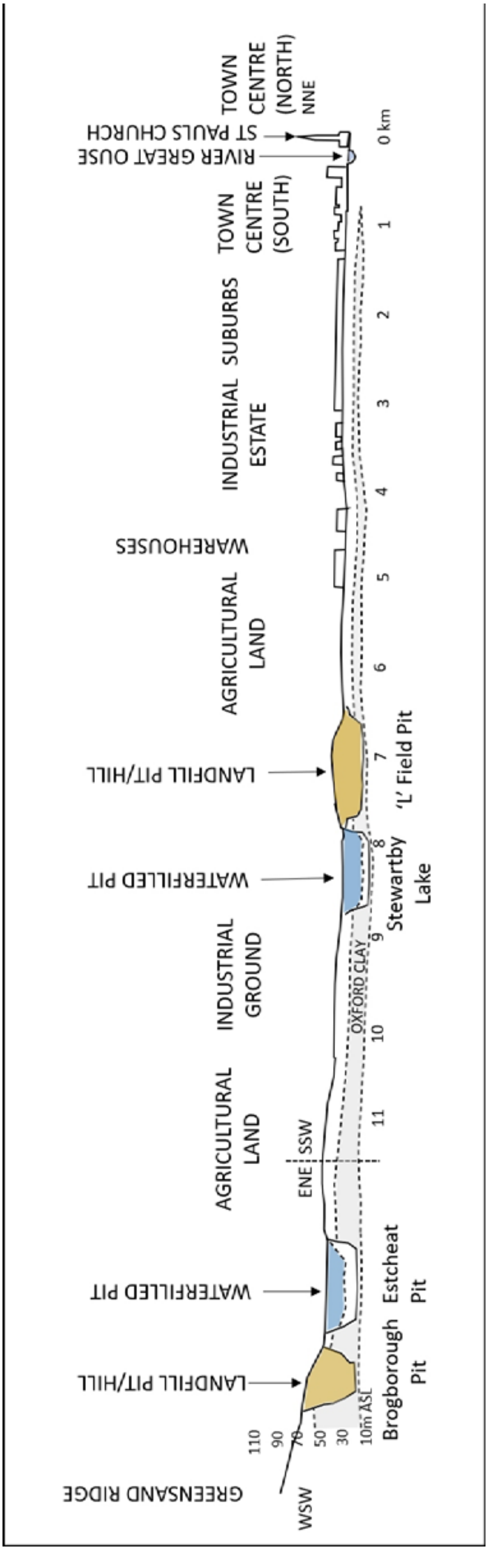

FIGURE 5. Section through four of the quarries, two of which have been filled with landfill and now form low hills.

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That was unusual. Hearing from such a well-known and brilliant scholar was a surprise, especially as I was working at the time out in the field on archaeological excavations, seemingly a long way from the world of well-known intellectuals such as Latour. Though familiar with his books and no doubt greatly influenced by them, I never imagined I would be in contact with him, even by email. Yet here his message was. A brief exchange of emails ensued, and I sent what further material I had to hand, but did not have the time then to follow up his interest properly, as I should have done. I regret that now. It is not every day that the keen and hawk-like sense of what stands out as significant to a scholar like Latour swoops down and alights on the mundane things one is working on. This paper presents a belated opportunity to expand upon the aspect of the evidence which attracted his interest.

The bounding surface described in the passage is of course the base and lower side of the quarries in Marston Vale which are the subject of this paper – a manifestation of the diachronous Boundary A at the base of the archaeosphere described in that 2015 paper. As we have seen, a geological layer dating from Jurassic times (the Oxford Clay) had been removed in places almost in its entirety, to provide material for the manufacture of bricks. It was replaced by a new layer of twentieth- and twenty-first-century (landfill) material. In one sense, the boundary is the ‘cut’ of the quarry. In another sense, it is the stark contrast between layers above and below the cut, and specifically between inclusions contained within those deposits, with fossils of extinct sea creatures below and the astonishing abundance of twentieth-century artefacts and novel materials above. If the cutting of the pit shown in Figure 3 above was the first phase in the formation of the stratigraphic boundary, Figure 6 shows the start of the second phase – the covering over of blue-grey remnants of the Oxford Clay at the base of the pit with initial consignments of landfill material arriving by truck to be dumped.

As already noted, it is impractical to cut an actual section across the landfill pits and their hills. But we can envisage what the boundary looks like, and describe the biostratigraphic signals associated with it. It takes the form of an interface, or the surface where the upper face of one layer (the Oxford Clay) comes into contact with the lower face of another (the landfill deposits). It might be represented in schematic form something like this:

Landfill deposited in the late twentieth century

——— CUT / UNCONFORMITY/BOUNDARY A ———

Fossil-rich muds deposited during the Jurassic

Without getting into detailed descriptions of soil colour, texture and consistency, let us briefly characterise the most striking difference between assemblages of material either side of the boundary in terms of material inclusions. Below, there is an abundance of fossils of now extinct species whose behaviour and morphology were entirely shaped by natural selection. There are no artefacts and no manufactured materials. Above the boundary, by way of contrast, there is an incredible abundance and diversity of artefacts and novel materials – “technofossils” is the term commonly used to describe these in the Anthropocene literature (Zalasiewicz *et al.* 2014). Such objects and manufactured materials are made by a species whose behaviour is shaped by cultural as well as natural selection.

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FIGURE 6. The formation of a stratigraphic boundary, late 1980s, Brogborough Pit.

Unlike natural fossils, which find their way into strata through natural processes, these technofossils have been deliberately buried. In the case of bricks and ceramics and glass, they have also been fired in the very process of manufacture – an artificial process that can be taken as a form of fossilisation, since it confers a high likelihood of long-term survival in the stratigraphic record. Some, like the bricks with the name of the company which made them indelibly stamped on their upper surface, might be called "media fossils" (Parikka 2012), in the sense that they convey linguistic or symbolic information. Sometimes this information is affixed to an object (e.g. a label), sometimes it encloses the object (e.g. plastic wrapping), sometimes it is engraved or fired or stamped into the very form of the object (e.g. stamped bricks) and sometimes it is encoded as digital data (e.g. CDs and video games).

Reinhard (2015) documents the 2013 excavation of Atari games, consoles and controllers deposited in a 10 m-deep cell within the Almagordo landfill site in New Mexico in 1983. These had been covered over with more recent landfill material dumped during the later 1980s and 1990s. Many game cartridges were still boxed with their instruction manuals. In some cases games in their individual packaging were boxed together in larger cardboard boxes as multiple batches. These were in perfect condition and usable on Atari 2600 computers after 30 years of burial. These provide just one example of the extraordinary and geologically unprecedented kinds of objects present in strata above the boundary.

As it happens, the circumstances surrounding the burial of this material in landfill were already known in outline before the excavation. One of the games (*E.T.*) was said to be spectacularly bad. There was also a market crash, as Reinhard explains, making it a

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viable business strategy for Atari to dispose of some merchandise. It is interesting to speculate whether any of this could be inferred from the stratigraphic evidence alone, if nothing were known of the context of deposition.

What are we to make of the existence of a stratigraphic boundary in the ground which, on the face of it, might appear to constitute a material divide between nature and culture, or nature and society? If that were the case, it would directly contradict the widespread view in contemporary social science and humanities that the nature/culture opposition, so deeply entrenched in modern thought, has no basis in reality and should be dismantled. Latour himself was prominent in expounding that view (Latour 1993). Perhaps this was why this particular set of evidence attracted his attention. As it happens, the bounding surface, far from being a divide between nature and culture, is actually a divide between natural deposits below and humanly modified deposits above which contain a mixture of natural and cultural things, including many hybrid entities. It testifies not so much to a human world, but to a human-natural one.

Landfill Materials

As well as thinking of landfill contents in terms of objects, it is useful to also think in terms of materials. Until recently, reliable data for the percentages and volumes of the different materials in modern landfill did not exist, but important work by William Rathje changed all that. His renowned "Garbage Project" investigated nine mid-late-twentieth-century landfill sites across the USA through systematic sampling of material from augur wells and trenches (Rathje and Murphy 2001).

Results were fairly consistent across all landfills sampled, reflecting more than just local patterns of deposition. Popular misconceptions were overturned, especially with regard to dumps of household rubbish. Categories of materials generally thought to occupy much space in landfill, such as fast-food packaging and disposable diapers or nappies, amounted to less than 3% of all garbage. Plastics amounted to 16% by volume as compacted, a substantial proportion but still less than expected. Occurring in greater amounts than anticipated, on the other hand, was construction-and-demolition debris, at 12%. Its deposition had generally not been recorded, so there was a clear disjunction between what was supposed to be in landfill and what was found to be there – the gap between garbage myth and garbage reality (Rathje and Murphy 2001).

Surprisingly, the proportion of all types of paper far exceeded expectation, at 40% of total landfill space. Newspapers alone amounted to a huge 13%. A general assumption tends to be that organic material such as paper would decompose fairly rapidly, but Rathje and Murphy's study challenges this 'myth of biodecomposition'. Clearly, decomposition does occur, giving rise to the production of methane which has to be vented out through wells, to be collected and processed, burnt off or released directly into the atmosphere. Leachate in the form of a toxic grey liquid is another product of the dark ecology of decomposing materials in landfill. However, landfills that are isolated from direct contact/exchange with the earth and the hydrological cycle – by being lined and capped with clay or plastic membranes – are much more stable and inert than generally supposed. It is typical for methane wells in landfills to vent methane for 15–20 years after landfill closure, but then for production of gas to decline rapidly, indicating

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stabilisation of biochemical processes below (Rathje and Murphy 2001, 116). In well-constructed dry landfills, the scarcity of water and oxygen inhibits microbial activity. In such a context, organic materials like paper and wood survive much better than might be expected: 'they do not so much degrade as mummify' (Rathje and Murphy 2001, 105). This discovery led to the important conclusion that, far from facilitating decomposition of such materials, landfills may actually act more as structures for their preservation: they are 'time capsules […] durable beyond precedent' (Rathje and Murphy 2001, 130).

Dig into a typical late prehistoric, Roman or medieval rubbish pit in England and you will usually find, mixed in with artefacts made of novel materials such as ceramic and glass, the remains of domesticated animals and plants. A twentieth-century landfill is no different in this respect, except in terms of sheer quantity of biological material dumped. Much is in the form of food waste, sent to landfill by supermarket chains, or food scraps in household rubbish, such as chicken bones, often associated with plastic packaging.

But there is a dark side to this, rarely reported on or entering into the realm of everyday discourse, as exemplified by the mass burial of exterminated factory-bred poultry carcasses following outbreaks of avian flu. Millions of birds unfortunately have to be killed in such circumstances. Though some are burnt or composted, many go to landfill. A characteristic method of burial was observed and photographed by Flory (2006) on landfill sites in the USA; similar practices undoubtedly have taken place on British landfills like those in Bedfordshire too. As Flory describes it, large trucks carrying thousands of bird carcasses arrived at the landfill site, having come directly from the poultry factories. To prevent leakage of fluids during transit, the interior of the trailers had been lined with thick plastic sheeting, with the carcasses tightly packed and sealed within. In preparation for the arrival of these consignments of bio-hazardous material, trailer-sized trenches were excavated by earth-moving machines through deposits of compacted landfill that had previously been dumped on the site. The giant plastic-wrapped deposit from each trailer was then tipped straight into a trench, still encased in its plastic lining. To seal these special deposits the earth-moving machines dumped further loads of household rubbish on top, thus completely enveloping them in that artefact-rich material. Once sealed and covered over, further layers of landfill continued to be deposited above.

No-one has ever carried out an archaeological excavation of such deposits, and no-one would want to, but it is important to visualise the stratigraphic formations which have been created. The thick plastic lining containing the poultry carcasses can be construed as a container. Even as it decays over thousands of years, it will survive in the form of a soil boundary enclosing the part-decomposed poultry remains, enfolded in the layers of compacted artefact-rich household rubbish that were backfilled into the trench. The cut of the trench, dug by machine into the compacted layers of landfill already there, can be construed as a second container enclosing the first. The cut of the quarry as a whole – sometimes sealed on sides and base by thick clay or concrete or some other impermeable material – is a third container enclosing the second and the first. In fact, the entire stratigraphic configuration is structured by nested sets of relations of inside/outside (cf. Graves-Brown 2013).

The poultry remains are therefore very well protected and have potential to survive as a durable stratigraphic signal on geological timescales. If ever uncovered, these

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would constitute evidence not only of mass incarceration of domestic species of birds by humans, for purposes of food production on industrial scales, but also of selective breeding for their physical characteristics. An important paper by Bennett *et al.* (2019) shows how the morphology of bones of modern factory-bred broiler chickens to be found in landfill are markedly different from wild counterparts, or indeed from the bones of domesticated poultry from older archaeological contexts.

Their significance, moreover, goes far beyond individual landfill sites. Each encapsulated mass burial is eminently dateable. Bones can be dated by radio-carbon dating and other techniques. The layers of dumped landfill material in which they are embedded can also be dated to a high degree of precision, even to the nearest year, through their artefact inclusions. The special deposits of exterminated poultry deposited in landfills throughout the world as the result of a specific avian flu epidemic could, in principle, be correlated with each other, adding up to a global stratigraphic signal.

However that may be, it is not just what is present as inclusions in landfill that is of interest, but what is absent as well. Consider for example the absence of human remains, not only from inside the thick plastic sheeting containing poultry carcasses, but also from enclosing deposits of dumped household, industrial and commercial rubbish within the landfilled quarry as a whole. The dearth of human bones is in contrast to the relative abundance of physical remains of domesticated animals and birds, mixed up with countless mundane artefacts, items mass-produced from novel materials and media fossils in the form of wrappings and containers. The marks of human actions and designs are everywhere – but of human bones there are no sign. This may present something of a conundrum for hypothetical geologists or archaeologists of the far future (assuming they only had the evidence of landfills to go on, and were unaware of the existence of cemeteries where most human remains are deposited). It would be like a Zen *koan* in physical form. Where, they might well ask, is the missing human skeletal material?

Conclusion

The landfill hills described in this paper are relatively small compared to landfill hills in other parts of the world, such as the Ghazipur Landfill near New Delhi, India, or the Puente landfill artificial mountain in California (Manaugh and Twilley 2013). But that is looking at things on the surface, without taking the unseen buried component of such sites into consideration. What these features may lack in height is more than made up for in depth. These are hills that go down as well as up. As large quarries that were filled with landfill to become low-lying hills, they represent a type of deeply stratified site that is commonly found in the vicinity of cities across the globe, but that manages to avoid attention often directed towards higher "artificial mountains" of landfill.

From a stratigraphic point of view, the evidence buried in landfilled quarries has potential to last much longer in the material record than landfill dumped on unquarried ground, however spectacular the latter may seem at the present time. In terms of the landfilled holes/hills of Marston Vale, the upper portions of the landfill above ground or just below the surface are likely to be subject in the near future to all kinds of human-wrought transformations. Some of these, such as the re-use of landfill sites as nature reserves or sports grounds, are described in other papers in this special forum. Landfill

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hills are also likely to be subject to a range of erosive geomorphological forces. Lower portions, on the other hand, especially the layers most deeply buried within the cut of the quarry, will be largely protected from surface forces of erosion by virtue of being so deeply buried. As trace fossils of the city testifying to a human-influenced biosphere, the deeper parts of the landfilled quarries (and the lower bounding surface between landfill and natural deposits which attracted Latour's attention) have potential to survive in the stratigraphic record far into the future on geological timescales.

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