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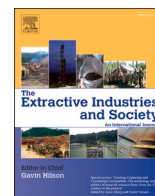
Original article

Between waste and profit: Environmental values on the Central African Copperbelt

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ABSTRACT

Industrial mining activity has transformed the environment of the Central African Copperbelt in the twentieth century. Copper extraction and processing altered the urban landscape, generated much waste, and caused severe long-term pollution. This article examines changing environmental values among diverse Copperbelt actors, including mine engineers, government officials, mineworkers, doctors, and farmers. Why were air and water pollution long accepted as 'negative externalities' of copper production? How have the environmental dynamics of mining on the Copperbelt been 'naturalised' over time? By focusing on topics such as air, water, health, cleanliness, and pollution, the tensions between the profit-oriented motives of mining companies, the technocratic solutions proposed by engineers, and popular concerns over human and environmental wellbeing are revealed. Although resignation towards industrial pollution on the Copperbelt prevailed for most of the twentieth century, views of environmental change were always contested and have changed recently. Relying on unique archival sources and interviews, this article shows changing attitudes towards copper mining in the Anthropocene.

1. Introduction

One of the most visible alterations to the Copperbelt landscape after a century of industrial mining activity is the presence of massive waste sites. On both the Congolese and Zambian side of the border slagheaps and tailings dams abound. These toxic dumps form a constant environmental hazard, as runoff water containing harmful chemicals seeps into surrounding streams and fine dust causes breathing difficulties among the region's population (Vranken et al., 2013; Ross, 2017; Peša, 2020). To manage waste sites, mining companies have commonly proposed technical fixes. In the 1950s, mine officials were aware that tailings dams contributed to river pollution, a problem that "was assuming alarming proportions" (NAZ, 1959). Nonetheless, in the 1980s Zambia Consolidated Copper Mines (ZCCM) engineers still professed this might be "effectively controlled" by covering the dams with slag (piling waste upon waste), "or by generating a vegetative cover" to create a more

"natural" look (ZCCM, 1984a). By claiming that toxic refuse could be rehabilitated, such views effaced all antagonism between mining and nature (Curtis, 2013; LeCain, 2017).

The economic value of waste was, furthermore, central to mining companies' waste management policies. Mine engineers stated that dumps "may be re-worked at some future date should this be economic", to recover valuable metal traces (ZCCM, 1984a). With improved processing techniques since the 1970s, dumps came to be "regarded as a mineral resource" (ZCCM, 1996). Waste was, thus, re-evaluated as profitable (Ofrias, 2017). High mineral prices after 2004 have enticed multinationals to industrially reprocess slagheaps, at Chambishi and Lubumbashi, whereas artisanal miners are recovering copper and cobalt from Kitwe's 'Black Mountain' (Zambia Daily Mail, 24 June 2017). Perhaps surprisingly, considering serious environmental hazards, the Copperbelt population has rarely demonstrated against waste sites. Lubumbashi's residents instead regard the 14.5 million tonne *terril*

(slagheap) as a landmark of industrial modernity (Jeune Afrique, 24 April 2014). The ways in which waste has been dealt with by mining companies, urban populations, and government officials on the Central African Copperbelt are revealing of particular environmental values (Liboiron et al., 2018). Mining companies have overwhelmingly proposed economic rationales or technological fixes for waste management, whilst mining communities have learnt to live with mining and pollution rather than protesting against it (Peša, 2020). This article explores these environmental values and argues that over the course of the twentieth century mining on the Copperbelt has been largely 'naturalised' – mining activities became a distinctive part of the urban environment, slag was used for roadbuilding and housing construction, whereas dump sites informed urban identity (Lora-Wainwright, 2017; Brock and Dunlap, 2018). Waste, in this respect, provides insights into the social relationships and cultural values of mining on the Copperbelt.

Through thematic examples, this article examines how environmental values have been established – and contested – on the Zambian and Congolese Copperbelt between 1930 and 2000. How have notions of 'waste' and 'profit' been construed? Did farmers have a different valuation of the Copperbelt environment than mineworkers? Using oral history and archival sources, this paper analyses the evolution of environmental inaction and action, highlighting forms of 'resigned activism' (Lora-Wainwright, 2017). When is arsenic viewed as an inevitable side effect of copper production and when does it become harmful pollution? How do mineworkers value a strong body and fresh air vis-à-vis monetary profit derived from mining? Foregrounding diverse attitudes towards environmental change on the Central African Copperbelt, this article traces how particular environmental values emerged and became hegemonic. Before the 1990s, technological optimism and economistic valuations of the Copperbelt environment appeared prevalent among mining companies, government officials, and the urban population. Yet rather than assuming the stability of such views, which have in any case been seriously challenged in the last decade, I seek to understand "the origins, articulations and ideologies of conflicts over nature" (Guha and Martinez-Alier, 1997, p. XXI). In depicting Copperbelt environmentalism, this article traces narratives on air, water, health, cleanliness, and pollution. It underlines that "struggles over resources … have always also been struggles over meaning" (Ibid., p. 13).

2. Environmental Histories of Mining on the Copperbelt, 1900-1990

The Central African Copperbelt region holds exceptionally large and high-grade copper deposits, as well as mineral reserves of cobalt, zinc, uranium, and gold. At the end of the nineteenth century, imperial rivalry over these resources divided the area between British Northern Rhodesia and Belgian Congo (later Zambia and D.R. Congo respectively). Industrial mining started in Élisabethville (Lubumbashi) in 1907, whereas Luanshya was the first large-scale copper mine to be developed in Northern Rhodesia in 1928. By the 1940s the Copperbelt had become a massive cross-border urban cluster, as the mines attracted a diverse population (mineworkers, traders, farmers, and others) of hundreds of thousands. The open-pit and underground mines had a transformative impact on the surrounding environment on many levels (Ferguson, 1999; Dibwe dia Mwembu, Donatien, 2001; Larmer, 2016).

The political, economic, and social history of the Central African Copperbelt in the twentieth century has been closely entwined with copper mining. The prospects of rich copper deposits spurred imperial expansion, copper mining funded colonial and post-colonial rule, rivalry over copper profits informed occasional violent conflict, while the collapse of copper prices in the 1980s and 1990s caused dramatic socio-economic decline. Colonial mining was in the hands of the giant *Union Minière du Haut-Katanga* (UMHK) in Congo and of Anglo American and the Rhodesian Selection Trust in Northern Rhodesia. While Northern Rhodesia's vocal trade unions played a major role in advocating for independence, quarrels over mining revenues were at the root of the

Katangese secession (1960-1963), which followed Congolese independence. Struggles to appropriate copper revenue motivated the (partial) nationalisation of mining, through Gécamines in 1966 and ZCCM after 1968. With the collapse of copper prices after the mid-1970s, the Central African Copperbelt went through decades of crushing economic crisis. World Bank loans in the 1990s enabled continued mining but also encouraged the privatisation of the mining industry, with new investors from across the globe attracted to the Copperbelt region, particularly since the spike in copper prices in 2004 (Larmer, 2016; Kesselring, 2018; Caramento, 2020; Rubbers, 2020). How this well-known history is entangled with environmental change remains little researched. It is plausible, for instance, that nationalised mining companies would have focused on maximising profit, dismissing pollution and environmental damage as inevitable side-effects of a flourishing industry. Through thematic examples, this article asks questions about environmental perceptions among diverse actors with differing views. When, why, and by whom is mining waste either viewed as a normal feature of urban modernity or regarded as a dangerous contaminant? Such questions are inseparable from issues of socio-economic wellbeing and political power (Peša, 2020).

Industrial copper mining has drastically reshaped the landscape of the Zambian and Congolese Copperbelt. The mines have moved millions of tonnes of earth, altered the course of rivers, and changed the composition of the air (Odell, Bebbington, and Frey, 2018). Irrespective of these profound changes, environmental aspects of copper mining were mostly overlooked until the 1990s. Copperbelt historiography, government and mining reports, and even accounts elicited through oral history seldom reflected on environmental change (Frederiksen, 2010; Vranken et al., 2013; Ross, 2017; Peša, 2020). Those narratives that did comment on environmental issues tended to 'naturalise' the effects of mining: government officials and mining companies tried to engineer environmental harm away through techno-scientific fixes, or subordinated environmental protection to a cost-benefit analysis, while mining communities silently learnt to live with pollution (Bridge, 2004; Lora-Wainwright et al., 2012; Ofrias, 2017). Demonstrating the prioritisation of profit over pollution control, ZCCM engineers in the 1970s maintained that due to the "unique role" of mining "in the national economy", "the industry has a duty to restrict its expenditure on the non-productive, usually costly, means of controlling pollutants so that the nation is not needlessly deprived of essential revenue." Moreover, officials professed: "Fortunately, Zambia's air and water still remain largely uncontaminated by industrial wastes" (ZCCM, 1970). The glaring visibility of mining-induced environmental change on the Copperbelt was accompanied by a peculiar invisibility in historical representation. This paper traces how such an attitude towards the Copperbelt environment came into being and was consolidated before 1990.

This article is based on archival research, utilising unique and little explored sources in Zambia (National Archives of Zambia (NAZ) and ZCCM archives), Brussels (UMHK papers and *archives africaines* (AA)), and D.R. Congo (Gécamines archives in Lubumbashi and Likasi (GECLUB and GECLIK)). These mining archives contain technical correspondence, annual reports, and engineering bulletins, in addition to newspaper articles and trade union minutes. To contextualise the views of mining companies and policy correspondence, I draw on more than 100 oral history interviews with long-term Copperbelt residents conducted between May and August 2018. In Likasi and Mufulira, mineworkers, engineers, menial workers, but also tomato vendors, nurses, and teachers were asked about their views on the mining industry, pollution, and urban environmental change. These interviews provide insights into popular perceptions of mining and its environmental impacts on the Copperbelt. Of course, both the documentary and oral evidence contains silences and distortions. Mining companies might have obscured the extent of environmental harm caused by their activities, newspaper reporting was often influenced by political allegiances and rarely criticised ruling powers, while oral accounts of historical

pollution are coloured by recent mediatised pollution scandals. Nonetheless, piecing these sources together allows a focus on changing environmental thought among diverse Copperbelt actors.

Copper mining, according to LeCain, involves 'mass destruction' of the environment (LeCain, 2009). Ross (2017, p. 137) acknowledges that mining "has perennially been one of the dirtiest of all industries." Still, its role "in transforming regional environments remains underexposed." Excellent works on the environmental history of mining have been published recently (Curtis, 2013; Kirsch 2014; McNeill and Vrtis, 2017; Leech, 2018), yet these rarely focus on Africa (exceptions are McCulloch, 2002; Hecht, 2012). Very few historical studies have examined the environmental aspects of mining on the Copperbelt (exceptions are Schumaker, 2008; Frederiksen, 2010; Ross, 2017; Peša, 2020). Considering the impact of copper mining, processing, and waste handling on the Copperbelt environment, such absence is remarkable (Brion and Moreau, 2006; Frederiksen, 2013). Archival records and oral history indicate that mine managers, government officials, and Copperbelt residents were fully aware of the mining industry's adverse environmental impacts, but that these were downplayed or dismissed, especially until 1990. In order to understand how such environmental values came into being, the following sections first discuss issues of air; water and waste; health; cleanliness and pollution. The conclusion assesses how heightened attention for the environment in the 1990s had its roots in earlier environmental values, which were only partially challenged (Fraser and Lungu, 2006; Mazalto, 2010).

Frederiksen and Himley (2020, p. 59) argue that by "radically redefining livelihood possibilities" and "reshaping lifeworlds", extractive firms "contribute to processes of subject (re)formation." In support of this claim, I draw inspiration from environmental psychology and its focus on environmental values and worldviews (Steg and de Groot, 2012). Values "structure and guide specific beliefs, norms and attitudes" and environmental values thus inform appraisals of and reactions to environmental change (Ibid., p. 10). Through their values and behaviour, individuals actively influence environmental change. It is therefore crucial to understand the historical development of environmental values and how these have spurred particular behaviour, from the environmental management practices of the mining industry, to national legislation, and environmental protest. After all,

> the way we think about environmental risks, problems, and environmental quality profoundly influences the decisions we make, the environments we design and build, the intervention strategies and solutions we initiate in the face of perceived threats, and how we experience, respond, and adapt to our … environments. (Gifford, Steg, and Reser, 2011, p. 459)

By closely studying the discourses in archival documents, newspapers, and interviews, changing environmental values can be traced over time. This paper draws attention to the divergent interests behind the production of environmental knowledge, as how different actors "utilize, transform, and protect the environment is shaped by how they understand it" (Turner, 2011, p. 25).

3. Air

Notions of pollution are particularly crystallised in debates about air (Thorsheim, 2006). Mining companies, government officials, and Copperbelt communities had divergent conceptualisations of smoke and varying attitudes towards smoke abatement. Discussions show different valuations of technology and highlight the contested meaning of concepts such as cleanliness and profit. Documents on air pollution from the 1930s and 1980s reveal that Copperbelt mining companies consistently prioritised production and profit over environment and human health. Still, Copperbelt residents did complain about smoke and its effects on their bodies and homes. While government legislation initially condoned the mines' right to pollute, regulations became much more

stringent from the 1980s onwards. This section explores changing attitudes towards air pollution on the Copperbelt.

In a 1936 study on the fumes from Lubumbashi's smelter, UMHK engineers examined the possibility of recovering noxious sulphur dioxide to produce sulphuric acid, a substance which facilitates copper refining. Monthly, 2,500 tonnes of sulphur dioxide were emitted in Lubumbashi, but still colonial engineers dismissed complaints about "the inconvenience of the fumes" as "strongly exaggerated." Although UMHK managers could have minimised the smoke nuisance using chemical methods or by building a higher chimney for dilution, they instead proposed to transfer operations and "desulfurise the minerals in" the small town of Kipushi where "the risks of criticism are less severe" than in Lubumbashi (UMHK, 1936). Evidently, mine officials were aware of the environmental impacts of copper extraction and processing. In this instance, however, the imperatives of production superseded the environmental disruption experienced by surrounding communities. On the Northern Rhodesian Copperbelt, the Smoke Damage (Prohibition) Act of 1934 reveals similar priorities. This act decreed that, notwithstanding the degree of pollution, within a circle of 5 miles of a copper smelter nobody would be allowed to claim damage from smelter operations. Representatives of the Rhokana Corporation in Luanshya asserted that land was "taken up by the public with the full knowledge of the actual disabilities arising from the proximity of the smelter", and moreover claimed advantages of "proximity to an industrial centre" (NAZ, 1936). In 1937 Rhokana pleaded that:

> the persons owning … the plots in Luanshya township … are really not morally entitled to any protection as against the Mining Company for emitting smelter fumes. … The danger to be guarded against is that some plot holder may abuse the existing unreasonable state of the law by harassing the Mining Company with a view to plundering without mercy. … [If a legal claim] resulted in the smelter being closed down even for a short period the result would be harmful to the whole Territory and such a state of affairs obviously should not be allowed under any circumstances whatever. (NAZ, 1937)

Such legislation evinces that the maximisation of production and profit were the guiding principles of the mining industry at this time and that government agents were willing to protect the mines against environmental damage claims. Instead of taking the hazards experienced by the Copperbelt population seriously, company officials dismissed complaints about pollution as attempts at "legalised brigandage" (Ibid.). Such attitudes proved remarkably persistent throughout the twentieth century.

This becomes evident in discussions about smoke abatement in Zambia in the 1970s and 1980s. ZCCM representatives commonly adopted one of three approaches towards air pollution: downplaying its severity, proposing technological fixes to curb emissions, or calculating the economic costs and benefits of smoke abatement measures. In the 1970s, even as Mufulira and Luanshya's smelters discharged sulphur dioxide directly to the air, engineers asserted that emissions did not "produce any ecological ill effects" and that "serious pollution levels or events have not been recorded" (ZCCM, 1984a). Perversely naturalising the Copperbelt mining industry, ZCCM representatives praised nature for diminishing the ill effects of smelter fumes. Engineers stated that due to "favourable climatic and geographical circumstances … prevailing winds will normally carry the fumes away over open country" (ZCCM, 1972). Occasional air pollution monitoring was put in place in 1970s Zambia, but standards for air quality control or enforceable legislation were still lacking (ZCCM, 1984a). In Luanshya in 1976 the "adopted maximum was ... exceeded on five separate occasions", indicating substantial air pollution, but officials still concluded that "averages are not – on the whole – excessive" (ZCCM, 1976). To combat sulphur dioxide emissions, mining engineers proposed technical solutions. Tall smoke stacks were built, but more importantly sulphur dioxide was captured and converted into sulphuric acid "to meet the industry's requirement."

This acid could be used to recover copper from low grade ores, which made the process "economically attractive" (ZCCM, 1984a). ZCCM framed pollution control in an economic logic of reclamation. Engineers designed new acid plants ("costly capital ventures") not only to reduce sulphur dioxide pollution, but more importantly to increase revenue by boosting copper production. In a balancing act between economic and environmental considerations, the mining industry subordinated smoke abatement to profit.

Throughout the 1990s, air pollution continued to be discussed as an issue of concern by various Copperbelt actors. Even critical voices tended to replicate the economic arguments and technological optimism of mining companies. In 1997 Mufulira smelter still had "no sulphur dioxide abatement facility", resulting in monthly sulphur dioxide emissions of 5,000 tonnes (ZCCM, 1997). Newspaper articles remarked that this would surely result in "danger to lives of people and animals" (Times of Zambia, 25 January 1993). Air pollution caused respiratory problems and made it difficult for vegetation to grow around smelters. Despite concern over this situation, journalists still favoured economic profit over environmental regulation, as "the economic life of the nation needs to continue." Enforcing strict air pollution standards would mean that "some industries like the mines in Zambia would be shut down" (Zambia Daily Mail, 7 July 1993). Due to economic difficulties, international pressures, and looming privatisation, ZCCM made pledges to change operational practices and reduce emissions after 1990. Yet stricter environmental standards and new abatement technology were only adopted haphazardly (ZCCM, 1997). Although laws did exist to curb air pollution, the problem proved very difficult to control. Newspapers blamed government agencies for adopting a "lukewarm approach" to this "potentially explosive issue" of "unchecked emission of toxic substances" (Zambia Daily Mail, 20 April 1995). Critiquing long-standing denialism and inertia, an opinion piece concluded that, "What is worrying is the general lethargy towards" Zambia's environmental problems "which continues to this day" (Times of Zambia, 19 January 1992).

Mufulira and Likasi residents have long acknowledged problems of air pollution. Today, *senta* and *kachoma* (sulphur dioxide emissions in Bemba and Swahili respectively) are much discussed. In certain neighbourhoods, such as Mufulira's Kankoyo or Likasi's *Usines Chimiques de Shituru,* located downwind from smelters or chemical plants, such emissions have caused serious hazards and recurrent complaints. Sulphurous smoke evokes a sharp choking sensation in one's lungs. It furthermore causes abnormally high rates of pulmonary diseases and skin rashes, wilted vegetation, and the corrosion of roofing materials (Copperbelt Environment Project, 2002). Instead of outright protest, smoke more often elicited 'resigned activism', which Lora-Wainwright (2017, p. 14) explains as the "processes through which pollution comes to be regarded as a normal and unavoidable part of the natural environment", as well as people's routine efforts "to counter or avoid pollution." In this vein, women would move agricultural fields several miles away from the smelter to evade emissions, mine management would transfer workers with signs of bronchitis to a purportedly 'dust free' environment, whereas urban residents showed much trust in the newest smoke abatement technologies (Interviews conducted by author, Likasi and Mufulira, May-August 2018). Mining communities tied air pollution to notions of 'development', as economic welfare (in the form of smoking chimneys and fully-operational smelters) was expected to ensure communal welfare. Smoke was in this context accepted as an inevitable side effect of employment and economic prosperity (Aiken, 1994). Congolese mineworkers referred to sulphur dioxide emissions as "the cough that comes from the mine" (*kikozi ya ku mungoti* in Swahili), which signals their awareness that pulmonary diseases originate from mine work (Personal communication, Donatien Dibwe dia Mwembu, Lubumbashi, 23 July 2019).

This resigned attitude has been changing, following recent mediatised pollution cases, including the death of Mufulira's District Commissioner after inhaling sulphur dioxide fumes and the protests this prompted (Lusaka Times, 18 October 2013). Most respondents identify air pollution in its current form as a new phenomenon. Even if previous technologies to control air pollution were less effective than they are today, Mufulira and Likasi residents claim that current levels of air pollution are much worse than they were in the 1960s. A Zambian newspaper article laments that there is no "remedy in sight because the corporate world seems to have more respect for their profits than human health" (Lusaka Times, 2 May 2012). Apart from actual emission levels or heightened environmental awareness, this more critical stance is likely informed by the privatisation of the Copperbelt's mining companies since the 1990s. The job losses and downsizing of paternalistic welfare services that neoliberalism entailed, opened up a space to freely express historically lingering environmental grievances (Ferguson, 1999; Rubbers, 2013). The framing of air pollution within an economistic cost-benefit equation or as being amenable to technological fixes, however, proved remarkably tenacious.

Copperbelt air pollution seems to provide a straightforward case of business interests and technological hubris trumping environmental concerns. Yet looking at the examples from this section reveals that there has been disagreement and dissent as well. Environmental values were contested, even as economic profit and technological optimism appeared overriding. From the Smoke Damage (Prohibition) Act in the 1930s, through to the environmental regulations of the 1980s, a variety of actors have discussed air pollution, explored options for abatement technology, and assessed the value of clean air. Disputes over water were even stronger than those over air, and provide additional insights into environmental consciousness on the Copperbelt.

4. Water and Waste

Severe water pollution, perhaps because of its immediately disruptive effects, has provoked more opposition than the generally 'slow violence' of air pollution (Nixon, 2011). On both the Congolese and the Zambian side of the Copperbelt border residents have repeatedly, and on occasion successfully, mobilised to secure potable water. One early report from the Congolese Copperbelt shows, however, that mining companies and water users did not always agree about priorities when faced with a choice between raising profits and securing safe water sources.

In 1931, UMHK management commissioned an investigation into water pollution caused by copper refining in Jadotville (Likasi). Chemists scrutinised the effects of the city's processing plants on the surrounding rivers. Copper refining discharged tonnes of tailings (residues of stones, sand, and mud) into the rivers. Palm oil, sodium carbonate, and sulphuric acid were also among the effluents. Tests showed that such materials were lethal to vegetation and animal life and that copper processing had disruptive effects on fishing, forestry, and agriculture for many kilometres downstream from the plants. However, instead of paying attention to the environmentally damaging effects of mining, the study was primarily concerned with recovering the tailings, as these contained up to 4% copper content. Engineers recommended to build a dam to retain copper content more efficiently, thereby turning harmful residues into economic profit (AA, 1931). Although this report shows that mine management produced considerable knowledge about the effect of chemicals and pollution, the imperatives of profitable production clearly overruled environmental concerns.

Four decades later a remarkably similar attitude prevailed. Gécamines conducted water pollution analyses from 1965 onwards, yet there are few signs that action was taken if test values exceeded permissible maximum levels. A 1968 trade union report noted that water in the Panda river had been severely polluted and that a new purification system was necessary to render water potable, but management rejected this option as it would entail high installation costs (GECLUB, 1968a). Yet profit was not always privileged over potable water, as mining communities occasionally did challenge the industrial pollution of water sources.

A major pollution incident on the Zambian Copperbelt resulted in a court case in 1981. Farmers complained about the loss of 223 cattle, 51 sheep, and 135 goats from metal poisoning on various farms along the Mwambashi river. The farmers claimed "a past history of cattle death due to pollution from the Chambishi mine" (ZCCM, 1982a). In January 1981 there had been an emergency spillage from the effluent pump at Chambishi, but the mining company countered that cattle death was unrelated to this event as "water tested from the Mwambashi River showed <u>acceptable</u> levels of copper and cobalt." On the other hand, the mud from the river banks did indicate "a very high level of copper, cobalt and manganese." According to the mining company this could not be related to the spillage incident, as "the public water flowing in the Mwambashi River has not been polluted by mining activities." Mining companies staunchly denied blame:

> There is ample evidence that the animals that were affected by copper poisoning drank water after disturbing the mud in the river and river banks. The only act being revealed as giving rise to a state of pollution is that of the animals themselves. It is common knowledge that river bed sediments contain all kinds of minerals. Hence the necessity for abstracting or impounding water to avoid ingestion of impurities. (Ibid.)

The mining company carefully phrased its environmental liabilities and called on the Natural Resources Board to "regulate the use of water in this mineralised area." Rather than taking responsibility, company officials shifted blame to the farmers and their animals, asserting that problems had been caused by letting cattle drink freely from the river which disturbed the mud: "the farmers who rear animals are expected to observe good husbandry practices … farmers have, by their very act created a state of pollution" (ZCCM, 1982b). Unexpectedly, the farmers won the court case against the mine (Interview with Joseph Makumba, Kalulushi, 21 August 2017). This example illustrates claims and counterclaims of environmental pollution caused by industry.

Recent cases of water pollution have similarly caused public outcry. In 2016 an acid truck overturned in Likasi, spilling almost 1,000 m^3 acid into the Panda and Mura rivers. This incident destroyed fields and fish ponds and made water unpotable for months afterwards. Several people who had drunk the water were hospitalised and the acid burnt the skins of those who had bathed in the river. This "enormous environmental disaster" did not provoke much response from the Congolese government, which was too enthralled with upcoming elections and governance difficulties to act decisively, leaving some of Likasi's residents feeling "abandoned", as they told the press (Code 243, 22 February 2016). Nonetheless, thirty cultivators joined forces to sue the Chinese mining company for polluting their fields. The cultivators claimed monetary compensation, but Gécamines officials responded that they would await the official investigation before acting – causing indefinite delays (Radio Okapi, 18 February 2016). Mining companies' power to define what constituted cases of 'wilful pollution' was thus far from upset.

Perspectives on 'waterscapes' have highlighted that there are no clear divisions between society, technology, and nature, as "society and nature are always intertwined to produce hybrid socionatures" (Karpouzoglou and Vij, 2017). Such an understanding of water draws attention to aspects of power, by asking who controls and who acts on water's flows, and how social and environmental inequalities are created. How water is managed is deeply politicised and contested (Swyngedouw et al., 2002). Disputes over clean water on the Copperbelt have evoked popular mobilisation and reveal tensions over environmental values, between the profit-oriented objectives of mining companies and residents' priorities of drinking water and fertile fields. Contestations over water at the same time show that urban residents have occasionally been co-opted into the productivist values of mining companies. After more than a century of mining activity, few mineworkers would today prioritise vegetable harvests over mineral

production. Still, this co-option has been challenged in cases of catastrophe, when mining communities openly criticised industrial pollution. Looking at health similarly illustrates that Congolese doctors generated alternative knowledge about pollution, but at the same time subscribed to Gécamines' ideals of a healthy and productive workforce.

5. Health

The medical files of the Gécamines department *Médecine du travail* are an exceptional source for understanding environmental value formation on the Congolese Copperbelt in the 1970s and 1980s. Gécamines thoroughly researched the effects of mining-related professions on worker health. Doctors were aware of occupational diseases such as silicosis and lead poisoning, and they examined the effects of toxic substances (arsenic, cadmium, and mercury) and heat exposure on workers' bodies (Dibwe dia Mwembu, 1990). Yet even this knowledge was underpinned by objectives of production. In determining environmental hazards and appropriate responses, *Médecine du travail* reports weighed worker health against productivity and profit. Gécamines direction proclaimed that medical services were designed to "lead to an improvement in productivity" (GECLUB, 1974). The activities of medical practitioners improved working conditions and worker health, but equally aimed to raise copper output by ensuring that workers would not lose days of work (GECLUB, 1982).

Espousing this productivist attitude, a Gécamines doctor in 1974 recognised pollution as a cause of occupational diseases but still maintained that, "to secure production, industries are obliged to accept these permanent risks" (Maadini, 1974). The medical department generated knowledge on health, disease, and environmental risks, yet it suffered from a lack of independence from Gécamines management. Medical practitioners lamented that *Médecine du travail* "does not have real budgetary or administrative autonomy", which "hampers the elaboration of multidisciplinary projects in the interest of the worker and the Company" (GECLIK, 1988). In 1987, a doctor complained that at Gécamines there "is a problem of mentality [as] each activity that is marginal to production", including medical services, "is badly viewed" (GECLIK, 1987). Even when knowledge about the environmental ill effects of mining on health existed, this knowledge was rarely made public. In some instances, medical research purposefully manufactured doubt about the environmental effects of mining (Auyero and Swistun, 2008). A 1984 report examined the high incidence of bronchitis at the *Atelier Central de Panda*, concluding that "undoubtedly air pollution in the workplace played a role." Nonetheless, this did not prompt a change of policy as allergies, smoking, and age could equally contribute to increased rates of bronchitis (GECLIK, 1984). Medical knowledge, thus, in some cases contributed to making pollution invisible (Rayner, 2012). Through such tactics mining companies entrenched priorities of production and profit, accepting occupational diseases as a 'negative externality'.

In discussions about dust and silicosis, medical practitioners and mine management systematically downplayed environmental hazards, even when these posed real risks to worker health. They did so by generating doubt, by favouring 'expert' over worker knowledge, and by individualising risk (Waters, 2019). To give an example, in 1969 the 'Katangese legislation' was revoked, which had "classified all workplaces where there was a risk of contracting pneumoconiosis as eligible for claiming damages." Instead, it was henceforth the task of the medical inspector to "determine whether a workplace put a worker at risk of contracting silicosis" (GECLUB, 1969b). As long as authorities did not formally recognise a mine as a "silicosis zone", "all diseases, even silicosis, will be considered as non-professional diseases" (GECLUB, 1968b). The intermediation of 'expert' judgement could not only overrule workers' grievances and disease symptoms, but also deprive workers of the right to object to dusty working conditions – leaving them with a choice to accept environmental hazards or quit their jobs.

Apart from expert control, Gécamines also tried to individualise

environmental risks by making issues of health and safety the responsibility of workers rather than mining companies. Company management claimed that "safety at work is one of our major preoccupations" (GECLUB, 1975). Gécamines urged workers to follow "appropriate individual protection measures." Risk, concomitantly, became an individual burden. Threatening disciplinary action, management stipulated that "the worker has the obligation to use the means of protection put at his disposition by the employer" (GECLUB, 1978). An inconvenience allowance for unhealthy working conditions existed at Gécamines, but "this is only paid if the employer is satisfied that the worker has respected work guidelines given to him. The employer can cut the daily allowance for the poor execution of work or for failing to follow directives" (GECLUB, 1977). Collective mining-related risks, from dust or falling rocks, were individualised through regulations which made individual protection measures, such as hard hats and dust masks, obligatory. Company officials thereby tried to minimise workers' compensation claims and protest, hence securing the long-term viability of copper extraction.

Gécamines' medical services archives, containing correspondence between workers, medical personnel, and mine management, provide unique insights into environmental value formation. To mine managers, medical services and work safety measures served a legitimising purpose, underlining "the credibility of Gécamines as one of the principal motors of national progress" (GECLIK, 1988). During the 1970s and 1980s, mine management tried to superimpose a discourse of production onto medical and environmental issues. In some cases, work accidents and their causes were silenced to maintain production and maximise output (Peša, 2020). Yet by consistently underlining the gravity of occupational diseases and by advocating for proper patient care, medical practitioners provided a counter-discourse. Even when they were co-opted into the productivist logic of mining companies, doctors continued to value health over profit. Workers, too, sought ways in which to express their grievances and gain compensation. While their struggles were often ineffective, their pleas for individual dust masks, clean drinking water, or aprons reveal a set of alternative environmental values.

6. Cleanliness and Pollution

Residents of Likasi and Mufulira eagerly discussed topics of cleanliness, urban order/disorder, and pollution in oral history interviews. Men and women also reflected on how these issues had changed over time. Jacques Magenda (Interview, Likasi, 7 June 2018), a Gécamines chemist, recalled that in the 1950s and 1960s, "Likasi was called Congo's prettiest town." This aesthetic was closely related to cleanliness and urban order. In Mufulira and Likasi colonial and early post-colonial mining companies maintained elaborate waste disposal and public cleaning services. State-owned companies Gécamines and ZCCM collected rubbish, made sure that roads were swept, and that ditches would not overflow during the rains (Rubbers, 2013; Peša and Henriet, 2021). Residents praised these attempts to enforce cleanliness, arguing that this contributed to urban 'order'. Valérienne Ngoye (Interview, Likasi, 9 June 2018), a welfare worker in Likasi, recalls, "inspectors would come to sensitise us about cleanliness. If we did not keep our house clean, we would be sanctioned. They would confiscate our ration tickets. ... This was a good system." 'Cleanliness' and 'beauty' were, thus, maintained through pervasive social control. Although some welcomed this control as contributing to order, Euphrasie Joa (Interview, Likasi, 14 June 2018), married to a mineworker, grudgingly recounted that "agents would perform unannounced visits to check if the houses were clean".

In the *foyers sociaux* (welfare centres) of Likasi, workers' families would be trained in how to maintain cleanliness, how to keep their house, and how to sweep their yard. Just as with worker health and safety, notions of cleanliness were individualised. While ZCCM and Gécamines assumed some of the tasks of urban maintenance, cleanliness

competitions such as those held in Mufulira, where the best-kept house would receive a prize (a cooking pot or new clothes), encouraged individual responsibility for urban order (Interview with Patson Katwisi, Mufulira, 3 July 2018). If workers' wives did not maintain cleanliness, their husbands' salaries would be cut, Ngoye attested. Agents of Gécamines' *hygiène et sécurité du travail* department and trade unionists were tasked with "promoting a spirit of prevention among workers with regard to matters of work accidents and diseases." But their duties extended beyond the workplace, as they could "insist on measures of safety, hygiene and health in workers' camps" (GECLUB, 1969a). Due to this company-imposed aesthetics of order and the individualisation of cleanliness, interviewees hardly ever complained about past dirt, urban disorder, or pollution. In both Mufulira and Likasi interviewees maintained that their towns had been clean in the 1960s and 1970s: company officials would collect garbage, paint their houses, and tidy the communal showers. Disorder only prevailed outside the workers' camps, as in Kikuula, the *cité* of Likasi, where residents themselves had to organise public cleaning and house maintenance. Paternalistic welfare provision thus took away workers' grievances with regards to dirt and pollution, subsuming them in an outward aesthetics of order and cleanliness (Rubbers, 2013; Larmer, 2016).

This changed radically in the late 1980s and especially in the 1990s. Due to financial difficulties, Gécamines and ZCCM could no longer maintain elaborate urban cleaning services. Jacques Kibombo (Interview Likasi, 11 June 2018) hence critiqued the inability of Gécamines to uphold Likasi's beauty. After the company's economic collapse, Kibombo regrets:

> … everything changed in 1990 … nobody cared for the roads or public lighting anymore … When Gécamines experienced hardship, so did Likasi. Before, you even had to wait for a company agent to trim your hedge, but now there are no more agents in charge of cleaning. … As long as Gécamines does not wake up, we will endure this situation.

Mufulira's residents equally complained that the distinction between workers' camps (Kantanshi) and council neighbourhoods (Chibolya) had faded. Levi Chushi (Interview, Mufulira, 6 July 2018) remarked:

> Previously Kantanshi had been well kept, company agents would maintain our houses and make sure the roads were passable. Today, Kantanshi has become just like Chibolya. For sure, if you make an effort to maintain your house yourself, you can. But otherwise, dirt is everywhere and people just throw rubbish anyhow. This has caused diseases; people are getting ill. It never used to be like this.

With the neoliberal disappearance of social welfare services previously provided by the paternalistic mining companies, residents of Mufulira and Likasi felt more inclined to complain about issues of pollution and waste. Nostalgic reminiscences of beautifully maintained lawns in the era of Gécamines and ZCCM had narrowed the space for images of dirt and disorder (Mususa, 2010). Yet after privatisation when the new mine owners continued to focus on production and profit, but without providing housing, education, and healthcare, workers felt entitled to protest against overflowing gutters, muddy roads, and dirty water sources. Notions of cleanliness and pollution had been tied to paternalistic welfare policies and reflected a dependency on the income provided by the mines (Ferguson, 1999; Bakker, 2010; Rubbers, 2013). Once this disappeared, mining communities started complaining about waste and pollution, even if actual pollution levels had perhaps not increased significantly at all.

7. Concluding Remarks

This article has examined environmental histories of the Copperbelt through examples related to air, water, health, cleanliness, and pollution. Following LeCain (2017, p. 279), this paper has explored how once

"copper is embedded into the built environment, it shapes how people act and think in unexpected ways." I have sought to explain how particular environmental values on the Copperbelt emerged and changed over time. By unpacking notions such as 'profit' and 'waste', and showing the contested understandings of technological hubris or economic rationality, this article has explored the environmental values of mining. "Copper was no mere 'raw material' that" Copperbelt residents "used to construct an abstract, *a priori* idea of modernity out in the real world – it was the very stuff from which those ideas were forged" (Ibid., p. 274).

The ideas this paper has explored were contested from the 1990s onwards. A rapid change of policy occurred in the 1990s in Zambia, and in the 2000s in D.R. Congo (Mazalto, 2010; Peša, 2020). Various forms of protective legislation, standards, and monitoring bodies were installed and all mines compiled Environmental Impact Assessments from the 1990s onwards. This had to do with international pressures and the economic malaise of Copperbelt mining companies. Low world copper prices caused plummeting production figures and spiralling debts, which forced ZCCM and Gécamines to take out World Bank loans to get by. Loan conditionality stipulated that mining companies had to have environmental regulations in place (Fraser and Lungu, 2006; Borowy, 2014). Privatisation further spurred mining companies to draw up Environmental Impact Assessments, as new investors were wary to take on environmental liabilities (McCullough, 2017). Among Copperbelt mining companies, this propelled a wholesale discursive shift on environmental management issues. In the 1992 Environmental Policy Statement, ZCCM defined itself as a "green mining company", which "does not see an irreconcilable conflict between mining activities and the protection of the environment." Managers asserted the necessity of "a sustainable balance between the generation of wealth and the protection of the environment" (ZCCM, 1992).

Nonetheless, an economic rationale continued to motivate environmental management, as Zambia's environmental problems "could become a major constraint upon continuing development" (ZCCM, 1984b). Knowledge about the environmental effects of mining activity became more visible in Zambia and Congo in the 1990s. On paper, there was a remarkable change in environmental management practices, through new laws and regulations. Yet the environmental issues that were discussed, as well as the solutions proposed to manage these, were not so different from earlier periods (Frederiksen, 2019). Entrenched economic and technical representations of environmental change persisted, making it difficult to effectively address pollution (Peša, 2020). Mining companies continued to approach environmental issues in a primarily economistic and technocratic manner, by trying to combine pollution control with profit generation, or by advocating the newest engineering solutions. This period was not a simple turning point in Copperbelt environmental values.

Among the Copperbelt population throughout the twentieth century, resignation towards industrial pollution has been more common than protest. As the examples of water pollution or sulphur dioxide emissions suggest, pollution did not automatically generate demonstrations, even after 1990. The long-standing environmental values on which Copperbelt modernity was built had not been upset by the privatisation of Gécamines and ZCCM. Perhaps this is the specific Copperbelt manifestation of the Anthropocene, a fixation on technology and profit rather than on human and environmental wellbeing (Hecht, 2018). Yet, as this article has argued, such values had never remained stable or uncontested. Alternative appreciations of environmental change, by medical practitioners or farmers who suffered livestock loss, destabilised priorities of economic growth. Especially as neoliberal policies have ruptured the social contract between mining companies and Copperbelt communities, causing job losses and general precarity, protest over pollution is likely to become more prominent. In 2019, after years of campaigning, farmers in Chingola were allowed to pursue a legal claim against Vedanta in a London court over polluting their fields and water sources (The Guardian, 10 April 2019). Protest has become more vocal and, in some cases, effective. Stricter environmental regulations might equally succeed in curbing harmful pollution. Historical trends, nonetheless, suggest that change will be haphazard.

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