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Digging fast, digging slow: mining and archaeology, an uneasy relationship

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Digging Holes Differently: The intersections of mineral extraction, archaeology and palaeoanthropology in southern Africa

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Introduction

Hidden in a corner of the hall of African Peoples Hall in the American Museum of Natural History in New York is one of the very interesting by-products of southern African diamond extraction in the late 19th and 20th century (fig. 1). Among ethnographic diorama's, currently themselves of great epistemological interest and material culture from historic societies from across the continent, is a geological cross section of the Vaal River deposits and the different archaeological artefacts found in the differently-aged river terraces.

These gravels were explored for diamond extraction from the 19th century. The archaeological materials and faunal remains found during this work provided the framework for the early understanding of the archaeological chronology and the faunal succession in the region. (Hodgkinson 1926; Broom 1928). This understanding can be cast as a by-product of the mining activities, but the relation between archaeology and mining may be more reciprocal as demonstrated in Goodwin and Van Riet Lowe's (1929) landmark publication on South Africa's Stone Age chronology: "In other words, if an experienced digger discovers Stellenbosch-type remains in a gravel, he immediately feels that the chances are a thousand to one that he will also discover diamonds" (Goodwin & Van Riet Lowe 1929, 39).

Other mining activities had and still have direct archaeological consequences, such as the exploitation of guano deposits at Border Cave (on the border of Swaziland and South Africa) leading to the discovery of human remains (Cooke et al. 1945). Sometimes the trajectories are indirect. The gold mining industry at the Witwatersrand did not itself lead to great archaeological discoveries. The impurity of the South African gold ores impacted the profitability of the mining until the discovery of cyanidation procedures. These require lime to maintain high pH values, which led to the exploitation of limestone in the dolomitic areas just north of Johannesburg (Esterhuysen 2019). This led to the discovery of fossil deposits which yielded a great many fossils of hominins (primates sharing a more recent common ancestor with us than we do with chimpanzees). The caves that yielded these fossil discoveries now form the core of the UNESCO World Heritage Site "the Cradle of Humankind"

For more than a century, mining and archaeological and palaeoanthropological research in southern Africa have an ongoing interaction in which the mutual effects change both activities although the effects are asymmetric. Here I attempt to sketch the contours of a feedback loop between the two. Mining, as a large-scale activity involving large amounts of financial capital, it has been the dominant partner in the relationship, largely dictating terms, but it has not been immune to influences from archaeology. In the following I discuss the main

types of interaction between archaeology and mining in southern Africa over the past 100-plus years: discovery, destruction, conflict and finally mitigation.

Discovery

Mineral extraction has been a catalyst for discoveries about the human past in southern Africa. The discovery of fossils hominins linked to lime extraction played a pivotal role in directing scientific attention from Asia to the African continent in search of human origins (Tobias 2007a).

The first African discovery of an extinct hominin (a species more closely related to living people than to our closest relatives chimpanzees and bonobos) is the Taung child. This skull of a juvenile hominin preserving a natural cast of its brain was discovered in limeworks at Taung in the Northern Cape province. This fossil was described by Raymond Dart, professor of Anatomy at the University of the Witwatersrand in Johannesburg as a new species: *Australopithecus africanus* (Dart 1925a). He proposed it as a primitive species on the human lineage. Dart's interpretation was initially contested by others at least in part because scientific attention was focused on Asia (Keith 1925, Smith Woodward 1925).

The following decades, more hominin fossils came from similar deposits elsewhere in the country, many discovered as a result of lime mining The centre of South Africa's gold-mining industry in the 19th and 20th centuries was the Rand near Johannesburg. Dolomitic formations suitable for lime mining are very conveniently located just North of the gold-bearing deposits. Lime-mining took place at a number of sites that are now included in the UNESCO World Heritage Site "the Cradle of Humankind". The richest site in this area is Sterkfontein. It had been worked since the 1890s, but in 1929 the rights to the site were transferred to a new operation. Significantly, the new mine employed George Barlow as quarryman. He had been a quarryman at the Taung limeworks worked at Sterkfontein in the 1930s. He was in contact with Robert Broom and collected promising fossils for him (Tobias 2007a). In the 1930s, *Australopithecus* fossils were also recognized from Sterkfontein and soon afterwards from other sites nearby Cooper's (Broom 1937; Shaw 1939). The expertise of Barlow also led to the recognition of the fossils from nearby Kromdraai, discovered *in situ* by schoolboy Gert Terblanche. The boy gave part of the material to Barlow, who alerted Broom. The letter to *Nature* then describes finding the boy in school to get to the materials. "*I had to hunt up the schoolboy. I went to his home two miles off and found that he was at school another two miles away, and his mother told me that he had four beautiful teeth with him. I naturally went to the school, and found the boy with four of what are perhaps the most valuable teeth in the world in his trouser pocket. He told me that there were more bits of the skull on the hillside. After school he took me to the place and I gathered every scrap I could find*" (Broom 1938). This was clearly worth the trouble, as a large part of the skull of a different species of hominin was located. This species was named *Paranthropus robustus*, it is a so-called "robust australopithecine", a highly specialized lineage that co-existed with early members of our own genus *Homo*. Paranthropus was more successful it appears as it is far more common in the South African fossil deposits than our direct ancestors (e.g. Brain 1981, also see Dusseldorp et al. 2013).

Further to the North near Mokopane in what is currently the Limpopo Province, it took teacher Wilfred Eitzman several years trying to attract scientific attention to the fossil materials from the Makapan limeworks (Eitzman 1958). After the announcement of the Taung child, he visited Dart in Johannesburg and Dart studied some of the fossil material, reporting that no

human remains or tools were present in the collections studied by him, but identifying the site as a location of great potential, where blasting should be monitored (Dart 1925b). This estimation proved to be correct as from 1947 a series of *Australopithecus* fossils was discovered at the site. The anatomy led Dart to propose that this was a different species from the Taung child (by then also known from other locations). He called the species *Australopithecus prometheus* (Dart 1948). The reference to the Titan giving people the use of fire was predicated on the observation of dark bone fragments in the deposits as well as the sheer richness of bone materials. He interpreted the remains as a "kitchen midden" (a term generally used for Danish shell middens from Holocene times) and suggested fire was used by the hominins living here (Barbour 1949).

The indications for fire use at the site are now thought to have been caused by Manganese staining from the groundwater (Kuykendal 2007) and by the dynamiting done in the course of mining activities (Crawford et al. 2004). In terms of anatomy, most palaeoanthropologists have tended to emphasise the similarities between the Makapansgat fossils with those discovered elsewhere in South Africa and the name *A. Prometheus* fell into disuse while all the fossils were grouped as *A. africanus*. Recent discoveries by Ron Clarke have revived the idea that two species of *Australopithecus* were present in South Africa and he has proposed to use the name *A. prometheus* for a 3.3 million-year-old skeleton he discovered at Sterkfontein near Johannesburg as well as for a part of the Makapansgat material (Clarke and Kuman 2019). Due to the rules of taxonomy, the first name that was published stands, even if it is later proven to be incorrect. This is responsible for instances such as a fossil whale called "king lizard" (*Basilosaurus*; the discoverer really wanted to find a dinosaur), and now thanks in part to mining activities we also have a non-fire using hominin called *Australopithecus prometheus*.

Insights in hominin behaviour come not just from their fossils but even more so from the remains of the tools they produced and the from finds that attest to the environment that they lived in. The cave faunas yielded environmental insights and some of the finds from the limeworks were interpreted as tools and in other ways in terms of human lifeways (such as the fire at Makapansgat). Fragmented bones and teeth from among others Makapansgat limeworks were proposed to represent an osteo-donto-keratic (bone-teeth-horn) industry (Dart 1957). These objects, together with the hominins themselves, are now understood to be the remains of prey accumulated by carnivores, rather than stone tools (Brain 1981). Stone toolmaking was established in East Africa by 2.6 and perhaps even 3.3 million years ago (Harmand et al. 2015). In South Africa stone and bone tools are associated with later deposits and fossils from our own genus *Homo* and *Paranthropus* (Dusseldorp et al. 2013).

More enduring insights in chronology and developing technology are derived from diamond extraction in the Vaal and Orange river gravels. Rivers build up terraces as they incise valleys. The oldest terraces are the highest ones from the current channel. Studying materials found in different terraces therefore builds up a coarse technological chronology. Such work has been conducted since the early years of the 20th century. And just like Boucher de Perthes in 18th century France, the South Africans gave much attention to the association between stone tools and animal remains. So Broom (1913), published "Man contemporaneous with extinct animals in South Africa" and Dart (1927) published "On mammoths and man in the Transvaal". Broom (1913) summarises observations of extinct animals in the Vaal river gravel and then notes the co-occurrence of (giant) Cape horse *Equus capensis* and giant buffalo (*Pelorovis antiquus*) with stone tools at a spring eye now known as Florisbad. Dart (1927) describes

mammoth teeth found together with stone tools in a former river bed of the Vaal. He states of those: “There is no lithic problem of greater urgency than that of the separation of the different age strata and there is every likelihood that the Vaal river in this respect will be of premier value” (Dart 1927, 44).

Archaeologists Goodwin and Van Riet Lowe did exactly that and the framework they constructed based in large part on “travelling widely and observing diamond diggings” (Underhill 2011, 6) has played an important role in providing a techno-chronological framework for archaeology (Goodwin & Van Riet Lowe 1929; Van Riet Lowe 1952). In recent decades this framework has been superseded by new classification methods and the development of direct dating methods using radio-activity (Underhill 2011). Yet it can still be encountered in some museums today.

Destruction

The main benefit of mining for archaeological and palaeoanthropological research is the removal of large amounts of overburden. Over the past centuries, the mining industry has relied on multiple mechanisms to do this, from cheap (sometimes forced) labour to dynamite. For mining to be worthwhile this fast and efficient removal of overburden is essential. This undoubtedly led to the unseen destruction of a great many fossils. Some older publications on famous fossil sites make for depressing reading.

Wilfred Eitzman who on the directions of a miner collected bones at Makapansgat recollects in 1958: “*The reports received from schoolboys and from natives were not exaggerated. The interior was a charnel house! There were thick seams of bones on both sides*

of the tunnel; bones were mixed with the rubble and blocks, dislodged the day before by dynamiting. A thick, high heap of bone was exposed about 40-50 feet from the entrance.
[…]
To my mind the hest material was lost in those few weeks in May 1925 when the most important parts of the bone bearing breccias were being dynamited and destroyed." (Eitzman 1958, 178).
Some of the destruction was not accidental:
"*In 1925 a complete fossil man was found just near the end of the first great tunnel in a crevice above the grey breccia on the east side. This fossil was destroyed and cast into the lime kilns. A certain person employed by the Northern Limes was responsible. The truth of this was beyond doubt; schoolboys heard about it independently. I questioned many natives who worked at the quarry and they confirmed it. The same person boasted about it as late as 1929 in the presence of Professors de Sitter, Gates and others.*" (Eitzman 1958, 182).

At other mining operations, such as Kromdraai and Sterkfontein near Johannesburg, early hominin discoveries may also have been lost. From the late 1800s to the 1930s, miners paid the fossil bones from Sterkfontein little attention (Tobias 2007a). And even when more attention came to be to the fossils after the announcement of the Taung skull, some of the fossils may still have disappeared. Philip Tobias (2007b, XV) described how the quarrymen turned an extra profit: "*Good specimens were displayed on a table in a pondokkie and these were sold to visitors. Some were pilfered by light- fingered rummagers. The table with specimens was seen by me on my first excursion to Sterkfontein in May 1945. To encourage visitors and promote sales, Cooper produced a small guidebook in 1935, telling the readers about the fossils and prophetically coaxing them with the declamatory invitation: 'Come to Sterkfontein and find the Missing Link'.*"

From the initial fossil discoveries, outstanding questions on human evolution focused increasingly on matters such as chronology and the way of life of the extinct hominin species. This requires detailed contextual information on the geological and depositional context of the fossil and archaeological remains as well as insight in the associations of fossil fauna, hominin fossils and archaeological implements. This means that as research questions become more sophisticated, the role of mining for archaeology and palaeonthropology changes and the benefits of mining activities decrease or disappear. Destruction of the context of discovery leads to "orphaned" fossils, such as the femur found during Vanadium mining at Berg Aukas, Namibia (Grine et al. 1995). This prehistoric femur may belong to *Homo erectus* or to an early representative of *Homo sapiens*. However, it was only recognized after it was removed from its context, meaning its informative value now is very limited.

A more famous example is the skull found in the 1920s during zinc mining at Broken Hill in what is now Zambia. It has been assigned to *Homo heidelbergensis*, a potential ancestor of our own species *Homo sapiens* (although upon discovery it was given its own species name *Homo rhodensiensis*) (Grün et al. 2020). The location of the skull is unclear from reports and this has led to enduring uncertainty of its placement in hominin evolution as well as the association with archaeological materials that might illuminate the way of life of this population. Archaeological stone and bone tools attributed to the Middle Stone Age may be associated with it (Barham et al. 2002). The Middle Stone Age (~300,000 – 30,000 years ago) is characterized by complex flint-knapping techniques (Dusseldorp & Lombard 2021 for discussion on association of fossils and archaeological materials). Without proper documentation of the materials in the field, associations of fossils and archaeological remains will always remain problematic. Fortunately, improvements in radiometric dating methods

have, almost a century after its discovery, led to the establishment of the age of this fossil. It was established to be ~300,000 years old (Grün et al. 2020). This demonstrates the co-existence of *Homo heidelbergensis* populations on the African continent with the earliest members of our own species (at Jebel Irhoud, Morocco).

The destructive influence of mining operations is not restricted to the early 20th century. Although lime mining in the famous Australopithecine bearing sites has long ceased, widespread mineral extraction activities in southern Africa still result in the accidental destruction of (part of) archaeological sites. This also leads to discovery, such as during diamond mining in dunefields on the western coast of the Northern Cape. Here, two rockshelters at Boegoeberg in Namaqualand, buried under dune sands were largely destroyed in the 1990s before the rockshelters were recognised. The remaining deposits allowed documentation of intensive shellfish exploitation during the Middle Stone Age, which had not been documented at many sites (Klein 1999). The Middle Stone Age is a crucial period in human evolution, when *Homo sapiens* first appears and the South African archaeological record illuminates the development of characteristically modern human behaviours (see e.g. Henshilwood 2012). Coastal foraging and shellfish gathering may have played an important role in these developments (Langejans et al. 2012; Marean 2014; Will et al. 2016), so the destruction of most of these deposits is a loss for archaeology.

Increasing mechanization likely contributed to this development. Where Goodwin and Van Riet Lowe constructed a chronology of lithic industries based on visiting diamond diggings in different Vaal terraces (Goodwin and Van Riet Lowe 1929; Van Riet Lowe 1952; Underhill 2011), now this is no longer possible. The size and speed of the diamond workings operating 24/7 have seen archaeologists having to pick up stone tools from a conveyor belt transporting material from the quarry and spoil heaps (Gibbon 2009; Gibbon et al 2009). Diamond mining can be profitable even if as little as one carat of diamond is recovered per 100 tons of gravel (Leader 2016). This is obviously predicated on quick and efficient removal and makes diamond quarries no longer suitable for detailed geological and archaeological obervations, even if only from a health and safety point of view. Much of the destruction remains out of sight as large-scale operations may not aid the recognition of important deposits and finds and so the exact destructive impact of mining on archaeological science is difficult to evaluate.

Mitigation

The realization that mining activities are destructive and can be severely damaging to heritage values is not a recent development. Arguably the most important palaeoanthropological occurrence in South Africa, Sterkfontein, was discovered during blasting activities in 1896. Within the limestone deposits on the urging of geologists the main cave was protected.[1] Lime mining continued in the nearby deposits however.

The legal protection of archaeological remains has a gradual history in South Africa. Deacon (1993) describes how the "Bushman Relics Act" of 1911 proscribes the export of archaeological materials and rock art, with the National Monuments Act of 1969, archaeological remains in the ground gain some protection, but many activities, among which mining, are exempted from the obligation to protect archaeological sites (Deacon 1993, Humphreys 1973). There are some exceptions: caves, rockshelters, shell middens are protected from such activities (Deacon 1993). The discovery of rockshelters underneath a dune at

[1] https://www.maropeng.co.za/content/page/mining-and-the-discovery-of-the-sterkfontein-caves Accessed 18 May 2022

Boegoeberg thus led to the cessation of work and their excavation (Klein 1999). As seems the case in other regions as well in time Archaeology was subsumed under legislation managing the environmental impact of large building projects. In South Africa this happened with the Environment Conservation Act of 1989 (Deacon 1993; Chirikure 2014).

With the advent of democracy in South Africa, the need for a new legal framework to deal with heritage as well as the need to redress the injustices and unequal protection afforded to different heritage types with Apartheid era protection afforded mainly to the (colonial) built environment (Deacon 1993, 2015). This led to the the National Heritage Resources Act of 1999 (Deacon 2015). Any development must take into account the archaeological values of the terrain and take steps for appropriate management (Fourie 2008). As a result under the current system much effort is expended into mitigation.

Currently, any development, whether it concerns building activities or large-scale mining operations it is typically required to commission a heritage impact assessment of their activities. Typically, this involves field survey for occurrences of archaeological materials on the surface, combined with literature research for reported archaeological finds from the affected area. If the development will destroy archaeological sites deemed to be significant, the developer will have to commission an excavation as a means of mitigation (Fourie 2008; Ndlovu 2014; Deacon 2015). This means that the Heritage site will still be destroyed but it will be documented.

This system has led to a great increase in archaeological work (Ndlovu 2014). There are some great success stories of this work. Heritage prospection and subsequent excavations in Namaqualand have led to the discovery of many dozens of sites and have provided valuable insights in the occupation history of the region (Orton 2012). In the course of this research a unique mass kill site of Springbok was documented (Dewar et al. 2006) In this region, Orton (2007) also conducted research into ephemeral occurrences that are often not selected for mitigation as small-scale archaeological phenomena are often deemed of low value. This led to recommendations on how to better deal with such occurrences (Orton 2007). Ndlovu (2014, 215) also highlights some important projects conducted as mitigation work. The current system has thus brought important successes in the preservation and study of archaeological heritage.

Nevertheless, not all news is good, and the current system also has some problems. Ndlovu (2014) thoroughly reviews the weaknesses in the system and here I want to only highlight one issue. This is the quality of the research and of the mitigation recommendations (see Ndlovu 2014, 212-213). Typically, archival research and field survey are employed, which mean that buried remains may not be recognized. Many reports contain relatively standard phrasing with the recommendations on how to proceed to state that remains underground and unmarked graves may be encountered after the work has commenced and that in such cases work should be ceased and archaeologists should be contacted to investigate and determine how to proceed (e.g. Van der Ryst and Kruger 2007; Van der Walt 2021). This places a large responsibility on the operators of equipment, often working at large scales and under time pressure and who are untrained to recognize archaeological occurrences. Further, one wonders to what degree the corporate culture of some operations implicitly dis-incentivises recognizing archaeological remains that may lead to the cessation of the operation. There are also indications that the efficacy of mitigation measures is sometimes insufficient. Ndlovu (2014, 212-213) observes that they are sometimes phrased in a very open-ended way. This means there is ambiguity in what actually will have to be done and places a lot of responsibility on

regulators. Compounding such problems is the fact that enforcement of the legislation suffers from low priority and poor support from the Police and Prosecuting authorities (Ndlovu 2011).

Stone-walled structures from the Iron Age, the period when farming societies occupied the eastern parts of South Africa provide an example. They are generally visible on the surface so do not suffer from the problems of visibility sketched above. They are generally considered to be of medium significance requiring recording and if archaeological deposit is present, excavation if they are to be destroyed. Despite this, they are sometimes accidentally (partly) destroyed (e.g. Van der Walt 2009, p. 40 for a clear example). On a larger scale, the sheer magnitude of development in some areas of the countries result in the loss of large numbers of sites. Mudzamatira (2019) documents the destruction of stone-walled structures for Gauteng province. In his study area near Johannesburg, building activities were responsible for most of the destroyed structures, but mining impacted such sites as well. The research shows that not just the digging of mines is damaging, but also the tailings and dumps that bury these structures (Mudzamatira 2019, 6; 9).

Mitigation may be conducted on a wider scale through sponsoring. The De Beers Diamond mining company has been an important driving force in the (ultimately succesful) nomination for World Heritage status of the Mapungubwe Cultural Landscape (Chirikure and Mathoho n.d.). The company has donated land and sponsored archaeological research in the area around its Venetia Diamond mine, located in the World Heritage Site's buffer zone. The company also includes archaeological impacts in its environmental incident reporting (Anonymous 2013).

Mapungubwe Cultural Landscape comprises a National Park in which a number of Iron Age sites is located, among which the site of Mapungubwe capital city of a large kingdom covering large areas of southern Zimbabwe and northern South Africa in the 12th and 13th century (Huffman 2007). An earlier capital, K2 is also located in the area. The Mapungubwe Cultural Landscape thus showcases the development of large, hierarchically organized, centrally governed state societies among agricultural societies in southern Africa. These were integrated in large-scale Indian Ocean trade networks as evidenced by the finds of glass beads from among others India and Chinese ceramics (Huffman 2007). One of the sources of wealth of Mapungubwe was gold that could be panned but was also mined. Gold was not initially valued by the predecessor societies of Mapungubwe, but in the Mapungubwe kingdom it was a means of wealth, signalled by very rich burials with gold objects (Main & Huffman 2021). The presence of gold ensured the long-term integration of these southern African kingdoms into the large-scale Indian Ocean trade. The recognition of the global significance of this cultural landscape is an important achievement in the post-Apartheid South Africa redressing its attitude to Heritage Sites (sensu Deacon 2015).

The magnitude of operations and the type of mining as well as the corporate philosophy of the mining company lead to varied types of impact and mitigation. More ambitious recommendations for mitigation as well as good enforcement my improve the situation. Nevertheless, the current emphasis on the mitigation of heritage (and environmental) impact represents an enormous improvement in the way that heritage values are managed compared to the situation prior to the late 1990s.

Conflict

Although legal frameworks and policies are in place to balance the demands of mining with the responsible management of Heritage sites, conflict still arises, not only in southern Africa but

worldwide. This is especially the case if sites are too highly valued for their destruction through mitigation. Two important cases from South Africa illustrate the problem, the approval of a open-cast coal mine very close to the Mapungubwe Cultural Landscape National Park and the sanctioning of diamond mining in the important Early and Middle Stone Age site of Canteen Koppie.

The Mapungubwe Cultural Landscape was declared a UNESCO World Heritage site in 2003 (Meskell 2011) and as described above, this process was supported by the De Beers mining company who operate a diamond mine in the park's buffer zone. The designation process has been described as rushed. At the time advisory organization ICOMOS advised against proclaiming the World Heritage Site as outstanding questions from ICOMOS on the management plan and the designation of the park's buffer zone had not been addressed (Meskell 2011). South Africa's government made commitments to ensure the establishment of the full buffer zone. The proclaimed site has a buffer zone incompletely surrounding the Mapungubwe Cultural Landscape.

In 2009 plans to establish a colliery 5.6 kilometers from the Mapungubwe cultural landscape were drawn up in the area where the buffer zone was not formalised (Meskell 2011; Leonard & Lebogang 2018). Coal of Africa (ironically, an Australian-owned company[2]) obtained approval to Department of Minerals and Energy in 2010 to open the mine (e.g. Swanepoel 2011; Ndlovu 2017). A "save Mapungubwe" coalition combining nature and heritage organisations was formed to try to block the construction of the coal mine.[3] The mining company then flouted environmental and participation regulations, starting building activities before obtaining the requisite environmental permissions and hence construction was temporarily halted on the order of the Department for Environmental Affairs (Swanepoel 2011; Ndlovu 2017 also see Leonard & Lebogang 2018 on participation). Nevertheless ultimately the mine construction was approved and went ahead. Interviews with local stakeholders show that granting permission for the mine is perceived as simply representing a business transaction for some politicians (Leonard & Lebogang 2018). That may suggest that opposition to it was always fighting an uphill battle

Subsequently, a buffer zone for the UNESCO site was formally finalized, much reduced from how it was originally envisaged, with the coal mine falling immediately outside it. The much-reduced buffer zone may have the advantage that it is actually realistically enforceable (Ndlovu 2017). Nevertheless, even in its much reduced area, it is under pressure from the mining industry and mineral prospecting rights are reported to have been granted inside it.[4]

This case illustrates the false dichotomy where mining is assumed to bring employment and development, while Heritage preservation is cast as an impediment to development. The Vele colliery was promoted by Coal of Africa as bringing development and prosperity to the region and South Africa as a whole (e.g. adding ZAR 11bn to South Africa's GDP over the course of its life) (Meskell 2011). Nevertheless, the mine closed down soon after it started operating as coal prices dropped (Leonard & Lebogang 2018). The mine is reported to have partially re-opened in late 2015 (without participation procedures involving local stakeholders) (Leonard & Lebogang 2018). However, at its mother company's website it is currently listed as "under care and maintenance until outstanding regulatory approvals are received and coal

[2] https://www.banktrack.org/company/coal_of_africa/pdf

[3] https://www.wits.ac.za/cals/our-programmes/environmental-justice/mapungubwe-watch/ accessed 18 May 2022

[4] https://oxpeckers.org/2020/02/mining-mapungubwe/ accessed 18 May 2022

prices improve"[5] The tourism sector associated with the Mapungubwe Cultural Landscape employed around 700 people in 2011 (Meskell 2011). Tourism is an essential sector for Limpopo Province's economy and represents a sustainable source of income (Leonard & Lebogang 2018). The benefits for the local and national economy of the mining project thus appear limited, while long-lasting impacts (environmental degradation, health consequences for local populations) may be felt for generations. The business case for Heritage preservation and associated tourism actually looks stronger than that of the colliery (Leonard & Lebogang 2018).

Another case is the site of Canteen Kopje. Located near Barkly West in the Northern Cape Province, the site was discovered when a diamond prospector found a skull at the location in 1929. The site has been listed as a national monument since 1948 (Jones 2016a). The skull is currently regarded as very recent in age, representing modern human populations (Smith et al 2012). However, the site itself demonstrates a deep succession of different stone tool technologies (e.g. Forssman et al. 2010; Lotter et al. 2017). The site is so rich that the *eminence grise* of Stone Age archaeology, Abbé Breuil said of it: "Not only could you fill a museum with the artefacts from this site, but you could build one with them also" (Clark 1962). The stone tools document some very important technological innnovations in human history, including the very early development of prepared core technology. This way of making stone tools characterizes the Middle Stone Age and Neanderthal archaeology and appears across much of the world around 500-300 thousand years ago, probably as a result of multiple independent inventions (e.g. Adler et al. 2014). But at Canteen Kopje, it appears that development of prepared core technology started perhaps by 1 million years ago (Lotter et al. 2017). This illustrates the scientific importance of the site.

Despite the decades-long listing as a national monument, a permit for diamond mining at the site was issued in 2014 by the Department of Minerals and Energy. The South African Heritage Resources Agency (SAHRA) took action to prevent the mining taking place in the protected monument. In 2016, the order not to mine at the site was lifted suddenly, perhaps due to the exercise of political influence (Leader 2016). This happened without the archaeological permit holder and other stakeholders being informed (Ryan 2016). Over a long weekend, mining commenced and a large trench was dug across the site (Leader 2016). Dr. David Morris managed to obtain a police interdict to halt operations. The protected status is upheld by the court and the site was safeguarded from further destruction afterwards (Jones 2016b). The case further illustrates how different branches of government may be working at cross-purposes and how the impression to politicians that mining brings large rewards while preserving heritage does not may result in severe damage to heritage sites.

Discussion

On the face of it he interests of Heritage preservation and mining appear on the face of it to be naturally in conflict. Nevertheless, the large scale opening up of landscapes by extractive activities do yield opportunities for discovery and study of deposits otherwise scientifically largely out of reach.

Mining, Archaeology and Palaeoanthropology are part of a complex web of societal relations. I focus on the immediate interactions between, looking at where the two physically intersect. But these activities have influenced each other in a variety of ways. From personal connections of mining personell recognizing fossils and alerting scientists to them (Eitzman

[5] https://www.mcmining.co.za/our-business/operations accessed 18 May 2022

1958; Tobias 2007b) to more indirect relations, like gold-mining stimulating lime quarrying which in turn exposed rich fossil deposits (Esterhuysen 2019). There are even wider societal interactions between the mineral extraction and heritage sectors. Bonner has demonstrated how much of the research architecture involved in studying early human evolution in South Africa, so to speak putting the country on the map, was funded by income from gold mining (Bonner 2007). These interactions fall beyond the scope of the current paper, but they are no less relevant.

The immediate interactions between Archaeology and Palaeoanthropology on the one hand and mineral extraction on the other evolve through time. In the early 20th century when little knowledge on the deep history of South Africa (or indeed the world) was available, mining stimulated discovery. With the general frameworks established, research questions changed and more detailed knowledge of contextual information, recording of find position etcetera was required to further research goals. This means emphasis shifts from discovery to the destructive aspect of mineral extraction.

The mineral extraction sector has been an integral part of the South African economy for over a century. As legal protection of archaeological heritage gradually increased, mining activities were long exempted from responsibility to protect or study archaeological remains that were disturbed (Rudner 1982, Deacon 1993, 2015; Chirikure 2014). This changed from the late 1980s as archaeology was included in environmental impact laws, and the more strictly in the National Heritage Resources Act of 1999. With these developments, the requirement to mitigate the impacts of developments including mining was proscribed. And although mitigation may be a euphemism for "controlled destruction" in some contexts, these developments have led to an exponential increase in the amount of archaeological observations that are made, and have made (some) mining companies more mindful of their environmental and heritage responsibilities.

When Heritage sites are too highly valued to allow mitigation (i.e. excavation/documentation resulting in the permanent destruction of the sites), conflicts arise. Prior to the establishment of legal frameworks, protection was based on goodwill from miners and the influence of public opinion. The protection of the Caves at Sterkfontein while lime mining continued in the fossiliferous deposits exemplifies this. Currently, legal recourse is available to influence mining policy. The case of the UNESCO World Heritage Site Mapungubwe Cultural Landscape, shows that here, the legal framework may not always be advantageous. With the Park's buffer zone legally not well-established, public opinion and warning signs from UNESCO can be put aside legally. The case of Canteen Kopje demonstrates that different national departments have different priorities, but the dogged legal action of archaeologists and their mobilization of public opinion can result in the long-term protection of archaeological sites over mining interests.

The spectacular discoveries of hominin fossils and increasing understanding of the archaeological record have resulted in much scientific attention being directed on South Africa. The realization of the importance of the archaeological and palaeoanthropological finds in the country arguably play a role in increasing constraints on mining industry. Even though Apartheid Heritage policy was focused on the protection of built sites generally colonial in character, archaeological sites such as Canteen Kopje were protected as far back as 1948. And while the National Monuments Act allowed mining in the normal course of business to destroy archaeological sites, exceptions were made for caves and rockshelters, important repositories of archaeological remains.

Mitigation of environmental impact can be done by "offsetting" the damage of mineral extraction by investing in the creation of nature reserves elsewhere. For heritage sites, the mitigation tools are more limited. You can only really document and excavate sites before they are destroyed. But sponsoring can be a valuable additional tool to mitigate conflict (also see Chirikure 2014). This was described in the case of De Beers supporting the UNESCO status for Mapungubwe Cultural landscape. Nevertheless, it can also take the form of "greenwashing". Take for example Shell (formerly Royal Dutch, now PLC), which is one of the parties proposing to start fracking in South Africa's southwestern Karoo region. This would be damaging both from an environmental but also an archaeological point of view (Orton et al. 2016). Of course, Shell does not advertise this abroad. In the Netherlands, where it was headquartered until 2021, commercials highlight the company's desire to operate sustainably and the company is involved in sponsoring of museums showcasing heritage. And, via its sponsorship the company appears to influence content of exhibitions as well (Plets & Kuijt 2021).

Finally, this paper has been given from the perspective of an archaeologist. I have derided what I see as the false contrast between mining bringing profit and development versus heritage preservation hampering development and upliftment of communities. Nevertheless, Ndlovu (2012) and Chrikure (2014) raise the point that presenting archaeology as representing good practice does not do the situation justice. Ndlovu (2012) strongly argues that by engaging with African communities aimed at building broad support for the preservation of archaeological heritage, the archaeological discipline itself can be abusive and developers touting employment opportunities even in the short time may profit from Archaeology's lack of real societal engagement and lack of transformation of an originally neocolonial discipline (Ndlovu 2012, 262-263).

Some of the quotes in this paper hint at the problematic role archaeological and palaeoanthropological research has played in South Africa's history. There is talk of "questioning the natives" demonstrating the problematic relationships between researchers and Africans. The mining industry leading to such valuable scientific discoveries and whose profits were instrumental in building the research infrastructure of Palaeoanthropology and Archaeology (Bonner 2007) relied on the provision of cheap African labour. During Apartheid, most archaeologists were opposed to the regimes treatment of Africans. Yet for some reason archaeological knowledge of past African societies was not broadcast as relevant to living Africans and research on the African kingdoms in the country such as Mapungubwe never really reached the Black Consiousness movement (Shepherd 2019). The knowledge our disciplines produce on the origins of the Human Family, embodied by the Cradle of Humankind World Heritage site and on the origins of Modern Human Behaviour from around 200.000 years onwards embodied in another proposed World Heritage Site is still not always relevant for Africans (Esterhuysen 2019). This combined with the perceived idea that mineral extraction is more conducive to making money than Heritage tourism is plagues the scientific disciplines and should not be overlooked.

Conclusion

Mining discoveries provided insight in the richness of the South African palaeoanthropological and archaeological record. As it helped establish the basic chronological frameworks, ever more detailed research questions emerged. The effect of this is that archaeological and palaeoanthropological research questions require ever more fine contextual detail and the benefits of the efficient but destructive removal of great quantities of overburden lessened. And

the increased insight in the deep past afforded by mining has led to a re-evaluation of the value of archaeological and palaeonthropological deposits which has introduced legal and procedural frameworks and constraints for the mineral exploitation industry and introduces a greater potential for conflicting priorities between both activities.

The relationship is not this simple though. Mineral extraction was responsible for the emergence of important archaeological phenomena in South Africa such as the establishment of early kingdoms represented by the Mapungubwe Cultural Landscape. It was instrumental in the discovery of the spectacular evidence of human evolution and the development of human technological behavior preserved in South Africa. It was responsible for the establishment of much of the research infrastructure in South Africa and currently through the legally required commission of Heritage Impact Assessments, mitigation and sponsoring, this relationship is continued. The contradictory effect of mining's role in supporting archaeological and palaeonthropological research is that it led to constraints on mining activities itself in slowly increasing amount of protection of heritage sites even though mining interests often are still seen to prevail over the interests of preservation.

(Adler et al., 2014)

(Broom, 1913, 1937, 1938) (R.J. Gibbon, 2009; Ryan J. Gibbon, Granger, Kuman, & Partridge, 2009)

(Hodkinson, 1926) (Esterhuysen, 2019) (Cooke, Malan, & Wells, 1945)

(Rudner, 1982) (Tobias, 2007b)

(Raymond A. Dart, 1925) (Keith, 1925; Smith Woodward, 1925)

(Deacon, 1993; Shaw, 1939)

(G.L. Dusseldorp, Lombard, & Wurz, 2013) (R. A. Dart, 1925) (R. A. Dart, 1948) (Barbour, 1949) (Kuykendall, 2007) (Crawford, McKee, Kuykendall, & Conroy, 2004) (Clarke & Kuman, 2019) (R. Dart, 1957) (Brain, 1981) (Harmand et al., 2015) (R. A. Dart, 1927) (Tobias, 2007a) (Eitzman, 1958) (Grine, Jungers, Tobias, & Pearson, 1995) (Grün et al., 2020) (Barham, Llona, & Stringer, 2002) (Gerrit L. Dusseldorp & Lombard, 2021) (Henshilwood, 2012) (Langejans, Van Niekerk, Dusseldorp, & Thackeray, 2012) (Marean, 2014; Will, Kandel, Kyriacou, & Conard, 2016) (Deacon, 2015; Fourie, 2008; Humphreys, 1973) (Leader, 2016) (Ndlovu, 2014) (Dewar, Halkett, Hart, Orton, & Sealy, 2006) (Orton, 2012) (Klein, Cruz-Uribe, Halkett, & Hart, 1999) (Orton, 2007) (Van der Ryst & Kruger, 2007) (Shadreck Chirikure, 2014; Ndlovu, 2011) (Van der Walt, 2009) (Mudzamatira, 2019) (S. Chirikure & Mathoho, n.d.) (Anonymous, 2013) (Huffman, 2007) (Main & Huffman, 2021) (Meskell, 2011) (Leonard & Lebogang, 2018; Ndlovu, 2017) (Swanepoel, 2011) (Smith et al., 2012) (Forssman, Kuman, Leader, & Gibbon, 2010) (Li, Kuman, Lotter, Leader, & Gibbon, 2017) (Bonner, 2007; Clark, 1962; Esterhuysen, 2019; Plets & Kuijt, 2022) (Orton et al., 2016) (Ndlovu, 2012) (Shepherd, 2019)

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