

Waters of Deep Ground – Mine Water and Emotions

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Abstract

This paper will present the findings of a participatory observation conducted through interviews with different mine water related stakeholders in South Africa. The aim of the study was to describe the different viewpoints and expectations that key stakeholders in South Africa have with regards to acid mine water. This is the first study of this kind ever conducted in South Africa and it will help decision makers to deal with mine water issues outside the scientific context.

Using an interdisciplinary approach, this project aims to describe a phenomenon that by now mainly has been seen as technical, chemical or in a geological dimension. Therefore, it will also use techniques that differ from the engineering-scientific usage, such as ethnographic methods. One difference is that the project used an open format and therefore allowed an aesthetic, poetic approach in order to describe and explore metaphors of mine water, which will be presented in the paper.

In fact, mine water is as much an aesthetic as a cultural object. The questions that will be asked and answered by the stakeholders are: What is Mine Water? How is Mine Water different from “Natural Water”? What do stakeholders relate with one or the other? How do they speak about them, how do different people call it? What concepts of understanding do they have? How do concepts differ from each other?

Metaphors and beliefs direct the emotions. According to the A-B-C-model of “Rational Emotive Behavior Therapy” (REBT), all humans “construct their views of reality through their language, evaluative beliefs, meanings and philosophies about the world, themselves and others” – ‘A’ stands for activating event, ‘B’ for beliefs and ‘C’ for emotional and behavioural consequence. As much as it is called consequence, it is no use to discuss emotions in order to change them (Ellis 2004). Once a belief/metaphor/interpretation is set, the emotion is almost determined. Originally designed to treat emotional difficulties, this research project explicitly does not aim to change any beliefs, it is an approach to get a deeper understanding of what stakeholders think of mine water and its treatment.

Key words: Mine water, art, South Africa

Subjective Introduction

This paper is about mine water and emotions – and since it is different from a technical paper, it will also include “subjective”, *i.e.* “personal” perspectives. This might be an unusual concept for an engineer or a scientist, but new problems need new solutions, and therefore we are trying to tackle the mine water issue in South Africa from a new perspective:

“There was a natural well in a flood plain next to the village, about which my mother kept telling stories. One day we went searching for the well, but we couldn’t find any traces anymore. She used to know the landscape as a child before mining started. I became more interested in the topic that made the well disappear. Taking artistic practice as a point of departure, I added spatial planning, ethnography and hydrology to document and explore the post-mining landscape, where I have been living since 2012. My thesis in the progress at Bauhaus Universität Weimar, Germany, deals with the effects of Uranium mining of WISMUT Inc. in Thuringia, Germany. Together with Christian Wolkersdorfer, whom I met during a mine water meeting in Thuringia, we started a collaboration of interdisciplinary research of the post-mining effects in Gauteng, South Africa, where he teaches Mine Water Management at Tshwane University of Technology. He told me that he became devoted to mining and decided to study this subject ever since he first explored an abandoned underground mine

in Austria’s Tyrol at the age of 14. Finally, substantial similarities between the Witwatersrand and Ronneburg inspired this project. Both mining sites are within striking distance of populated areas and both deposits, besides other substances, contain radioactive Uranium in the mine water, tailings and waste rock piles. With Christian Wolkersdorfer’s support and local knowledge, I interviewed seven different people on their knowledge, relation and feelings towards mine water in their area: Two researchers, two local authorities, two environmental activists and one local resident. This paper aims to combine theory and data-collection from the field in order to explore the topic in a holistic way.”

At this stage, we did not investigate the cultural differences of South Africa and the perceptions in regards to mine water that might arise from those differences. Instead, a baseline approach was taken to identify various interpretations of mine water in South Africa, mainly in the Witwatersrand area. Yet, it might be interesting, to study whether people with different ethnical backgrounds or even the various languages in the country have different points of views when it comes to mine water and pollution.



Fig 1: Young South African men in eMalahleni near an acid mine water discharge which leaves acidic white crusts of metal sulphates.

Scientific Introduction

Acid mine drainage (AMD) became an eminent problem in South Africa when it first discharged from the Western Pool of the Witwatersrand gold fields in 2002 (Coetzee 2003). Yet, the “problem” did not begin in the year 2002, and first scientific investigations about AMD and potential health issues date back to the 1970s (e.g. Smit 1977, Wittman & Förstner 1976). Since then, and to this day, AMD in South Africa is an issue that is regularly covered by the media and NGOs (Lieberink 2010), especially when drinking water supplies are directly affected by mine water pollution (May 2012). As there is currently no uniformly accepted definition of mine water or acid mine drainage, the chemical evolution of mine water is highly complex. A large number of disciplines are dealing with mine water, so confusion for stakeholders that are scientific novices is inevitable – not only in South Africa, but world-wide (e.g. Brazil, Germany, Alaska, USA). Not everybody might immediately understand the definitions of mine water presented by Nordstrom (2011), who clearly identifies acid, circum-neutral and alkaline mine drainage. In addition, as soon as the number of chemical equations in a scientific paper or presentation exceeds (1), many people certainly claim that scientists want to hide the issue of acid mine drainage by using “scientific” language. This paper describes first results of an effort to combine scientific and artistic thinking by investigating the perceptions that stakeholders in the South African mine water context have (Fig. 1). Its starting point are identifying the philosophical concepts of “water”, the concepts of “risk” and finally the concepts of “mine water” from a stakeholder’s point of view.

Water, not solely technical “stuff”

This project starts with examining assembling aspects on the topic of water as a philosophical matter. A book concerning this topic one encounters frequently is *«L’Eau et les rêves»* (Water and dreams) by Gaston Bachelard, chair in history and philosophy of science at the University of Paris (Sorbonne). Written in the middle of the past century, it describes and analyses various qualities of “archetypes” of water. It might be of relevance to know that the author stated the production of scientific knowledge not as “a gradually increasing total body of truth, but as an active dialogue between reason and experiment” (Blackburn 1996).

Water has a long record in the history of philosophy, documented *i.e.* in the pre-Socratic western philosophy in Greece. Around 600 B.C., Thales of Miletus (the inventor of the eponymous theorem) regarded water as a primary matter (*arche*), which is alive and responsible for change and the diversity of things. A few centuries later, Empedokles, around 400 B.C., defined four primary elements consolidating the world: water, earth, fire and air – united or separated by love and hate. He was coeval of Leukipp and Demokrit, who developed the theory of undividable elements (*a-tomos*) – antecessors of modern physics and chemistry (Kunzmann et al. 2002).

Water as cognitive interest was not solely a European phenomenon. Asian philosophy of Dao, in the same era, appreciated water as a very general paradigm of all existence. In Chapter 78 of “*Tao te Ching*”, Laozi says:

“Nothing in the world
is as soft as water.
Yet for dissolving the hard and the inflexible
nothing can surpass it.

The soft overcomes the hard;
the gentle overcomes the rigid.
Everyone knows, this is true,
but few can put this into practise” (McAnally 2007, 5–6)

More metaphorical cognition can be found in the even older divination-system “*I-Ching*” (The book of changes), assumingly written between 1100–600 B.C., during the Zhou-Dynasty of ancient China. It is based on observations of political, social and natural phenomena. Famous psychologist Carl Gustav Jung used and practised it as a “method of exploring the unconscious” (Richard 1950). “The book of Changes” is compiled from eight hexagrams – where water is used as a source of metaphorical imagination and cosmology – it represents a building block (“trigram”) of life. Within a complex system, the elements (wind, water, rock, sky ...) interact with each other, create images and divination, which those who inquired adjusted and interpreted with regard to their own lives.

Our cultures are mainly rooted in these and similar stories, metaphors and beliefs of cosmology. This is, in other words, what Gaston Bachelard calls “imagination”. His concept of “water” is defined as based on the pre-Socratic ancient Greek philosophy of the four elements (Bachelard 1983, 3). For his examination, he also analyses poetry – works by Samuel Beckett and Edgar Allen Poe. Especially the chapter on “*Deep Water*” is contextualised with dark, melancholic aspects such as: “to contemplate water is to slip away, dissolve, and die” (Bachelard 1983, 47). In his chapter on “*Imagination and Matter*”, he states, that “Water is truly a transitory element. It is the essential, ontological metamorphosis between fire and earth. He [sic!] dies every minute; something of this substance is constantly falling away. (...) Water always flows, always falls, always ends in horizontal death.” (Bachelard 1983, 6). But water can also be maternal and nourishing (Bachelard 1983, 119). Another quality of water is its ability to reflect – more truly than a solid mirror could, as the story of Narcissus tells us. Furthermore, it has the ability to assimilate “all kinds of substances, even contrary matters joining its fluidity” (Bachelard 1983, 93) – it even “moderates the other elements“. And most of all, it “radiates purity” (Bachelard 1983, 143).

Ivan Illich’s book “*H₂O and the waters of forgetfulness*”, which basically refers to “*Water and Dreams*”, draws various lines even further. Not only, that this “tangible”, but “elusive” element would dilute other substances, even more it has a “nearly unlimited ability to carry metaphors“. It “always

possesses two sides” – in some African languages “water of beginning” was also detonated as twins: “Water is deep and shallow, life-giving and murderous. Twinned, water arises from chaos and waters cannot be, but dual” (Illich 1986, 24–25).

Across cultures, when a person dies and travels from life to death, the “other world” often lies beyond a body of water – a river, an ocean, a bay – sometimes by walking, sometimes with a ferry. “The slow, flowing waters the traveler crosses are everywhere emblematic of the stream of forgetfulness; the water has the power to strip those who cross it of memories that attach to life” (Illich 1986, 30).

Besides his work on further development of the interpretation of the qualities of water, Ivan Illich's merit in the 1980s was to outline the dichotomy of the two concepts about this “stuff”: “From the start I shall refuse to assume that all waters may be reduced to H₂O. (...) For not only does the way an epoch treats water and space have a history: the very substances that are shaped by the imagination – and thereby given explicit meanings – are themselves social creations to some degree” (Illich 1986, 4).

From Roman aqueducts to contemporary plumbing systems, he describes the process of an alienation. H₂O to him became just a scarce, technical resource to be managed, without a history, without imagination. In the beginning of the last century, due to fear of newly discovered bacteria, people started “to abstain from drinking water unless it came from an approved faucet or bottle“. People (in the US) stopped having contact to untested, untreated natural water. In the second half of the century, this process increased: “entirely new and unthought-of pollutants became known. Many people refused to serve it to their children as drink. The transformation of H₂O into a cleaning fluid was complete. (...) Water throughout history has been perceived as the stuff which radiates purity: H₂O is the new stuff, on whose purification human survival now depends” (Illich 1986, 75).

Perception of risk

As mentioned above, water in general became associated with a “risk”. According to Ulrich Beck, whose famous book “Risikogesellschaft” (Risk society) was first published in 1986, “risk [has become] the defining characteristic of our age” (Beck 1992, quoted in Adams 2002, 180). Unlike more traditional human concepts of dangers, risks are expansive, invisible and can only be judged by experts. Ortwin Renn, Chair in Technik- und Umweltsoziologie at the University of Stuttgart, adds his concept of “creeping danger”, as most risks we experience today, are imperceptible through our senses and impossible to assess through experience, but are “communicative signals, that cause specific recognition”. This can clearly be seen by the results of the study by Munnik et al. (2010) in the Witbank Area of Mpumalanga, where post-mining “conditions worry the residents”. Exposure to radiation, toxic chemicals in the air and drinking water – all these are risks perceived through communicative signs. Therefore “it is typical for creeping danger that it takes place outside of our personal, sensory perception. We depend on others to believe – or not –, whether there is a risk”. While technical understanding of risk mainly includes the probability and the magnitude of harm (Renn 2014b), the “public” adds much more components involved into their highly individual risk assessment.

Researchers in the field of cultural theory criticized the hegemony of statistics and technical risk assessment. For example, John Adams claims in his book “Risk”, that statistics of fatal crashes with their great volume and distinct causes are one of a few subjects of “reliable statistics” (Adams 2002, 11). Usually, “league tables” that show “probabilities of death from different causes – from ‘radiation’ to ‘being a coal miner’ – are constructed from data of immensely variable quality”. While statistics, created by the number of accidents “per unit of time (...) are interpreted by experts as objective indices of risk and are sometimes compared with the subjective judgements of lay people, usually with the aim of demonstrating the hopeless inaccuracy of the latter” (Adams 2002, 12–14).

Risk assessment is not a one-way-track and it is a dynamic process – “Risk is culturally constructed” (Adams 2002, 9). The perception of risk may for example depend on age, gender, nationality, mental state, personal experiences – interpreting statistics “as objective measures of risk for individuals” would be an “insuperable problem” (Adams 2002, 14). Furthermore, risk assessment is an interactive process, since “both individuals and institutions respond to their perceptions of risk by seeking to manage it, they alter that which is predicted as it is predicted” (Adams 2002, 14).

The psychometric paradigm of risk research originates mainly in the work of the “Oregon Group” of Baruch Fischhoff, Sarah Lichtenstein and Paul Slovic. Some of their risk-related variables, as listed in Rohrman (1999, 8), are: risk level aspects (such as estimated annual number of fatalities, magnitude of risk, (un)avoidability of accidents/disasters and danger of health) or qualitative features: dreadfulness, associations with fear, (un)familiarity, known to exposed, (not) observable, un(controllability), (un)known to science, immediate vs. delayed effects, impacts for future generations – plus all personal relations to hazard, such as being (in)voluntarily exposed, personal influence on choice, degree of concern, being worried, personal exposure, being personally affected and the desired distance to hazardous facility. On the other hand, there are benefit aspects such as those provided by risk source for an individual, social benefits, revenge for human needs and acceptability aspects including the social acceptability of a risk or willingness-to-pay (for risk mitigation) (Renn 2000, 21).

Ortwin Renn specifically outlines the freedom of choice to be exposed to the risk as a main factor in risk assessment, as well as whether a source of risk is perceived as “artificial or natural” (Renn 2014a, 257). Risks from “natural” sources are judged less critical compared to “artificial” ones. Also, the state of knowledge, both personal and scientific, influences the perception of risk and contributes to individual risk perception. Associated with this knowledge factor is the public trust in quality of information and “performance” distributed with the source of risk by experts, as outlined in the introduction. Components which build “credibility” are impartiality, openness, transparency and honesty. The component which is judged as “performance” is compiled by competence, fairness and the commitment a person perceives.

Interviews

We collected data in seven qualitative interviews with stakeholders being involved in post mining and mine water issues in the South African Gauteng Province, mainly in the Witwatersrand, as this has not been done before within this context. All seven interviews were conducted in a semi-structured manner, six were arranged, while only one was captured spontaneously in the field. As mentioned above, they are not categorized by name, gender, nationality, ethnical background nor along the level of education or the like. Build categories of relation towards mine water are: expert, representative of local authorities, environmental activist and local lay person. This section is a first trial to interpret these interviews.

The opening questions were always asking for a definition of what the interviewee regards as mine water; secondly, whether he or she considers it as a natural or artificial phenomenon; and thirdly which was his/her relation towards it.

Concerning definitions of mine water, the answers overlapped each other. Most trained experts, either scientists employed by institutes or officials from local authorities stated definitions similar to the following: “Mine water is any water which is involved in or affected by mining processes. So it is water flowing into mines, flowing out of mines, water used on mines“. Especially the environmental activists endeavoured for a comprehensive definition including suggesting a row of examples while stressing that mine water does not necessarily need to be acidic. One found that “different definitions are confusing“, while he claimed that there are “very active NGOs in the area – and they love confusion, they love vagueness“. He thinks that they benefit from this inaccuracy, which is why he created his own definitions. Only one person within the interviews, a local layperson, admitted: “I don’t want to lie to you. I don’t have no clue what I define as mine water“. However, she is confronted daily with the observation and contact: “the water was running from that side. Normally they [*i.e.* the experts, G.R.] said, there was something that they said, ‘How did this water grow on that side?’, because they said, its coming from a certain somewhere and pulling through and that’s why it’s just accumulating and stuff like that. Really I want to say to you: I really don’t have any clue, but when you go nearer to the water, you can see: it’s not clear water! There is different kind of chemicals or different designs that is also flowing in that water. I think, the water is also more poisoning“. As can be seen, her relation to mine water seems different from the others, possibly because she is much more personally affected and does not have reliable, easily understandable information on this subject. Furthermore, she is involuntarily exposed to the source of risk. With emphasis she said: “My feeling towards this water on the right hand site is to say: they have to remove it! We are really not happy

with it. We don't want it, it doesn't belong to us and there is no other area that people can move us to". Another substantial statement within this first question on definition was that one of the researchers addressed it first of all as a "serious, environmental problem world wide", that is costly to the public. Fitting this statement, an authority interviewee found a "negative connotation" to the term "mine water".

Answers to the "natural/artificial" questions varied much more. The only person who found it clearly "artificial", claiming that it was against the "normal geological formation", was a representative of local authorities. The other representative found it "natural, but partly modified". One of the activists evaded the question saying it was "disturbed and changed", the other regarded it as "natural". One expert called it "both", as acid rock drainage was a natural phenomenon, while acid mine drainage arose through human activities and therefore is artificial. Another one called it "allogenic", he suggested to use the term "anthropogenic" instead of "artificial", although, this term to him "doesn't mean much, when it comes to water resources".

Conclusions

As has been shown in this baseline investigation, the judgement on mine water substantially depends on the information on the subject and voluntary nature or freedom of choice to its exposure. A local person personally affected, possessing almost no resources to escape or unwilling to move (*e.g.* because of social local networks), may perceive the threat more intensively than someone less engaged and with more spatial and social distance. Risk – as has been seen – is not objective, but subjective. It is important to acknowledge this fact and respect it when communicating with the public or communities. As Renn says, trust is nothing that can be built, but only facilitated through credibility and fairness (Renn 2014a).

Concerning the "naturalness" of the source of risk, it remains an open question why the interviewees varied so much in their assessments. One interpretation could be that they separate mining activities and mine water from each other.

Drawing together all findings, it emanates that the dual nature of water reveals itself once more in mine water – especially, when it is perceived at least as partly natural. It takes up substances from an unknown realm – dark, deep and disturbed through human activities. This fact may also contribute to the qualitative feature of hazard: namely fear association.

If we extend the argument further concerning imagination, the question is whether there could be an archetype of mine water and if so, what would it look like? If we agree with Illich/Bachelard, there is a lack of metaphorical embedding – a rather general approach is missing, not only a technical approach or treatment, stressing aspects of controlling, but also cultural and philosophic concept of this matter. It may be similar to what James Griffith (Department of Forestry Engineering, University of Vicosa, Brazil) suggests as "narration incorporated into ecological restauration", specifically speaking about post mining sites in Brazil (Griffith 2014). His argument is that "narration" would support a more subjective approach towards a landscape. As water is a part of a landscape, mine water is too. This is the case even if it is an unplanned and an unwanted entity or process. Suppression and ignorance from the cultural perspective may not lead to a sustainable and reliable practise with this entity.

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