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After the deluge: Appraising the 1970 Mufulira mine disaster in Zambia

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Abstract

This article endeavours to position the Mufulira mine disaster in the wider historiography of mining in post-colonial Zambia. In the early hours of 25 September 1970, about two million tonnes of water, and slimes cascaded into the main working area of the Mufulira copper mine on the Zambian Copperbelt. It choked the mine's main and intermediate haulages, and put three incline shafts, an ancillary crusher, and pumping stations out of action. This deluge, the worst mine disaster in the country's mining history, resulted in the death of 89 miners and had the subsequent socio-economic effect of having to resettle their widows and orphans. The cataclysm also led to a cut, by as much as 50 per cent, of the nation's copper production, its main foreign exchange earner. The resultant reduction in government revenue generation due to a decline in copper production had a severe impact on the nation's fiscus. But most importantly, this tragedy occurred at a time of serious socio-political challenges in the newly independent state of Zambia. While the incident at Mufulira was costly to shareholders, the state, and the affected families, it also became a blessing in disguise because its aftermath set new standards in mine safety on the Copperbelt as well as in the rest of the mining industry.

Key words: Zambia; mining industry; Mufulira; Copperbelt; Roan Selection Trust.

Opsomming

Hierdie artikel poog om die plek van die Mufulira-mynramp binne die breëre mynbouhistoriografie van post-koloniale Zambië te bepaal. In die vroeë oggendure van 25 September 1970 het ongeveer twee miljoen ton water en slik die hoofwerkgebied van die Mufulira-kopermyn in die Zambiese Koperstreek oorstroom. Die slik het die hoof- en tussenvervoerstelsel van die myn verstop en het drie skuinsskagte, 'n bystandklipbreker en pompstasies buite werking gelaat. Hierdie vloed, die ergste mynramp in die land se myngeskiedenis, het die dood van 89 mynwerkers veroorsaak en bykomende sosio-ekonomiese gevolge gehad met die hervestiging van hulle weduwees en weeskinders. Die ramp het ook tot 'n afname van tot soveel as 50 persent in die koperproduksie, die belangrikste buitelandse valutaverdiener, van die land gelei. Die gevolglike daling in die generering van

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owerheidsinkomste as gevolg van ’n afname in koperproduksie, het ’n invloed op die fiskus van die land gehad. Van groter belang is dat hierdie tragedie in ’n tyd van ernstige sosiopolitieke uitdagings in die nuut-onafhanklike Zambiëstaat plaasgevind het. Terwyl die Mufulira-mynramp die aandeelhouers, die staat en die gesinne van die gestorwe mynwerkers negatief beïnvloed het, het dit ook positiewe veranderinge tot gevolg gehad deurdat nuwe mynveiligheidstandaarde in die Koperstreek en die res van die mynbedryf ingestel is.

Sleutelwoorde: Zambië; mynbou; Mufulira; Koperstreek; Roan Selection Trust.

Introduction

The danger of a sudden and accidental inrush of water or material which flows when it is wet, is a long-standing mining hazard. Accidental inundation is a major cause of concern to the mining industry when it is necessary to work in the vicinity of a large body of water. This is because it presents a menace to life. A lake or an ocean, a large pool of water in an upper stream or water flooding adjacent old workings, if suddenly released to the lower active workings, could easily flood mine workings and lead to fatalities. However, arguably, the most dangerous mining activity involves the extraction of coal. Explosions of methane gas and coal dust, separately or together, have killed thousands of miners in coal mines in different parts of the world. Fatalities from other causes, such as roof falls are higher in aggregate but tend to attract less attention than explosions, because fewer people are killed in each instance.[1] In mining, as well as in other hazardous industries, various safety controls can be implemented to modify the exposure to the inherent risks involved; to minimise their likelihood of occurrence; and to contain the consequences of accidents should they unfold. Ironically, the loss of life and the horrific way in which victims of mine accidents die are often seen as part of a reformist, yet never-ending endeavour to ensure greater safety in mining operations.

The world has witnessed some dreadful mine disasters. The tragedy at Aberfan in Wales was one of the worst disasters in the history of the coal mining industry in the United Kingdom. A waste-tip slide in Aberfan, South Wales on 21 October 1967 buried twenty houses, a farm, the Pantglas Junior School, and killed 144 people of whom 116 were children.[2] The tragedy’s causes were rooted in ignored warnings from the community and the shortcomings of individuals and management employed by the National Coal Board which was guilty of not monitoring the proper construction of the tips.[3] The coal tips were placed on top of existing natural springs that could not withstand the load of the waste. Several official letters had complained of the danger posed by the coal tips before the accident occurred, but no steps were

1. R. Edgecombe, “Dannhauser (1912) and Wankie (1972): Two Mining Disasters: Some Safety Implications in Historical Perspectives”, *Journal of Natal and Zulu History*, 13 (1990–91), p 71.
2. M. Johnes, “Aberfan and the Management of Trauma”, *Disasters*, 24, 1 (2000), pp 1–17.
3. Johnes, “Aberfan”.

taken to prevent a slide.[4] Following this disaster, Sir Ronald Prain the chairman of Roan Selection Trust, Mufulira mine's holding company, inquired into the safety precautions taken at the Mufulira mine. He asked whether a similar situation could arise on the company's mines on the Zambian Copperbelt.[5] He was assured by management that there was no such danger. As will be demonstrated below, however, the accident at Mufulira – just like the disaster at Aberfan – was caused by negligence on the part of the owners of capital. The wrong mining method was used.

Similar to the incident in Aberfan, on 26 February 1972, a dam failure caused a coal waste slide that killed 118 people in the Buffalo Creek Valley, West Virginia. The slide was the result of the failure of a mine-waste impoundment that released 17.6 million cubic feet of water and sludge, and broke two other impoundments.[6] The failure was caused by the incorrect dump construction that collapsed after several days of heavy rain.

In yet another disaster, the Sunshine silver mine in northern Idaho experienced a large fire on 2 May 1972. As many as 91 mineworkers died of smoke inhalation and carbon monoxide poisoning.[7] The cause of the fire was not determined conclusively but it was known that polyurethane foam had been applied previously to seal the ventilation system and this escalated the degree of the fire and released a large amount of toxic fumes. The polyurethane foam was rated to be non-burning and self-extinguishing, but this was found not to be the case.

Southern Africa has not been spared from similar mining accidents. Two of the worst mine accidents took place at Durban Navigation No. 2 Colliery (DNC) near Dannhauser in northern Natal in 1926, and there was another disaster at Wankie No. 2 Colliery in Zimbabwe (then named Rhodesia) in 1972.[8] Both accidents began as methane gas explosions, and killed almost all who were underground at the time. At DNC 121 miners were killed, while 427 miners lost their lives at Wankie.[9] In the aftermath of these disasters there were inevitably intensive investigations and remedial action was taken in the form of stringent regulations governing mining operations. One crucial recommendation that was implemented as a result of the accident at Wankie was the adoption of methanometers which helped to provide

4. M. Johnes and I. Mclean, *Aberfan Disaster* (Oxford University Press, Oxford, 2000).
5. Mining Industry Archives (hereafter MIA), Ndola, Zambia, 10.5.5D, Sir Ronald Prain (London) to General Manger, Mufulira Copper Mine, 21 August 1967.
6. J.H. Kelly, et.al., "The Buffalo Creek Flood and Disaster: Official Report from the Governor's ad hoc Committee of Inquiry. West Virginia Division of Culture and History. http://www.wvculture.org/history/disasters/bucreekgov.report.html (Accessed 4 August 2013).
7. B. Launhardt, "Sunshine Mine Fire: A View from the Inside", United States Mine Rescue Association homepage, available at http://www.usmra.com/saxewell/sunshine-view.htm (Accessed 4 August 2013).
8. Edgecombe, "Dannhauser and Wankie", pp 71–90.
9. Edgecombe, "Dannhauser and Wankie", pp 75, 82.

advance warning of small quantities of gas emission, undetectable by the traditional safety lamp, thereby allowing early remedial action to be taken.[10]

At the Coalbrook North Colliery in the Orange Free State, South Africa, coal pillars spanning over 2.5 square kilometres collapsed suddenly on 21 January 1960 and killed 435 people.[11] In the weeks preceding the accident, several indications of overstressed pillars were evident, including a strata collapse a month before which injured one worker. The collapse also released large quantities of methane gas. The positive result that emerged from this disaster, was the creation of the Coal Mining Research Organisation in 1961. This new body was tasked with the responsibility of investigating problems of strata control and other related aspects of mining safety.

Zambia has had its share of mine accidents, but the one that must stand out as the worst and most tragic was the disaster at Mufulira in 1970. However, the study of mine accidents as social phenomena in Zambia is still shrouded in silence. Although mining has been a vital part of the country's history from pre-colonial times, there have been no studies undertaken by historians on tragedies that have occurred as a result of this economic activity. The country's mining historiography is characterised by general accounts rather than in-depth studies backed by research.[12]

Despite the long history of mining in the country, only two mines have had their history studied in close detail. In his recent research project (2018), Hyden Munene examines Nkana mine's corporate structure, profitability, and labour relations,[13] while John Phillips's study (2000) on the Roan mine demonstrates that the outbreak of the Second World War affected mineral exploration in the periphery and played a role in Britain's, and thereby the Allied, victory.[14] On the other hand, Walima Kalusa, argues (1993) that the wartime expansion of copper mining activities at Roan mine contributed to increased incidents of pathological disease such as silicosis and tuberculosis.[15] Occupational ailments due to the deterioration of housing and sanitation in the African mine compound arose because the mine paid little

10. Edgecombe, "Dannhauser and Wankie", p 87.
11. C.D. Martin and W.G. Maybee, "The Strength of Hard Rock Pillars", *International Journal of Rock Mechanics and Mining Sciences*, 37, 8 (2000), pp 1239–1246.
12. L.H. Gann, "The Northern Rhodesian Copper Industry and the World of Copper, 1923–1953", *Rhodes-Livingstone Journal*, 18 (1955), pp 1–18; A. Roberts, "Notes Towards a Financial History of Copper Mining in Northern Rhodesia", *Canadian Journal of African Studies,* 16, 2 (1982), pp 347–359; F.L. Coleman, *The Northern Rhodesian Copperbelt, 1899–1962* (Manchester University Press, Manchester, 1971); and L.J. Butler, *Copper Empire: Mining and the Colonial State in Northern Rhodesia, 1930–1964* (Palgrave Macmillan, Houndsmill and Basingstoke, 2007).
13. H. Munene, "A History of Rhokana/Rokana Corporation and its Nkana Mine Division, 1928–1991", PhD thesis, University of the Free State, 2018.
14. J.G. Phillips, "Roan Antelope: Big Business in Central Africa", PhD thesis, University of Cambridge, 2000, p 248.
15. W.T. Kalusa, "Aspects of African Health in the Mining Industry in Colonial Zambia: A Case Study of Roan Antelope Mine, 1920–1964", MA dissertation, University of Zambia, 1993.

attention to improving facilities. This was because management put increasing its profit at the core of the mine's operations. It is thus true to say that the above studies were not concerned with the hazards associated with copper mining on the human and physical environment. It is precisely that barely glimpsed aspect that this article explores in the context of Zambia's further integration into the world's capitalist economic system in the immediate post-independence period. The article relies heavily on primary sources of information available in the archives of Zambia's mining industry. This archival repository is in Ndola.

A short historical background of Mufulira mine

In 1970, the year the disaster occurred, Mufulira mine, situated 320 kilometres north of the country's capital, Lusaka, and thirteen kilometres south of the international boundary with the Democratic Republic of the Congo, was not only the biggest underground mine in Zambia, but also one of the largest in the world. Evidence of copper mineralisation in the area was first reported in 1923, and by 1930 diamond drilling had outlined reserves of around 30 million tonnes averaging 4.41 per cent copper.[16] Although a small concentrator was completed in 1931, further development was suspended with the onset of the world economic depression, and production did not actually commence until 1933. During the Second World War, the mine played its vital role of producing large quantities of copper for the Allied war effort.[17]

Between 1956-7 exploration works revealed a major western extension of the ore body, and a 50 per cent increase in capacity was planned to exploit the new additional reserves. From mid-1968 until September 1970, ore was mined at a rate of approximately 7.5 million tonnes a year. The mill-head grade averaged some two and a half percent copper, and copper production was in excess of 160 000 tonnes per year.[18] At the time of the disaster, an expansion programme was in hand which would have increased production capacity to 190 000 tonnes of copper per year by early 1971.[19] At the end of June 1970, the ore reserves were some 136 million tonnes, averaging 3.27 percent copper content.

Access to the mine was by five shafts, all sited in the highly competent pre-Katanga rocks of the footwall. The two Prain shafts served the western extension of the ore body, and the Boise and Selkirk shafts the eastern parts. The centrally-sited

16. MIA, Ndola, 10.8.10E, Mufulira Copper Mine, Summary of Operations at Mufulira, 1969.
17. See, especially R. Prain, *Reflections on an Era: An Autobiography* (Metal Bulletin Books, Surrey, 1981). For a detailed description, see A. Tembo, "The Impact of the Second World War on Northern Rhodesia (Zambia), 1939–1953", PhD thesis, University of the Free State, 2015.
18. MIA, Ndola, 10.8.10E, "Mufulira Copper Mine, Summary of Operations", 1969.
19. A comprehensive description of the geology of Mufulira mine is available in F. Mendelsohn, *The Geology of the Northern Rhodesia* (Macdonald, London, 1961).

14 shaft was equipped only for hoisting ore.[20] Immediately prior to the disaster the mine was pumping 82 000m^3 of water per day. Stations on the 500-metre, 597-metre, 600-metre and 825-metre levels were pumping independently to the 434-metre level, from which point the water was lifted directly to the surface. A system of drainage crosscuts was used on the lower levels to drain the aquifers in the hanging-wall, particularly the dolomite horizons.

Disaster strikes!

At about 2:55am on 25 September 1970, large quantities of mud entered the Peterson Section of Mufulira mine at various points between the 434-metre and 580-metre levels and flowed into the lower levels via the Peterson shaft system. The whole event took place in a very short period of time, and within fifteen minutes or less, large sections of the eastern half of the mine were overwhelmed with mud. At the time of the accident, 1 500 miners were on duty at the mine. Spearheading the search were proto rescue teams who came from all the Copperbelt mines, led by Greg Phimister, the Mufulira Division's ventilation engineer. When rescue operations were finally called off after three days, 89 men were still missing and presumed to have been killed.[21] Of the 89 men, 64 were employees of the Mufulira Division and 25 worked for Cementation Limited, a private contractor engaged to rehabilitate one of the shafts.[22] The total volume of sludge and mud which flowed into the working areas of the mine was estimated at 450 000m^3. Many of the eyewitnesses reported that the initial mud rush was accompanied by an unusual noise, described in various terms as a "blasting sound", "a shaking", "an explosion", and even as rumbling "thunder". The majority stated, however, that this noise was completely different from the very familiar sound of normal blasting operations.[23]

The largest group of men were lost within the critical area of major flooding between the 533-metre and 580-metre levels. Out of total gang strength of 60 working on these levels, 47 were killed. Another 9 men who belonged to other gangs (supervision, first aid, sampling, and Gang No. 5U551) were killed on the same levels, making a total of 56 victims. It is also important to note that on the 580-metre level alone, 30 men were killed out of the 39 who were working there at the time of the disaster. This translates into a 77 percent fatality rate, and was the highest in the entire disaster area.[24]

Survivors of the disaster gave various testimonies. Abel Musonda, a 24-year-old crane driver, said from his hospital bed in Ronald Ross Hospital that he owed his

20. MIA, Ndola, 10.8.10E, "Mufulira Copper Mine, Summary of Operations", 1969; and MIA, Ndola, 18.4.2B, "Mufulira Copper Mine Ltd. Annual Report for the Year 1969".
21. Government of the Republic of Zambia (hereafter GRZ), *The Mufulira Mine Accident: Final Report on the Causes and Circumstances of the Disaster Which Occurred on 25 September 1970* (Government Printer, Lusaka, 1971), p 4.
22. *Mufulira Mirror,* Special Edition, 29 September 1970.
23. GRZ, *The Mufulira Mine Accident*, p 5.
24. GRZ, *The Mufulira Mine Accident*, p 5.

life to a colleague who was also struggling to flee the terrifying rush of mud and slime. As he put it:

> I got so tired that I had reached the point where I could go no further. The wet mud was flowing under me and I started shivering. My chest was burning and I could hardly breathe. I'd almost given up hope, but I managed to pull myself up to another level where there was some water dripping. It was this water which gave me the power to carry on. But I had not gone very far before I was exhausted again. Then I noticed someone above me clinging to a pipe and he pulled me up to where he was.[25]

Another survivor, Winnel Chishe, 38, a pump operator described how the shaft suddenly went dark as he and his colleagues heard a rushing sound coming towards where they were standing. He explained that they escaped death by holding onto a wire only as thick as a pencil.[26] Forty-year-old Kenani Kabanda said "I first heard a violent noise and then saw muck and water flowing towards us. Electrical cables snapped and ventilation fans stopped working. There was total darkness underground".[27] Another miner, James Kazembe, was working in a group of nine men in a cross cut at the 2 150 feet level, when he saw mud and water rushing towards his group. He said, "we didn't know what to do. The group split up and started running. The rest of the men disappeared".[28] Another survivor said, "it was like being trapped in quicksand. I only managed to save myself by grabbing an electric cable and hauling myself up".[29]

The mud in the mine consisted mainly of floatation tailings;[30] this contained variable proportions of fragments and boulders of various ore and hanging-wall rock types as well as soil and vegetation. The tailings originated from a large pool of saturated or near-saturated slimes and tailings lying north of the Boise and Selkirk shafts in a hollow depression caused by subsidence over the entire mining area. A crater which appeared in this accumulation of tailings was first observed within 30 minutes of the mud inrush underground,[31] but it probably developed at an earlier stage. The tailings entered the mine through what is known as a sinkhole – a near circular chimney cavity, which developed beneath the surface accumulation of tailings. The sinkhole enabled mine waste to penetrate the caving hanging-wall and it entered the occupied workings via the stopes.[32] The total volume of tailings missing from the surface crater was estimated to be 700 000m^3 and the total volume of the mud in the working areas of the mine was estimated to be 450 000m^3.[33]

25. *Zambia Daily Mail*, 28 September 1970.
26. *Zambia Daily Mail,* 28 September 1970.
27. *Times of Zambia*, 29 September 1970.
28. *Times of Zambia,* 29 September 1970.
29. *Times of Zambia,* 29 September 1979.
30. "Tailings" refers to the waste fraction of the ground ore, while the coarser material is referred to as "sand" and the finer fraction, as "slimes".
31. GRZ, *Mufulira Mine Accident*, p 7.
32. GRZ*, Mufulira Mine Accident*, p 8.
33. GRZ, *Mufulira Mine Accident*, p 8.

Significant events prior to the disaster at Mufulira No. 3 Dam

The first evidence of a sinkhole appeared on 22 November 1968 in the 18/19 section of the mine and measured some 60 metres in diameter[34] (see Figure 1 below). This was also the first sinkhole to appear at the surface over the deeper levels of the mine and within the area which was blanketed by tailings. This was followed by logbook entries made by shift bosses on 16 January 1970; these recorded unusual pressure conditions on the 518-metre level. Similar conditions were noted on 8 August 1970. This resulted in three sub-level crosscuts having to be abandoned.[35] A mud extrusion affecting 57 and 59 sub-level crosscuts and the footwall slot in the centre of 17 Block on the 533-metre level was recorded on 30 March 1970. This was reported immediately to the mine captain responsible for the section.[36] Further extrusions affected five other crosscuts in 16 Block and 17 Block, and the footwall slot, before the end of July 1970. The pattern of these events indicates that there was a large volume of mud in the stope and that it flowed over the footwall and towards the east and the hanging-wall following the retreat of the stoping faces. The material had low water content and was highly viscous; this meant that the rate of movement was extremely slow. The chief geologist described it as rock flour with the consistency of toothpaste, containing a high proportion of talc and argillaceous material and resembling the decomposed insoluble debris derived from certain hanging-wall aquifers, such as intermediate dolomite, which had been encountered in drainage crosscuts on the 411-metre, 430-metre, 488- metre and 564-metre levels.[37]

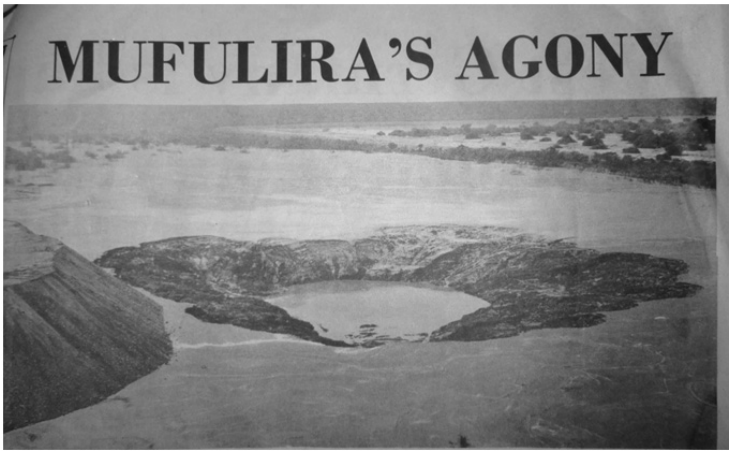

Figure 1: Aerial view of the sinkhole at Mufulira No. 3 Dam (Source: *Times of Zambia*, 24 October 1970.)

34. GRZ, *Mufulira Mine Accident,* p 16.
35. GRZ, *Mufulira Mine Accident*, p 16.
36. GRZ, *Mufulira Mine Accident*, p 16.
37. GRZ, *Mufulira Mine Accident*, p 16.

On 2 April 1970 the underground manager, Mr Forder, recorded the following in his logbook entry:

> … for your information, as from today there is a likelihood that tailings will follow on from the mud intrusion on the 1,750 SLC. Even if it does not do so now it may well do so at a later date. Please ensure that the Shift Bosses and Mine Captains in charge do not ignore any surge of tailings and pass the information on to you as soon as possible.[38]

This was a very realistic assessment, except that it included the dangerous assumption that the first sign of tailings in the mine openings would be a comparatively minor inflow. The nature of the mud was reported verbally on the same day but was only subsequently put in writing to the general manager of the mine on 1 October 1970. This was five days after the tragedy.[39] No sooner had the verbal report been made, than the occurrence was inspected by various officials and at a subsequent meeting (of which no written record exists). According to an official report issued by the Zambian government in 1971, *The Mufulira Mine Accident: Final Report on the Causes and Circumstances of the Disaster,* it was decided at the on-site meeting to take no immediate action other than to "bury" the mud in the stope under clean ore by controlled blasting.[40]

The affected crosscuts and the footwall slot was visited by Mr A. Walden an inspector of mines on 14 April 1970. In his report he observed that there were "… mud intrusions; slow flow; low moisture content being loaded out and stored in old footwall crosscuts". However, no action was proposed or taken.[41] The problem of tailings at Mufulira can be traced to the beginnings of capitalist mining at the site in the early 1930s. In 1933, when the mine was first brought into production, a shallow natural valley lay some 500 metres north of, and parallel to, the sub-outcrop of the ore-bodies, that is, on the hanging-wall. The first tailings to be dumped in this valley were used to infill pools of stagnant water by Malcom Watson and his team as part of anti-malaria measures.[42] Between 1933 and 1943 the concentrator tailings were de-slimed for a sand-filling operation, that is, the 325-mesh fraction was removed. Some 3.9 million tonnes of sand-fill were placed underground, and an approximately comparable tonnage of slimes was run into the area which became known as No. 3 Dam. A slimes overflow drain was commissioned in 1943, and for some time after this date, tailings were apparently only run into the area to fill the sinkholes which

38. GRZ, *Mufulira Mine Accident*, p 16.
39. MIA, Ndola, 10.5.5D, Chief Geologist to General Manager, 1 October 1970.
40. GRZ, *Mufulira Mine Accident*, p 16.
41. MIA, Ndola, 10.5.5D, "Inspection Report at Mufulira Mine", by A. Walden, Mines Inspector, 14 April 1970.
42. Watson was recruited to undertake a campaign against malaria on the Copperbelt, similar to a previous campaign he had undertaken in Malaysia. This involved draining huge swamps and ditches; a weekly oiling of stagnant water; regular spraying against mosquitoes and the cleaning of rivers. As a result of these preventative measures, by the late 1930s the Copperbelt had become one of the healthiest places Europeans could live in central Africa.

periodically developed over near-surface stopes as they collapsed. It became standard practice to fill such holes, which were up to 25 metres deep with waste rock and classified mill tailings. Whether or not the tailings in No. 3 Dam dried out during this period of disuse, remains unknown.

From 1945 to 1950 the percentages of stopes which were sand-filled dropped from 62.5 to 9 percent following the introduction of caving mining methods in 1944. From 1944 onwards, progressive collapse of the hanging-wall led to the formation of a depression on the surface within which lay No. 3 Dam. By 1950, this depression was up to 4.6 metres deep, and included the whole of the dam. Following the failure of the wall of No. 7 Dam during the 1951 to 1952 rainy season, mill tailings were again impounded in No. 3 Dam while construction of No. 8 Dam was completed. Finn noted that:

> This entailed raising and extending the wall, and, as the area was over caving stopes, it was desirable to limit the amount of water and fine slimes impounded. Following the pioneer work at Roan Antelope, where hydrocyclones had been successfully used to build the wall of the Makoma Dam, a similar installation was made which rapidly increased the capacity of No. 3 Dam; the cyclone overflow was impounded lower down in the valley by an earth wall.[43]

This seems to have been the earliest awareness of the potential danger represented by an accumulation of slimes and tailings on caving hanging-wall ground. However, no action was taken by those responsible. The most probable reason for this inaction by responsible authorities is that they simply failed to condemn a dubious mining practice of such long-standing, which had been approved by the mine's respected engineering consultant and an array of other technical staff.

By 1956 the original surface of the ground underlying No. 3 Dam had subsided to form a basin with a maximum depth of 12 metres. Air photographs taken at this time showed two large pools of surface water centred on an extensive accumulation of tailings and slimes which was evidently forming an effective seal over the ground surface. The accumulation of surface water was rightly regarded as a matter of concern and two 9 000 litre per minute pumps were established on pontoons to drain the pools.[44] Due to the difficulty in maintaining the pumps, however, this programme achieved only a limited degree of success. Moreover, as the ground was actively subsiding the distribution of the surface water was constantly changing. By 1963 the two pools had merged, and the quantity of water present was estimated at 30 000 cubic metres. The total catchment area around the basin was now 510 hectares, and it was estimated that one centimetre of rain would result in a surface accumulation of 50 000 cubic metres of water.[45] Although some of the tailings that entered the mine

43. MIA, Ndola, 10.5.5D, A.A.T. Finn, "Tailing Dam Construction at Mufulira Copper Mine Ltd, Zambia", *Transactions of the Institution of Mining and Metallurgy*, 74 (1965), pp 813–840.
44. GRZ, *Mufulira Mine Accident*, p 10.
45. GRZ, *Mufulira Mine Accident*, p 10.

as mud flow may have dated back to as early as 1933, more than 75 percent had been emplaced since 1963. This was when management decided to use mine waste material to fill-in the surface depression caused by underground caving of ore.[46]

In 1963 it was decided that the pumping of water from the depression was impractical. The full implication of this decision was obviously not recognised until after the disaster. The written and oral evidence made available to the commission of inquiry into the accident emphasised the concept that this accumulation of tailings could be expected to drain as the water would percolate downwards through fissures in the caving ground beneath and would also to some extent be lost by evaporation. Subsequent events proved that this did not, in fact, happen to any significant extent, and for several reasons. First, the accumulation of tailings was contained in a closed basin with a layer of slime at the base, which was known to be almost, if not entirely, impervious because it had previously proved strong enough to withstand large accumulations of surface water above. The underlying soil was largely clay which acted as a further seal and prevented vertical migration of any fluid except through fissures caused by caving. If material did penetrate downwards through such fissures it would be in the form of an emulsion of slimes, tailings and water. There was no evidence to show that the solid fraction separated out as percolation proceeded – as was suggested by some witnesses – and every reason, after the disaster, to believe that this did not in fact happen to any significant extent. Loss of water by evaporation was not a particularly significant factor because systematic desiccation of tailings accumulation was normally only considered to be feasible in a desert environment.[47]

A missed opportunity

Following the Aberfan colliery disaster in 1967, Mufulira mine investigated the nature of its tailings. The concentrator superintendent and the acting engineering superintendent, in a joint letter to the general manager of the Mufulira mine, J. Ainsworth noted that:

> … the lower levels of this deposit [i.e. tailings accumulation in No. 3 Dam] may be very fluid. Some drainage of water doubtless takes place through the upper rocks of the caving area and these may well provide an efficient filter through which the water passes leaving substantially solid tailing above … There is no doubt that the whole surface of the caving area is continually on the move … A decision on whether this constitutes a hazard or not must lie with those more competent to assess the position from a mining point of view. Should movement of rock release any appreciable quantity of this tailing, especially if it retains much water, into the mine workings, the danger to life and equipment might be considerable.[48]

46. V.S. Vutukuri and R.N. Singh, "Mine Inundation: Case Histories", *Mine Water and the Environment*, 14, 9 (1995), p 120.
47. GRZ, *Mufulira Mine Accident*, p 12.
48. MIA, Ndola, 10.5.5D, Concentrator Superintendent and Acting General Manager to General Manager, Mufulira Copper Mine, 1 September, 1967.

For his part, the mine superintendent, Geoff G. Runnalls, was of the opinion that:

> … any possible danger of an inrush of this tailing into the mine workings would necessitate the following two conditions: i) An open cave or sinkhole connecting an underground opening with the lower limit of the tailing creating a vertical or near vertical channel through which the tailing would flow [and] ii) A high enough water content in the tailing to permit it to flow down any channel.[49]

This was a very realistic assessment, and furthermore the mine superintendent considered that neither of these conditions would arise, as all previous sinkholes had shown to be self-sealing and no trace of the tailings used to infill them had ever appeared in the mine. At that time, however, no chimney caving had occurred under the central area of No. 3 Dam and the possible effect of a high head of tailings was, therefore, ignored! The mine superintendent also discounted the possible significance of the high water content of the tailings. Earlier, the chief geologist, V.D. Fleischer had supervised a limited hand-augering programme at the eastern end of the tailings accumulation. At the time, tailings were being introduced from the north. In his oral evidence submitted to the commission, Fleischer stated that as far as it was possible for him to recollect, the most westerly of the auger holes was on the eastern edge of the delta.[50] This practice of disposing tailings on caving hanging-wall ground was termed "basically wrong" by the commission.[51]

Mufulira was the major producer in the former RST group. Together with the group's other mines at Chibuluma, Luanshya and Chambishi, Mufulira belonged to the Roan Consolidated Mines (RCM) following the nationalisation of the mines on 1 January 1970.[52] Under the new arrangement, the Zambian government held a stake of 51 percent in RCM through the Zambia Industrial and Mining Corporation (ZIMCO); RST owned twenty percent (RST was a subsidiary of the American Metal Climax, Amax) while Anglo American Corporation held 12.25 percent, and the investing public (mostly former holders of RST), the remaining 16.75 percent.[53]

The resulting five-man commission of inquiry into the disaster, chaired by a mining expert, Nicolae Mihailovici, found that no individual could be blamed for the tragedy but beyond this point was unable to discern precisely any degree of blameworthiness. However, the commission's report maintained that responsibility – as distinct from blameworthiness – could indeed be distinguished and that:

> … since no freak occurrences of nature were involved, the final responsibility inevitably must rest with the company. The accident was caused by faulty

49. MIA, Ndola, 10.5.5D, Mine Superintendent to General Manager, Mufulira Copper Mine Ltd, 3 August 1967.
50. GRZ, *Mufulira Mine Accident*, 13.
51. Vutukuri and Singh, "Mine Inundation", p 122.
52. For a brief but nuanced discussion on the nationalisation of mines, see A. Sardanis, *Zambia: The First Fifty Years* (I.B. Tauris, London, 2014), pp 51–66.
53. *Financial Times,* 14 November 1970. For a comparative analysis on Nkana mine, see Munene, "A History of Rhokana", pp 114–117.

> operational procedures; a [mining] method, a tailings disposal practice, and a drainage scheme, all sound enough in their isolation, became a dangerous combination.[54]

In the eastern part of the mine where three ore bodies were superimposed, a block caving method was used for many years. In the years preceding the accident, this was replaced by a variation of sub-level caving method called the cascade method.[55] This new method, despite of its demerits, was adopted because it produced more ore than the caving method.[56] Andrew Sardanis has also argued recently that this accident was due not to negligence by the mine in 1970, but as a result of bad mining methods employed by the previous owners who for decades before had decided to cut corners in order to increase profitability.[57]

The commission of inquiry also noted that there were challenges with regard to management practices and record keeping at the mine. Although no human being could be blamed for the disaster, it was noted that there was a total failure by management to realise what could happen under certain conditions. Mine management had failed to appreciate the significance of the geological evidence indicating the source of the mud which had built up before the disaster, and it was under the misapprehension that any indication that tailings had penetrated the hanging-wall would be a controllable inflow into the mine workings, given ample warning. The commission stated that:

> … there is lack of records concerning the critical decisions which were made at various times, namely the decision to adopt a caving method of mining in 1946; the decision to infill the surface depression with tailings in 1963; and the decision regarding the significance of underground and mud extrusions which took place prior to the disaster.[58]

Only a small number of senior officials were aware of events prior to the disaster. It was further observed that there was no evidence of formal meetings between management and senior technical staff which might have helped to avert the disaster, and vital information was apparently passed to decision-making levels in a very informal manner. There was no evidence that the Mining Department was ever informed of the decision to fill surface subsidence with tailings, or that the matter was discussed with them. Regulations which could have been invoked by the Mines Department to control the undermining of a tailing disposal area were also imprecise.[59] One of the critical recommendations made by the commission was that there was need by Mufulira mine to:

54. GRZ, *Mufulira Mine Accident*, p 19.
55. Vutukuri and Singh, "Mine Inundation", p 120.
56. Personal communication with Ian Phimister, Bloemfontein, April 2014.
57. Sardanis, *Zambia: The First Fifty Years*, p 64.
58. GRZ, *Mufulira Mine Accident*, p 19.
59. GRZ, *Mufulira Mine Accident*, p 19.

> … review the management system and to ensure that regular and formal discussions are held between management and technical departments and that records are kept. The system must aim to achieve the maximum of technical personnel's expertise and ensure that advice and opinion is not withheld through difference or discouragement.[60]

This was the most serious public censure yet of a Zambian mining company's operational arrangements.

Impact of the disaster

The mine disaster was a catastrophe for Zambia in many ways. The impact of the calamity on the relatively small community of Mufulira was profound. There were no problems for the first few days following the accident because of the pressure of events. Soon, however, it was realised that this was a catastrophe. Three major decisions were made to sustain miners' morale; all available information was passed to employees as clearly and as promptly as possible; spare labour was seconded to other divisions of RCM or redeployed at Mufulira; and planning began on how to restore the mine to full capacity.[61] This information helped to reassure employees that their future was secure and that management had every confidence that all the problems would be overcome eventually. No employee of Mufulira Division was laid off.[62] RCM also produced a television documentary "Ordeal at Mufulira" which was enthusiastically received by audiences in Zambia and overseas.[63] It gave a narration about how the mine had been "saved" through the skill, courage and resolution shown by the mine management in the aftermath the accident.

However, there were tragic scenes in the township adjoining the mine on 27 September when the news broke that all hope had been abandoned for saving the lives of the 89 employees trapped underground. President Kenneth Kaunda described the Mufulira disaster as an "unforgettable" national tragedy, "the worst we have ever faced as a nation either before or after independence".[64] The search for the missing men was called off after three days to prevent the loss of more lives because the safety of rescue teams could not be guaranteed**.** After three days of agonising waiting, and at the news that the search had been called off, relatives of the men could only stumble back dry-eyed to their homes from the gates of the mine. They were too shocked to weep.[65] At one house, the brother of one of the trapped miners collapsed when told the news and had to be helped to regain consciousness. Some wives became hysterical and had to be restrained by friends and relatives to prevent them

60. GRZ, *Mufulira Mine Accident*, p 19; and *Times of Zambia,* 29 October 1971.
61. *Times of Zambia*, 13 February 1974.
62. *Mufulira Mirror,* Special Edition, 29 September 1970.
63. *Times of Zambia,* 13 February 1974.
64. *The Guardian,* 28 September 1970; *Mufulira Mirror,* Special Issue, 29 September 1970; and *Times of Zambia*, 28 September 1970.
65. *Zambia Daily Mail*, 28 September 1970.

from injuring themselves.[66] As reported by the *Zambia Daily*, there was an intense air of tragedy in the township. There was no one who had not lost a husband, a father, a friend or neighbour. The sound of mournful wailing was heard from many of the houses.[67] Mary Robinson, the wife of one of the expatriate workers who was killed was too shocked to take in the fact that her husband had died. She said "I'm not weeping now. Perhaps I will break down when I go back home … [when] I was told my husband had died I [could] hardly believe it".[68] Such expressions of emotion are normal when it comes to deaths resulting from a disaster. As noted by Robert Kohn and Itzhak Levav, bereavement following disasters may be qualitatively different from that in anticipated deaths in the sense that "the grief may be delayed, exaggerated, or absent … Furthermore, in a disaster, grieving over a loss may be complicated by chaos, loss of property, relocation, and unemployment".[69]

Many of the local miners' families were repatriated to their rural homes while Mrs Robinson and her three children went back to Britain. The families were repatriated using money raised by the National Disaster Fund chaired by the Archbishop of Lusaka, Emmanuel Milingo. The National Disaster Fund took care of 472 school children of the dead miners by May 1971.[70] Another expatriate widow Mrs Slater, was offered employment by the Mufulira mine and stayed on with her six children.[71] Each local family was given monthly allowances of K20 per adult and K5 per child. Mrs Robinson was given K300 to enable her send her children to school in England. In addition, families were also paid their husbands' working benefits from the mine management. By January 1971 the Disaster Fund had given out K25 000 with another K200 000 held in a bank account to help bereaved families.[72]

As fear gripped the mining town, some people wondered whether it was safe to work for mining companies anymore. Mary Mutale said "I will never let my husband even think of working in a mine again".[73] Joyce Chabala added that "after this accident, I will advise my husband to go home and concentrate on farming"[74] while a schoolgirl, Grace Zulu, thought working underground was equal to "gambling" and would ask her father to do "some other job".[75] These fears were not unfounded based on rumours circulating on the Copperbelt following the disaster. As one miner, Benson Mwendo, said: "… at present there are many rumours about the actual cause of the accident, which include sabotage, witchcraft, and ghosts … "[76] Another miner

66. *Zambia Daily Mail*, 28 September 1970.
67. *Zambia Daily Mail,* 28 September 1970.
68. *Zambia Daily Mail,* 5 October 1970.
69. R. Kohn and I. Levav, "Bereavement in Disaster: An Overview of the Research", *International Journal of Mental Health*, 19, 2 (1990), pp 61–76.
70. *Times of Zambia*, 12 May 1971.
71. *Times of Zambia*, 20 November 1970.
72. *Times of Zambia*, 19 January 1971.
73. *Times of Zambia,* 29 September 1970.
74. *Times of Zambia,* 29 September 1970.
75. *Times of Zambia,* 29 September 1970.
76. *Zambia Daily Mail*, 19 February 1971.

Alfred Muchena claimed that miners were working in fear because of the many fictitious stories that had been circulating about ghosts that haunt shafts "who were demanding for more people to die".[77] These fears were understandable. When he received the report of the commission of inquiry into the accident on 20 May 1971, President Kaunda observed that after a disaster of that nature in an industry so plagued with dangers, many people harboured all sorts of ideas.[78] Government hoped the publication of the report would allay such fears.

However, some of the widows soon returned to Mufulira from their home areas, mainly in the Northern Province where they claimed that relatives of their dead husbands victimised them. Those who returned applied for, and were given, plots of land on which to settle in Kamuchanga Site and Service. One returnee said, "as we arrived home, the people thought we were rich and started questioning us about the benefits we received from the government and the Relief Fund Bank".[79] Another said she ran away from her village one night because the relatives of her dead husband threatened to seize all she had.[80]

Prior to the disaster, it was expected that Mufulira would provide nearly 60 percent of RCM's estimated copper output of 330 000 tonnes for the financial year ending 30 June 1971. Following the tragedy, Ian MacGregor, the chairman and chief executive of Amax Inc., said he regretted there was little prospect of getting any copper production at the east end of the mine in the foreseeable period.[81] Ever since the tragic accident, the mine had only been producing a fraction of its planned production. At first the mine was closed down completely as far as underground mining was concerned. Limited production was resumed in November 1970 at the rate of 3 000 tonnes per month as compared to 13 500 tonnes immediately prior to the disaster with a planned production figure of 16 000 per month for early 1971.[82] As it stood, sales for the first few months of 1971 were cut by about 18 000 tonnes per month compared with the previously hoped-for rate of 29 000 tonnes.[83] Ametalco Limited, which was the selling agent for the RCM copper declared *force majeure* in respect of copper shipments from Africa effective from October 1970 because of an anticipated decline in production at Mufulira.[84] To impose such limitations indicated that the effect on production was severe. However, it was subsequently found that most of the shipment commitments could be met by drawing on supplies in the delivery pipeline and stocks at the refineries and of ore concentrates waiting to be smelted at RCM's other producing mines.

77. *Zambia Daily Mail*, 19 February 1971.
78. *Times of Zambia,* 21 May 1971.
79. *Times of Zambia*, 11 February 1970.
80. *Times of Zambia*, 11 February 1970.
81. *American Metal Market,* 77, 188, 1 October 1970; and *Financial Times*, 2 October 1970.
82. *Mining Journal*, 5 February 1971; and *Mining Journal,* 4 December 1970.
83. *Financial Times*, 14 November 1970.
84. *Mining Journal,* 2 October 1970.

The disaster had implications outside the suffering of the people directly involved with mining. For Zambia, it meant a loss of profits badly needed to support the government's programmes, and to pay for the takeover of 51 percent of Mufulira and other RCM operating mines. The disaster occurred less than a year after the Zambian government took a 51 percent stake in the copper industry.[85] For the world, it meant a loss of copper supplies which, paradoxically, was to be reflected in firmer prices of the metal on the international market. In order for ZIMCO to meet the six-monthly bond repayments for the shares bought from RST and Anglo American Corporation during the nationalisation process, it was projected that the price of copper on the London Metal Exchange had to be about £450 per tonne.[86] With a fall in the price of copper, it was feared government could not offset the debt owed to RST and others without dipping into foreign reserves which by the time of the disaster stood at £200 million.[87] In 1970, the price of copper on the London Metal Market averaged £748 per tonne; in 1971 it was £444 and in 1972 had dropped to £428 – barely enough to cover the cost of production and marketing.[88] Since the nationalisation of the mines on 1 January 1970, government revenue came from a single mineral tax on profits of 51 percent and further income tax on the balance of profits after the mineral tax had been levied.[89] Ironically, the Zambian government could have come out far better after the disaster if it adhered to the previous system of taxing production rather than profits as envisaged under the new mine tax arrangement. Government would have been able to tax the production at RCM's other mines; Luanshya, Chibuluma and Chambishi, instead of taxing the whole group, which was now making a loss.[90]

Apart from reduced production figures, the company also faced a huge financial burden of rehabilitating the mine to bring it back to full strength of production. The damage caused by the disaster was extensive because the violent inrush of mud wrecked almost everything in its path. An alarming situation resulting directly from the disaster was the loss of lower level pump stations and the flooding of these levels by water.[91] The main portion of the rehabilitation programme was the clearance of mud from the eastern end of the mine and the restoration of pumping facilities. At the time of the inrush of mud, most of the major underground pumping stations were put out of action. Due to this, the financial implications of the accident were massive. RCM declined to declare a dividend to shareholders in respect of the quarter ended 30 June 1970. Aside from the loss in production, the company's directors used the major expenditure to re-equip the mine as another rationale for not paying dividends.[92] RCM's shares, which touched 55 shillings in 1970, had by

85. *Sunday Times*, 4 October 1970.
86. *Mining Journal*, 4 October 1970.
87. *Mining Journal*, 4 October 1970; and Munene, "A History of Rhokana", p 120.
88. A. Roberts, *A History of Zambia* (Heinemann, London, 1976), p 231.
89. Roberts, *History of Zambia*, p 231.
90. Roberts, *History of Zambia*, p 231.
91. GRZ, *Mufulira Mine Accident*, p 7.
92. *Mining Journal*, 16 October 1970; *Glasgow Herald,* 10 October 1970; *Times of Zambia*, 9 October 1970; and *New York Times* 12 October 1970.

November more than halved to 26 shillings, reflecting the cost of rehabilitating Mufulira, rising costs and a falling metal price.[93]

The accident had a negative effect on copper production both at Mufulira and for Zambia as a whole. Production of the metal fell from an average of 617 000 tonnes per month of ore hoisted during the period May to August 1970 to a mere 30 000 tonnes in October 1970.[94] The opening up of new stoping faces at Prain Shaft enabled production to be raised to 324 000 tonnes per month by April 1971, but it proved impossible to reach previous levels of production before 1972. RCM normally contributed about 50 per cent of Zambia's total copper production. In turn copper exports provided 95 per cent of the country's export earnings and two-thirds of the government's total tax revenue.[95] Financial experts expected a drop of about 25 percent in the government's total tax revenue which was compounded by the fall in copper prices from £748 to £450 in November 1970.[96] The finance minister, John Mwanakatwe said K55 000 of the loss was in the form of tax revenue and there was about K70 000 in profits. The loss represented 100 000 tonnes of copper that the mine would have exported.[97]

In addition, prices of copper on the international metal market fell sharply from the buoyant levels of the first half of 1970. The RCM chairman, Sardanis, noted that the disaster would create a "serious effect" on the company's production and earnings in the 1970/71 financial year.[98] Indeed, the company reflected lower income in the first and the third quarter of 1970 when the net profit fell to £8.2 million from the previous three months' £11.3 million to 30 June.[99] Earnings per share fell from seven shillings to five shillings and five pence while the price of copper fell further to £445 per tonne.[100] After the passing of the dividend payment for the June 1970 quarter, due to the disaster, RCM resumed payments, although at a reduced rate. A lower dividend for the September quarter amounted to two shillings and 6.8 pence after deducting Zambian income tax. This compared with an equivalent of five shillings and 9.3 pence per share for the first quarter of 1970.[101] Even so, Sardanis was confident that RCM was still going to earn enough money to support ZIMCO repayments of the bonds which were issued as compensation to former shareholders of RST under the Zambian government shareholder deal. As far as dividends were

93. *Investors Chronicle*, 20 November 1970.
94. By mid-1973 the price of copper on the international market rose owing to a number of factors such as reduced global stocks, and a strike by miners in the USA in mid-1971. For details, see Munene, "A History of Rhokana", p 121.
95. Roberts, *History of Zambia*, p 235.
96. *New York Times*, 28 November 1970.
97. *Zambia Daily Mail,* 9 April 1971.
98. *Financial Times*, 14 November 1970.
99. *Financial Times*, 14 November 1970; and *Investors Chronicle,* 20 November 1970.
100. *Investors Chronicle,* 20 November 1970; and *Times of Zambia,* 13 November 1970.
101. *Mining Journal*, 4 December 1970; Sardanis, *Zambia*: *The First 50 years,* pp 61–70; and Munene, "A History of Rhokana", p 115.

concerned, holders hoped for the best, but they would no doubt hope even more fervently that the Copperbelt would be spared from another such tragedy.[102]

Industrial companies that supplied Mufulira mine also felt the impact of the disaster. The most affected were the suppliers of drilling tools, compressor machines, safety and protective equipment, steel products, charcoal, poles and mining timber. Some companies almost shut down while others had orders f or goods and services revoked. One of those that almost came to a standstill was Padley & Venables (CA) Limited. A spokesperson for the firm stated that "we had to lay off 19 of our operators and workers. We are left with only 26 workers. The disaster has affected us seriously and we are in a difficult position".[103] Due to the monopoly by companies supplying the two mining houses on the Copperbelt, there was little likelihood that this supplier could sell to Nchanga Consolidated Copper Mines (NCCM), the other holding company (previously owned by Anglo-American Corporation). NCCM also had its own suppliers. Alternative export markets in the Congo and East Africa were considered but the cost of road transport proved prohibitive. Another supplier, Ingersoll Rand was saved by the effects of the disaster because it also supplied NCCM apart from RCM. However, the firm's orders from Mufulira mine were cancelled owing to the disaster. Mining Timbers of Kitwe observed that there had been a 50 per cent drop in sales of charcoal and poles to RCM mines owing to the disaster.[104]

A positive effect that came out of the disaster at Mufulira was that it led to the improvement of safety on the mines in the country, particularly with regard to the disposal of mine waste. Following the accident, two highly authoritative international publications, the *Mining Journal* and *Mining Magazine*, called on the international mining community to set up a special watchdog team equipped in such a way that it would be able to carry out periodic probes of mines to try and avoid any similar set of circumstances which could potentially cause a disaster – at any time and any place in the world – similar to the Mufulira tragedy. An urgent need for this was seen as a result of examinations made of the interim and final reports of the Mufulira disaster which underlined the problem of management on the spot being too engrossed in detailed problems of day-to-day mining to make objective analyses of problems such as those that led to the Mufulira collapse. The *Mining Journal* maintained that "expert and dispassionate inspection of major mining properties by an outside team at regular but not too frequent intervals (three to five years is suggested) would seem likely to have a most useful effect".[105] The task of the outside investigators, or the chairman's strangers, as the *Mining Magazine* termed them, was to spot if there was anything amiss at any mine in the country.[106]

The newly-created Ministry of Mines and Minerals Development began to initiate action in implementing the main recommendations of the commission of

102. *Financial Times*, 14 November 1970.
103. *Times of Zambia*, 13 January 1971.
104. *Times of Zambia*, 13 January 1971
105. *Times of Zambia*, 11 June 1971.
106. *Times of Zambia*, 11 June 1971.

inquiry. These dealt with regulations for monitoring and controlling waste dumps resulting from mining operations. The commission's report made one recommendation for the review and re-organisation in the staffing of the Mines Department. It made special recommendations on the relationship between surface subsidence, caving phenomena and underground mining; such events had to be covered by new legislation. Concerning the disposal of tailings which could behave as a fluid, the commission insisted that no caving methods of mining under rivers, lakes, swamps, drainage channels, unconsolidated water-logged formations, or other materials with similar properties should be permitted.[107] According to the Mining Safety Regulations, issued under Section 105 of the Mining Ordinance No. 146 of 1962, there was no specific prohibition of undermining tailings dams in the country. However, Regulation 202 stated that:

> … no owner or manager shall mine or permit mining on or under any land lying within a horizontal distance of 300 ft from any building, roads, railways, rivers, water rights, lakes, or any other object or surface requiring protection except with the written permission of the Government Mining Engineer and subject to such conditions as he may prescribe … whenever, in the opinion of the Government Mining Engineer, it may be necessary to protect the surface of any ground or to protect any buildings, roads, railways, rivers, lakes or any object whatever situated thereon, the Government Mining Engineer may, by notice in writing, prohibit the owner or manager from mining in any portion of a mine except under such conditions as the Government Mining Engineer may prescribe.[108]

But as the commission noted, there was no evidence, with one exception, that any of the Copperbelt mining companies ever sought the permission of the Mines Department to undermine a tailings disposal area. Neither had the Mines Department ever invoked Regulation 202 to prevent such undertakings at Mufulira No. 3 Dam or other Copperbelt mines.[109]

The commission remarked that "everyone concerned was almost certainly unconsciously influenced by the fact that any doubts about the practice (of infilling surface subsidence with tailings) raised problems which, by lapse of time, had become almost insurmountable".[110] A similar warning was contained in the comment that "a truly objective appraisal of the situation at Mufulira prior to September, 1970, was almost impossible, since both the company staff and the Mines Department had to a large extent been *conditioned* to the situation by long association" [emphasis added].[111] In this regard, the commission recommended that the mining companies should ensure that no individual mine, and the Copperbelt as a whole, became so

107. GRZ, *Mufulira Mine Accident*, p 20.
108. Quoted in GRZ, *Mufulira Mine Accident*, p 18.
109. GRZ, *Mufulira Mine Accident*, p 18
110. GRZ, *Mufulira Mine Accident*, p 18.
111. GRZ, *Mufulira Mine Accident*, p 19.

insular in their attitude that new ideas and the questioning of practices established by time and tradition were inhibited.[112]

Speaking at the unveiling of a monument in honour of the 89 mine disaster victims, President Kaunda said the miners perished in the execution of what he called the humanist revolution, fighting among other things, poverty and its offshoots of hunger, disease and ignorance.[113] He went on to say that Zambia would always remember the 89 victims as heroes who had sacrificed their lives in the service of their fellow man. The disaster also had an impact on the political landscape of the country. Zambia could not afford unemployment particularly on the volatile Copperbelt at such a time when intra-party conflict in the governing United National Independence Party (UNIP) had become rife. The opposition Zambian African National Congress (ANC) wanted to make political capital out of the disaster and took the government to task for what it termed "negligence" in the way investigations were being conducted. ANC MP for Mongu constituency, Mufaya Mumbuna, accused the government of not taking the mine disaster seriously, and of acting irresponsibly in not publishing details of the report on the disaster.[114] Earlier, when he visited some of the homes of disaster victims, whom he said were members of his party, ANC leader Harry Mwaanga Nkumbula claimed that he had "new evidence" regarding the accident. He said, "I am prepared to reveal this evidence to the Commission of Inquiry into the disaster if only the commission care to ask me".[115] While government easily dismissed these assertions, it nonetheless remained under pressure to learn what had caused the accident in order to prevent a similar occurrence from ever happening again.

Conclusion

Several hazards affect mining activities and render them among the most dangerous industries worldwide. These disasters include explosions, fires, rock and roof falls, landslides, toxic gas outbursts, and water inrushes. These hazards, however, can be prevented from escalating into accidents – or if they do escalate, their consequences can be contained or mitigated. Zambia's worst and most tragic of such events was the Mufulira disaster in 1970 in which 89 men died. The mine disaster at Mufulira is a poignant story in which all safety levers (technical, organisational, and regulatory) were pulled in the wrong direction. A number of decisions were made which precipitated the accident sequence and aggravated its consequences. As Vutukuri and Singh rightly note, the Mufulira mine accident proved that before initiating a new mining scheme or method, it is prudent to carry out a risk assessment for men, equipment before adopting the envisaged process.[116]

112. GRZ, *Mufulira Mine Accident*, p 20; and *Mining Journal*, 10 December 1971.
113. *Zambia Daily Mail*, 21 October 1976.
114. *Zambia Daily Mail,* 12 February 1971.
115. *Zambia Daily Mail*, 3 November 1970.
116. Vutukuri and Singh, 'Mine Inundation', p 122.

The disaster occurred because of the failure to foresee risks involved in the implementation of a new mining method and ways of waste disposal at the mine. The accident had serious effects on the small mining town, the families of victims, the company itself, and the national economy at large. The cataclysm led to a cut, by as much as 50 per cent, of the nation's copper production at a time when the price of the metal had already begun to fall on the international market. The resultant reduction in government revenue generation due to a decline in copper production affected the nation's gold and foreign currency reserves as government dipped into these to finance projects. While the disaster at Mufulira mine was costly in both human and financial resources, it also brought about new standards in mine safety on the Copperbelt, especially with regard to mining beneath tailings dams and water bodies.

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