LIGHTNING MYTHS AND BELIEFS IN SOUTH AFRICA: THEIR EFFECT ON PERSONAL SAFETY

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Declaration

I declare that this thesis is my own unaided work. It is being submitted for the Degree of Doctor of Philosophy to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

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Signed this ……….. day of …………….., ……………

For Wim, Markus and Daniël

Abstract

Every year, lightning kills and injures people and animals and damages property in South Africa. Rural people who work outdoors tending the land or herding animals are particularly vulnerable to lightning strikes. A lightning awareness effort might help to reduce the annual number of lightning deaths in South Africa. This thesis describes an attempt at understanding southern African traditional myths and beliefs related to lightning and to examine how these could inform lightning awareness and education. Lightning awareness efforts in other countries are assessed in terms of their suitability with respect to South Africa. Finally, a model for a mobile lightning warning and awareness is proposed based on the current African mobile culture. Mobile telephones have created a revolution in communications in Africa. Millions of people living in rural areas never had any infrastructure: no fixed-line telephone infrastructure, not even electrical power, hence no computer communications, but mobile telephones and the short message service (SMS) have changed that. The proposal suggests leveraging the exponential growth of a mobile culture in Africa and gives a high-level outline of what such a system might look like.

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1 Introduction

Lightning kills many people in South Africa every year. Reports in the lay press indicate that in January 2011 alone, 17 people were killed by lightning in the Eastern Cape, KwaZulu-Natal and Mpumalanga.

Research around the world shows that people who are outdoors during a lightning storm face the highest risk of being killed or injured by lightning. South Africa has a large rural population, with many people involved in subsistence farming and it is those people, who work outdoors tending the land or herding livestock, who are most vulnerable. Even indoors, rural people are at greater risk since most live in houses that have no lightning protection systems and many do not even have reinforcing steel, metal plumbing or electrical wiring that can provide a path for a lightning current to ground (Gomes, 2006), (Cooray, 2007), (Cooper, 2010). In addition, many rural homes either have thatched roofs or newspaper to insulate the roof, both of which can easily be set alight by lightning.

Focusing on lightning fatalities, however, hides the true extent of the problem because lightning injures more people than it kills – a ratio of ten injuries for every lightning death seems to be a commonly used rule of thumb (Rakov, 2003), (Cooper, 2010). Lightning also destroys livestock and property.

One way of addressing the problem would be to provide lightning awareness education that reaches the maximum possible number of people with information regarding personal safety during an electrical storm. The worldwide need for lightning awareness campaigns is well established in the literature (Holle, 2008), (Lengyel, 2010), (Ab Kadir, 2010), (Jandrell, 2009), (Eriksson, 1986), (Dlamini, 2009). Indeed, the decline in the number of lightning deaths in the United States has been partly attributed to the effectiveness of lightning awareness campaigns (Holle, 2008), (Lengyel, 2010).

Jandrell (2009), Eriksson (1986) and Dlamini (2009) have pointed out the need for lightning education in southern Africa, but to date this has not happened.

South Africa has a very diverse population and people from different cultural backgrounds have different traditions and beliefs. It would, therefore, be

important within the South African context, to gain an understanding of the myths and beliefs regarding lightning, because lightning education should take cognisance of this knowledge.

A project was initiated in 2009 to attempt to understand traditional myths and beliefs related to lightning. It was innovative as it required working at the interface between the humanities, science and engineering. It brings together an interest in indigenous knowledge systems and a curiosity about whether these could inform strategies for increasing the safety of rural communities.

This thesis resulted from the project and addresses the following research questions:

- What are the common myths and beliefs surrounding lightning in different areas in South Africa?
- How do the myths and beliefs that make people either more or less vulnerable to being killed or injured by lightning?
- What role should these myths and beliefs play in a lightning awareness safety campaign?
- What form should a lightning awareness campaign take in South Africa?

All the questions contribute to the investigation of the central hypothesis that underlies this work, namely that people's perceptions and unquestioned traditional beliefs about lightning, combined with a lack of information, could affect their risk of being killed or injured during a thunderstorm. Hence this thesis considers both traditional beliefs and a possible approach to create lightning awareness. This thesis considers the hypothesis by breaking it down into the following steps:

1. Finding and recording common beliefs from a wide variety of data sources;
2. Evaluating whether the beliefs increase or decrease people's risk of being killed or injured by lightning;
3. Considering whether it would be useful to address the common beliefs and perceptions in a lightning awareness or education effort;
4. It concludes by proposing a lightning awareness model that would be useful and effective in South Africa.

The material is arranged to provide some general background in Chapter 1, which will establish the need for a lightning awareness campaign in South Africa by looking at lightning occurrence patterns and lightning death statistics, as well as the motivation provided by engineering codes of practice. Chapter 2 documents the methodology that was used to gain some insight into lightning myths and beliefs in South Africa and gives examples of each method that was used. In Chapter 3, some of the common myths and beliefs are recounted. Chapter 4 examines lightning awareness campaigns in other countries and gives a critique of how well suited each would be in South Africa. The chapter concludes with an assessment of whether the beliefs discussed in Chapter 4 contribute to risk with respect to lightning injury. Chapter 5 makes a proposal about possible ways of approaching a lightning awareness campaign here, followed by some general conclusions in Chapter 6.

1.1 Lightning occurrence patterns in South Africa

There are about five million cloud-to-ground lightning flashes per year around the world (Evert, 2005). Satellites equipped with technology that can detect optical and radio frequency radiation emitted by lightning, have made a large volume of data about lightning activity available in the past three decades (Rakov, 2003). About 40 countries have lightning detection networks and the data from these networks continue to be of interest to the lightning research community. Evidence of this is provided by a number of papers in the International Conference on Lightning Protection (ICLP) in Vienna in September 2012, for example, research using alternative methods of lightning stroke detection to verify the accuracy of lightning detection networks (Mata *et al*, 2012), (Naccarato *et al*, 2012), (Lu *et al*, 2012), (Saito *et al*, 2012).

The information collected by lightning location systems can be used to establish how much lightning there is in South Africa compared to other countries and to determine which areas in South Africa are most vulnerable.
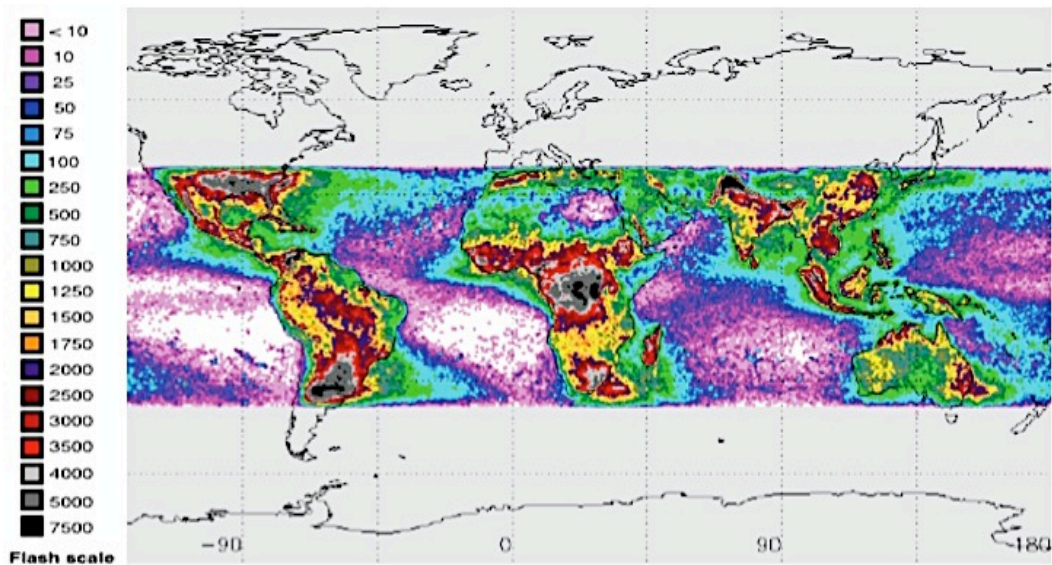
Figure 1.1: Image of the total number of lightning flashes detected by a lightning imaging sensor aboard a satellite, recorded between January 1998 and November 2010 (Global Hydrology and Climate Center, 2011). The greyed-out areas indicate areas not covered by the lightning imaging sensor.

A satellite image of the total number of lightning flashes compiled by NASA (National Aeronautics and Space Administration) over a 13-year period between January 1998 and November 2010 is shown in Figure 1.1 (Global Hydrology and Climate Center, 2011). The data was obtained from NASA's Lightning Imaging Sensor, which detects both cloud-to-cloud and cloud-to-ground lightning in a particular band around the equator. Researchers have found that the flash rate reaches a maximum value at the equator and drops off as the latitude increases (Cooray, 2003), thus the grayed-out areas not covered by satellite detection in Figure 1.1 are likely to experience less lightning flashes than the latitudes that are covered. Figure 1.1 shows that South Africa is subject to a high lightning flash rate, with large areas receiving between 3500 and 5000 flashes. These flash rates are ranked second, third and fourth on the image's flash scale, which is surpassed by very few countries in the world.

Locally, South Africa's lightning ground flash density information for the period between 1975 and 1986 was collected by the Council for Scientific and Industrial Research (CSIR), but more recently, the South African Weather Service (SAWS) implemented the Southern African Lightning Detection Network (SALDN), that consists of 20 lightning location stations (Jandrell, 2009).

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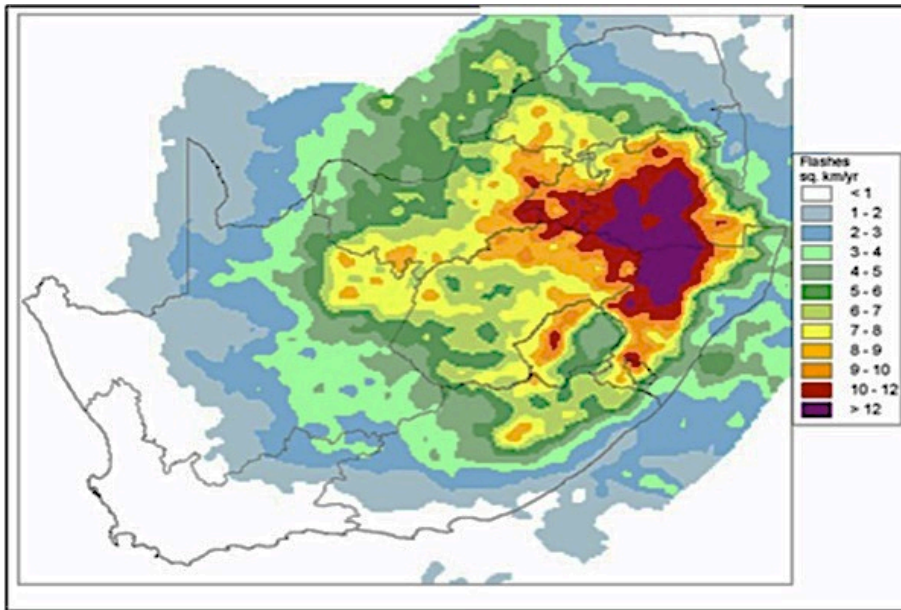
Figure 1.2: Lightning ground flash density map based on data collected by the South African Lightning Detection Network for the period 2006-2008 (Jandrell, 2009)

The SALDN map in Figure 1.2 shows that the areas in South Africa with the highest lightning ground flash density N_g (flashes per kilometer squared per year) are Gauteng, the Drakensberg and the interior of KwaZulu-Natal. In a substantial area, the ground flash density exceeds 12 N_g km^{-2} $year^{-1}$. Since Gauteng is densely populated, this poses a non-trivial risk to personal safety.

1.2   Statistics on deaths and injuries due to lightning

Lightning is one of the major causes of weather-related deaths (Ab Kadir, 2010). In the United States for example, it is second only to floods as the natural hazard that kills the most people (Cooray, 2007), (Carte, 2002).

South Africa does not have a repository of data on the number of deaths and injuries due to lightning, but this is consistent with the same frustration experienced by lightning injury researchers around the world (Ab Kadir, 2010). Blumenthal (2005) and Meel (2007) both comment on the scarcity of data on lightning fatalities in South African medical literature.

Internationally, statistics indicate that people engaged in outdoor activities are most vulnerable to be killed or injured as a result of a lightning strike (Rakov, 2003), (Ab Kadir, 2010), (Meel, 2007), (Zhang, 2010). Using data from medico-legal laboratories, Blumenthal (2007) found that during the period 2001 – 2004, lightning killed 52 people in Gauteng province – all of

them were outdoors. Data from the United States indicates that 30% of people killed by lightning were working outdoors (Rakov, 2003). This means that rural people who work outdoors tending the land or herding livestock are most susceptible. Indeed, the annual lightning death rate in the United States has declined steadily since the 1930's, which is partly attributed to a decrease of the rural population in general and, in particular, a decrease in people involved in agricultural labour (Holle, 2008).

South Africa still has a substantial rural population. The total population of South Africa is estimated to be 49.99 million (Statistics South Africa, 2010), of which 43.7% live in rural areas (Versteeg, 2010). The country has a large agricultural sector that employs farm workers and many rural people are involved in subsistence farming. There are thus many people who could potentially be at risk during lightning storms.

Lightning death and injury statistics are often based on reports in the lay press, namely on-line and print newspapers.

There are, however, two problems with using the lay press as a source of information. Firstly, the press relies on its news gathering network and the public for information. If a lightning death occurs in a remote rural village in South Africa, as has been reported for Asia (Ab Kadir, 2010), the news might never reach the newspapers. Secondly, news items compete for space in the news media, so even if the press does have information about a lightning death, it might be crowded out by another item, deemed to be more important or newsworthy (Cooper, 2010).

It is thus clear that the lay press cannot be relied on as a consistent source of information, but it does provide a glimpse into the extent of the problem, although the actual number is likely to be higher due to the problems associated with using data from the lay press.

Statistics from the South African on-line lay press and other sources have been collated and sifted for repetitions and are shown in Table 1 in Appendix A. The information indicates that 135 people were killed by lightning between 1 January 2009 and 31 January 2011. Given the tendency that lightning deaths are underreported in the lay press, it is safe to say that at least 135

people died of lightning related deaths during that period, but the exact number would be greater than that.

Holle (2008) uses a rate of fatalities per million people to compare lightning deaths in different countries. He reports a current rate of about 0.3 deaths per year per million people in Australia, Canada, Europe, Japan and the United States. Using the data in Table 1 of Appendix A, South Africa has lightning fatality rate of at least 1.01 per million people per year, more than three times the rate in the developed countries described by Holle. There is thus much room for improvement.

The problem of the news media underreporting lightning deaths is compounded when considering other damage caused by lightning. There are no records of how many people are injured by lightning strikes, but there could potentially be a large number of people who are affected. It seems that, as a general rule of thumb, about 10 people are injured for every person killed (Ab Kadir, 2010), (Holle, 2008). This statistic is borne out by a news report on 27 November 2010 (Myburgh, 2010) of an incident in Pongola, KwaZulu-Natal: a local crèche held a year-end party in a marquee tent. The tent was struck by lightning and six people were killed, more than 60 injured and admitted to hospital.

Besides killing and injuring people, lightning also kills livestock and game and destroys property. If human deaths and injuries are underreported, it stands to reason that such incidents are even more substantially underreported. There are, however, press reports that confirm that this is not pure conjecture. In November 2010, 47 head of cattle were killed by lightning in the village of GaMatlala, in Limpopo (Matlala, 2010). For the villagers, this was a disaster - the headman of the village is quoted as saying that "stock farming is our only means of survival". The Daily Sun reported lightning killing 15 of a man's 32 goats in January 2010 (Ramotekoa, 2010). The report, shown in Figure 1.3, included a photograph of the dead goats. In February 2011, lightning killed a male lion on a game farm in the Free State province (Van Der Merwe, 2011). The lion was used for breeding and was reported to have a value of R400 000.

Figure 1.3: Daily Sun (Ramotekoa, 2010) report on goats killed by lightning

1.3 Engineering codes of conduct

The question might be raised as to why engineers should make any effort to understand local myths and beliefs about lightning and the answer lies in professional ethics and codes of conduct to which engineers subscribe.

The Rules of Conduct for Registered Persons of the Engineering Council of South Africa (ECSA) (Government Gazette, 2006) are used for illustrative purposes, but many engineering codes of conduct worldwide contain similar clauses. ECSA is the statutory body that regulates registration as a Professional Engineer. A code of conduct can be described as a set of rules that prescribes how the members of a profession are to conduct themselves in matters pertaining to their professional lives. ECSA's Rules of Conduct for Registered Persons are entrenched in South Africa's legislation in the South African Engineering Profession Act 46 of 2000 (Engineering Council of South Africa, 2010), so everybody registered as a professional engineer by ECSA is bound by it.

The Rules are introduced by a paragraph stating that their purpose is, amongst other things, to ensure that registered professional engineers (Government Gazette, 2006):

- "apply their knowledge and skill in the interest of humanity and the environment";

- "respect the interests of their fellow beings".

Furthermore Rule 3(3)(a) states that engineers "must have due regard to public safety, public health and the public interest generally".

It is evident from these sections of the Rules of Conduct for Registered Persons that engineers should care about and take into consideration the local beliefs when they interact with communities. In a country with a homogeneous population, this would not be such an issue. In a country like South Africa, however, there is large diversity of groups with different languages and cultural identities. The challenge to engineers introducing technology into an area is to understand and accommodate such local views.

1.4   Indigenous knowledge systems

A second motivation for this work comes from a growing interest in South Africa in so-called indigenous knowledge systems (IKS) – this can be seen from the journal *Idilinga – African Journal of Indigenous Knowledge Systems*, that is dedicated to IKS and has been published twice per year since 2002, as well as South Africa's National Research Foundation, that includes indigenous knowledge in the research that it funds (National Research Foundation, 2012:9). In its strategic plan, the National Research Foundation (NRF) describes its mandate as promoting and supporting research "… in all fields of science and technology, including indigenous knowledge…". Indigenous knowledge in Africa is a way of doing things and of thinking about things that developed over a long time as people learned to adapt to the environments where they were living (Moji, 2009).

The distinction between IKS and myths is that IKS is a term that is used to describe traditional ways of doing and thinking that could add value to current endeavours, whereas myths are any traditional beliefs.

One of the directions in the interest in indigenous knowledge systems seeks to incorporate local traditional ways of thinking and doing into learning and teaching and to exploit it in commercial projects. A recent example is the commercialisation of dieting products containing *hoodia*. *Hoodia* is a plant that was used by the San to control their appetites during periods when food was scarce.

The Department of Basic Education (DBE) is seeking to promote indigenous knowledge by including it in the school curricula, where it might contribute to the understanding of concepts in the curriculum. The DBE defines Indigenous Knowledge Systems as knowledge that communities used (or might still be using) and passed on from one generation to the next (Department of Basic Education, 2012a:7). In the Curriculum and Assessment Policy documents for Grade 10 – 12 for both Life Sciences and Physical Sciences (Department of Basic Education, 2012a), (Department of Basic Education, 2012b) the need for including indigenous knowledge is mentioned. The curriculum cites the physics example of using friction to make fire. Pabale (2006) and Maselwa (2004) used different methodologies to investigate whether local lightning beliefs could be incorporated into school physics lessons on electrostatics.

By interacting with communities, engineers might learn something of interest by subjecting their indigenous knowledge regarding lightning to scientific scrutiny or, alternatively, to spread lightning safety awareness by leveraging indigenous knowledge that promotes safe behaviour during an electric storm.

1.5   Concluding remarks

This chapter has made a case that there are many lightning deaths in South Africa annually and that there is a need for a lightning awareness. The chapter has also laid out the underlying hypothesis of the thesis, namely that the things that people believe about lightning and their lack of information could affect their chances of being killed or injured during an electric storm. It has also outlined the steps that were followed to investigate this hypothesis.

2 Methodology

In Ian McEwan's novel Solar, the antihero of the story is Prof Michael Beard, a winner of the Nobel prize in Physics. When Beard meets a Humanities lecturer who says that he is interested in the narrative that climate change has generated, Beard thinks that "People who kept on about narrative tended to have a squiffy view of reality, believing all versions of it to be of equal value." Although the novel is written in a tongue-in-cheek way, it does point to a two real problems, namely:

- The wide divergence of humanities and social sciences viewpoints on one hand, and science and engineering viewpoints on the other hand;

- The tendency of scientists and engineers to dismiss interpretations that fall outside of scientific methodologies.

The challenge of this study was for a researcher with an engineering background to collect data from outside the field of science and engineering and to use methodologies that are unfamiliar to engineers. This section gives an overview of the methodologies that were used in this study to gain insight into lightning-related myths and beliefs and provides details of the data collection procedures employed. To gain an understanding of these myths and beliefs, engineers have to venture into fields that are unfamiliar to them, such as literature, oral tradition, anthropology and interviewing.

2.1 Quantitative versus qualitative methodologies

In science and engineering, research mostly tends to be quantitative in nature: the researcher postulates a hypothesis, devises an experiment that will test it, takes measurements and analyses the measurements to determine whether or not the hypothesis was correct. The type of data or measurements that are collected, can be analysed and evaluated in an objective, dispassionate way. Key issues are data reliability and sufficiency, i.e. what is the margin of error in the measurements and is there enough data to give a representative sample with respect to the hypothesis?

In humanities and social sciences, on the other hand, a large volume of research is qualitative. Denzin and Lincoln (2005) define qualitative research

as: "…study[ing] things in their natural setting, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them." (Denzin *et al*, 2005:3). Corbin and Strauss define it as: "A process of examining and interpreting data in order to elicit meaning, gain understanding, and develop empirical knowledge." (Corbin *et al*, 2008:1). Creswell(1998:15) describes it as "an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting."

The methods that are used in qualitative research include case study, interviewing, observing participants, collecting and analyzing documents, artifacts or audiovisual material (Corbin, 2008), (Creswell, 1998). Contrary to the scientific method, which strives for objective numeric data, qualitative researchers are interested in understanding how people experience things and make sense of phenomena. The observations and interpretations of the researcher are also important, therefore this chapter outlines how the research question developed and was shaped and changed as the research progressed.

A useful metaphor for qualitative research in general and this study in particular, is that of the researcher as a quilt maker (Denzin *et al*, 2005), who uses whatever bits and pieces of material (s)he can find and stitches them together to create a new picture that gives a fresh perspective. In this project, information on people's perceptions of lightning were collected and assembled to shed light on whether the things that people believe put them at greater risk of lightning injury.

Charmaz (2007) speaks of collecting rich data for qualitative research. In this study, the data is given richness through the use of many different sources, namely interviews, literature in the form of short stories and praise poetry, and oral tradition.

Another important difference is that quantitative researchers start off with a theory and then construct an experiment that will either prove or disprove the theory. Alternatively, they start with an observation and then develop a theory

to generalize the observed behavior. Qualitative researchers, on the other hand, do explorative research, that asks: "What is going on here?" rather than seeking evidence to answer a specific question. Grounded theory, proposed by Glaser and Strauss (1967), is an example of explorative research: the researcher systematically collects and analyses rich data to come up with a theory (Glaser *et al*, 1967), (Creswell, 1998), (Charmaz, 2005).

In this study, both qualitative and quantitative approaches are of value, thus the methodology used was a mixed methods methodology, as described in Section 2.2.

2.2 Mixed methods and a grounded theory approach - the methodology used for this study

The approach adopted for this study is a pragmatic one that acknowledges that both qualitative and quantitative research can contribute to a better understanding of lightning myths and beliefs in southern Africa, hence the methodology used for this study is a mixed methods methodology. Pragmatism means that you do what works for your specific study and both subjective and objective knowledge are valued (Creswell, 2007). Morse (1991) pinpointed the greatest advantage of mixed methods when she said that smart researchers have the versatility to choose from many research methods, but of course the researcher must make sure that the choice of the repertoire of methods is carefully motivated.

There has been a growing interest in mixed methods over the past twenty years, where mixed methods researchers integrate both qualitative and quantitative approaches in a single study (Barnes, 2011). Creswell suggests that in a mixed methods study, metaphysical concepts like *truth* and *reality* should be abandoned (Creswell, 2007:27), therefore the researcher does not have to be bound by either a positivist or a constructionist worldview.

The mixed methods design followed in this project is a triangulation design, where one type of data is used to validate or expand the other data type (Creswell, 2007), (Barnes, 2011).

When using mixed methods in a study, the researcher must decide:

- Whether the qualitative and quantitative parts of a study are sequential or concurrent. In sequential research, the collection of one data types cannot proceed until the other has been completed (Barnes, 2011), (Morse, 1991), (Creswell, 2007).

- Whether the qualitative and quantitative parts of the study are equally weighted or not (Barnes, 2011), (Morse, 1991), (Creswell, 2007).

For this study, the qualitative and quantitative data collection can occur simultaneously and the qualitative data is more heavily weighted, as one does not rely on the other. The qualitative data comprises the collection and analysis of references in the oral tradition, literature and interviews. The survey questionnaire is the quantitative part of the study and it is used to demonstrate that the myths and beliefs are not unique to a few individuals,, but represent the beliefs of a larger section of the population.

Graphically, the research design is shown in Figure 2.1.
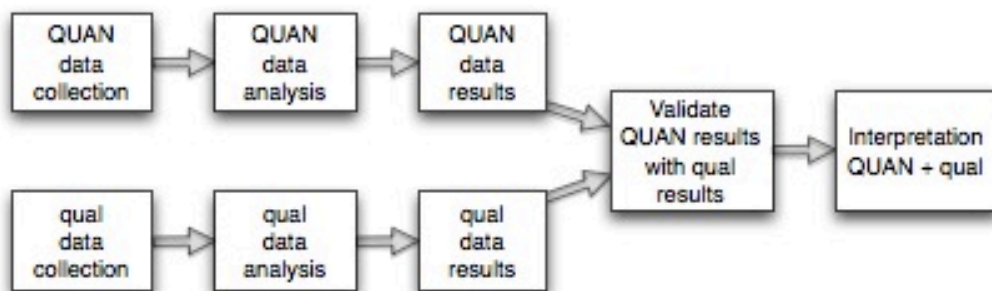
Figure 2.1: Mixed methods study design

The qualitative part of the study was conducted using a grounded theory methodology as described by Charmaz (2006). In grounded theory, a theory is developed based on the data. Sometimes, as happened in this study, data is collected based on an initial research question, but analyzing the data suggests a new direction.

The research process used in this study is shown graphically in Figure 2.2. It starts with the definition of a research question. In this case, the initial research question was: *How do South African lightning myths and beliefs relate to the physics of lightning as understood empirically by engineers and scientists today?* To test lightning myths against current physical knowledge, the

first step is to track down the myths and beliefs. The first iteration of data collection, therefore, involved casting the net widely to identify a range of potential sources of folktales, myths and legends.
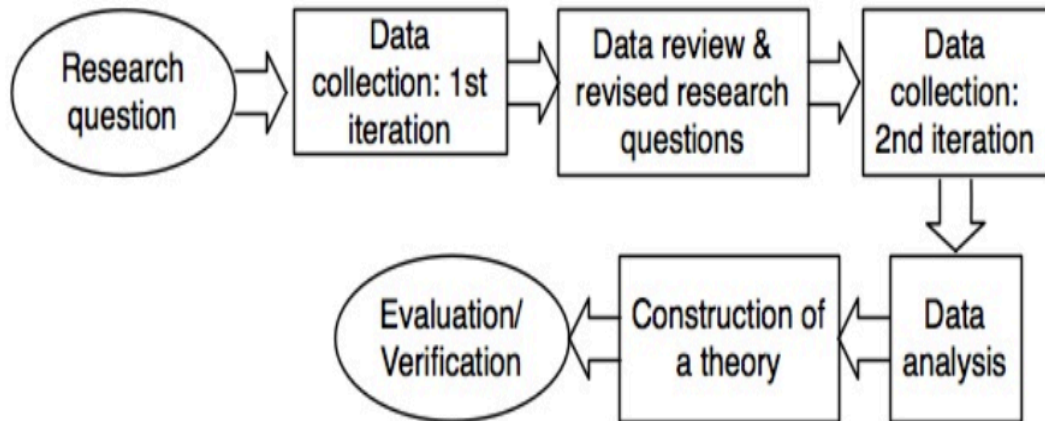
Figure 2.2: Qualitative methodology used for this study

There is no collection or volume bringing together all the South African lightning stories and certainly no work that has systematically researched the stories in a qualitative way.

Using the major secondary sources[1] and expert opinion, I identified oral tradition, oral narratives and poetry as my initial source. I supplemented these with both academic collections of myth and folktales (Berglund, 1976), (Werner, 1933), (Schapera, 1971) and with popular renditions of folktales such as Bourke (*circa* 1948) and Cantrell's (1978) collections and Phyllis Savory's volumes of folktales written in English, such as the *Zulu Fireside Tales* (Savory, 1963) and *African Fireside Tales* (Savory, 1982).

As the research progressed, I extended the sources to include contemporary material in the form of literature and newspaper texts from the popular South African tabloid, the Daily Sun, as well as interviews from a range of sites.

The data collection procedures are described in detail in paragraph 2.3.

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[1] As regards the secondary sources that I used in mapping the field, I relied on Finnegan (1970) and White (1982), major commentators on African oral literature and southern African praise poetry respectively. I also drew on the scholarship of Hofmeyr (1993) and Vansina (1985) and older African anthropological studies by Werner (1933) and Krige (1936). Arising from these, I identified two major sources of oral tradition, namely the Bleek and Lloyd archive and the texts written by Bishop Henry Callaway, both discussed in paragraph 2.3.1 and in Chapter 3.

The myths, tales and beliefs documented during data collection, are discussed in Chapter 3, with commentaries with respect to the current empirical understanding of the physics of lightning.

Early on in the study, it became apparent that nothing of substance would come of the initial research question, since most of the myths are unrelated to the current scientific understanding of lightning. As described by Charmaz (2006), the data suggested a shift in the research direction. Since there seemed to be no connection between the physics of lightning, the data suggested a more fruitful research question would be: *How do commonly held myths or beliefs either increase or decrease people's risk of being killed or injured by lightning?* A secondary question that would arise from this analysis would be whether this information could be incorporated in a local lightning education initiative, either to warn against dangerous behaviour or to encourage safe behaviour.

Data was analysed to find and group together common themes. Only themes that occurred in several sources were pursued in this study. There are beliefs that only occur in one source, and those were not included in the study. An example of such an eccentric belief is the Daily Sun story (Sigwela, 2009) of Mazwabantu Jonas, who breeds and sells tortoises, because he believes that they have magical powers, including the ability to prevent lightning from striking a house. Since this belief in tortoises as lightning protection was not encountered in any other source, it was not included in the study.

2.3 Data collection procedures

Any research project must involve rigorous data collection procedures (Creswell, 1998). Rigorous data collection procedures normally entail collecting multiple forms of data and evolving appropriate methods of analysing them. This section discusses the different data sources that I used for the study, namely oral traditions, praise poetry, contemporary literature, tabloids and interviews undertaken in Johannesburg and during field work visits to three different sites. The field work consisted of visits to the Khomani San in Witdraai in Northern Cape, two visits to Hlabisa in KwaZulu-Natal and a visit to three villages in the Mokopane area in Limpopo. Each trip, was between 2

and 4 days in the field. Each trip was well planned in advance in collaboration with somebody with well-established contacts in each of the communities visited.

In this section, the data sources are divided into three categories narrative and poetic sources, interview sources and media sources.

2.3.1 Narrative and poetic sources

I have classified oral tradition, praise poetry and contemporary literature as narrative and poetic sources. Each type of source is discussed individually, together with the methods of analysis used in each case.

Oral tradition

A rich oral tradition existed in indigenous communities in Africa long before the skill of writing was introduced by Christian missionaries and other literate Europeans that came into contact with them. Missionaries were expected to learn the language and habits of the groups they were sent to convert and to report back regularly to their home communities (Delius, 2001).

Many misconceptions existed in the past about the oral tradition. One such a misconception was that African oral stories were part of a primitive stage of cultural development in the evolution towards a written culture (Finnegan, 1970). Oral stories were regarded as primitive, traditional and communal, folktales handed down from one generation to the next. That was changed by Finnegan's (1970) work that recognized oral tradition as literature, of which the performance was an important element: storytellers were artists that introduced individual variations in style, content and language and they used tone, gestures, music and interaction with their audiences.

In considering stories taken from the oral tradition, it is therefore important to recognize that if the transcribed tales seem simple, it is because they lack the artistic element of performance. It is also important to remember that each story is the work of an individual artist - they are not, as Krige (1936) described them, general folklore. Within these constraints, however, transcribed and translated oral literature can still make a contribution to our understand-

ing of how lightning was viewed by analyzing lightning imagery used in oral literature.

In selecting sources on oral tradition, I chose two collections that are recognised as the leading sources in southern Africa, namely the Bleek and Lloyd archive (Centre for Curating the Archive, 2011), (Bleek, 2007) and Henry Callaway's work (Callaway, 1886a & 1886b) .

The Bleek and Lloyd (Bleek, 2007) archive of San stories, translated into English, was originally published in 1911. The importance of the Bleek and Lloyd archive is demonstrated by the ongoing scholarly engagement with it, such as the work of Deacon (1996), Lewis-Williams (2000), Hewitt (2001), Wessels (2010), a conference entitled *The Courage of ||kabbo* held in Cape Town in 2011 that brought together many leading academics working on the archive and an exhibition by artist and academic Pippa Skotnes entitled *The courage of ||kabbo: Landscape to Literature*.

The Bleek and Lloyd archive consists of work done by Dr Wilhelm Bleek and his sister-in-law Lucy Lloyd. Some of the translated stories from the archive were published in *Specimans of Bushman Folklore* (Bleek, 2007) Most of what we know today about the language and culture of the original San hunter-gatherers who lived in the Kalahari, was recorded by Dr Bleek, a German linguist, who came to South Africa in 1855 to compile a Zulu grammar (Lewis-Williams, 2000).

Bleek was interested in the San and heard that there were some San prisoners in Cape Town and on Robben Island. He started interviewing some of the San prisoners and later got permission to employ some who were unfit for hard labour in his house, where they taught him their language and he recorded and translated their tales. His sister-in-law Lucy Lloyd and, later, his daughter Dorothea Bleek, continued with his work on the San, which comprises about 12 000 pages of handwritten notes.

The Centre for Curating the Archive at the University of Cape Town has digitised Bleek and Lloyd's collection of notebooks and has created a search index that makes it possible to search them using a large number of search terms (Centre for Curating the Archive, 2011). For this study, I used the

search index of the digitised version of the archive, using *lightning, thunder* and *rain* as a search terms – only those parts referenced in the search index were considered, so examining the digitized notebooks could possibly reveal other stories about thunder and lightning.

The San stories entitled *‡kagara and !haunu, who fought each other with lightning* and *The Thunderstorm* form part of the *Specimens of Bushman Folklore* (Bleek, 2007) collection and have been included in this study.

The story of ‡kagara and !haunu is relevant in the context of lightning myths and beliefs in Southern Africa in the sense that it refers to beings who are able to control lightning. One of the reasons why this research project is relevant is that there are many people in South Africa today who believe that witches have the power to control lightning so that it selectively kills or injures livestock and people or destroys houses (Harnischfeger, 2003). Any attempt to help communities become safer from lightning, will have to incorporate this view of the world.

Another important source is the writing of Bishop Henry Callaway, a Christian missionary working among the Zulu people, (Callaway, 1868a). Henry Callaway wrote down and translated numerous stories and oral tradition regarding religion and beliefs told to him by Zulu informants (Callaway 1868a and 1868b). He qualified as a medical doctor, but he had always felt that he had a calling to serve in the Church. He offered to come to South Africa as a missionary for the Church of England. He and his wife arrived in Durban in 1854, when he was 37 years old (Benham, 1896). He was convinced that missionary work in South Africa was not very effective due to the missionaries' speaking only poor Zulu. Initially, he spent up to 10 hours per day learning Zulu. He decided that he wanted to live among the Zulu people where they lived in the rural areas, not among those that worked in the towns for the colonialists.

He moved inland to a farm called Springvale in 1858, where he taught, had a surgery and held church services for the people living in villages in the surrounding area. He started writing down oral literature as told to him to improve his Zulu. He wrote in a letter (Benham, 1896:76): "I have been very

busy lately writing accounts from the mouth of different [Zulus], of their habits, traditions, belief, etc. Some of these are extremely interesting… My object in writing those 'dictation lessons', was simply with the view of improving my knowledge of their language; now I continue not only with that view, but for the intrinsic value of the information itself." This work resulted in one of the major sources of Zulu oral literature.

For texts from the oral tradition, I have focused on narrative units that contain a high level of repetition, indicating that they have been around for a long time (Vansina, 1985) or units of the narrative that are repeated across several data sources.

Praise poetry

A form of oral tradition that is still alive in South Africa today is praise poetry. Many South Africans will still remember the praise singer at the presidential inauguration of Nelson Mandela on 10 May 1994. He was Zolani Mkiva, a traditional Xhosa oral poet, from a family of recognized *iimbongi* (Xhosa oral poets) and he performed an oral praise poem at the inauguration (Kaschula, 1997).

Praise poetry was selected as a data source, because in her important work on oral literature in Africa, Finnegan (1970:111) identifies panegyric as "one of the most developed and elaborate poetic genres in Africa". She describes South African praise poetry (1970:121) as "one of the most specialized and complex forms of poetry to be found in Africa."

Finnegan (1970:121-122) describes praise poetry as intense and containing dramatic descriptions, often using allusion and metaphor in elaborate praises of distinguished people.

There are a number of subgenres of praise poetry, ranging from praises for the clan, the chief and war heroes, to singing your own praises or praising a peer and even domestic and wild animals (Peek, 2004). Praise poems in many southern African indigenous languages have been recorded.

Lightning often features as an image of power in praise poetry, for example in this passage describing a warrior (Damane, 1974:232):

The bravery of Fako is incomparable,

He may be likened to the lightning, the Koena

The sorcerer's lightning for the soldiers.

The tropes used in praise poetry give one a sense if the different ways in which lightning is regarded in different communities.

White (1982) identifies several collections as making an important contribution to praise poetry as a field of study, namely Schapera's Tswana collection, Damane and Sanders volume of Sotho praise poems, the Zulu poems collected by Cope and Hodza and Fortune's Shona poetry. These collections were therefore selected as the sources for finding lightning images.

Contemporary Literature

Literature can sometimes give clues about local myths and beliefs. A technique used by some African writers is to incorporate oral traditions and literary forms into their texts. One early and famous example of this trend is Chinua Achebe's *Things Fall Apart*. The novel is set in eastern Nigeria and draws on a range of Igbo verbal art forms – narratives, proverbs, riddles, praise songs. This technique not only provides a nuanced and textured sense of the Igbo community, but also makes its philosophical, religious and epistemological systems apparent to the reader.

One source used in this study is southern African literary texts that use this technique. Drawing on overviews of the literature, like Gray (2002) as well as expert opinion, appropriate literary texts were located.

An example of literature providing a clue about local myths and beliefs about lightning is a short story entitled *The Day Mabata-bata Exploded*, by Mozambican writer Mia Couto (1986). In the story, a cattle herd sees how a bright flash kills one of his cows and immediately attributes it to the "lightning bird".

A short story by Phaswane Mpe is analysed in detail in Chapter 3, using both a close textual reading and the historical context in which the story is set.

Two Afrikaans poems have been included in the contemporary literature. They do not contribute to any of identified myths, but they give an insight into

diametrically opposing views of lightning. They were included because I know them well from school Afrikaans lessons.

The method used for the contemporary literature is a close textual, drawing on recognized protocols of the discipline (Warren, 1959), (Scholes, 1966). Applying these techniques, I was able to excavate the full range of meanings that the stories attach to lightning.

Interviewing

The techniques of both unstructured and structured interviewing were used in this study to gain insight into local myths and beliefs about lightning.

Unstructured interviews are directed conversations with individuals with relevant experiences that allow the researcher to explore a specific topic in depth (Charmaz, 2006). Unstructured interviews give researchers the freedom to explore interesting avenues that might emerge during a conversation.

The advantages of an interview is that it is flexible and it can be used with people with low levels of literacy, whereas the disadvantages are that it is difficult to exclude interviewer bias, leading questions could be asked and it is expensive and time-consuming (McMillan, 2001).

Structured interviews can take the form of questionnaires and face-to-face interviews that follow a fixed set of questions. Questionnaires are convenient for gathering a large amount of data that can be represented in a format that is more familiar to engineers in charts and graphs. Questionnaires have the advantage that they can be anonymous, the questions are standard and it is economical, but the disadvantages are that questions can be ambiguous and the researcher does to have the opportunity to probe and clarify solutions (McMillan, 2001). In this study, questionnaires were used, but no structured interviews were conducted.

Ethics clearance was obtained for both structured and unstructured interviews from the Human Research Ethics Committee (non-medical) of the University of the Witwatersrand (protocol number H1 10226). For ethical reasons, participants in both structured and unstructured interviews will not be identified. All participants were told of the purpose of the study and were informed that their participation was voluntary.

Although I have not used unstructured interviewing as a research method previously, it was a method with which I felt very comfortable, since I worked as a journalist for seven years before studying engineering and interviews are an integral part of journalism.

For this study, most of the interview participants were *sangoma*s. A *sangoma* is a clairvoyant who communicates with ancestral spirits, amongst other things to diagnose illnesses. The experiences and stories of *sangoma*s were considered relevant for this project since part of their training is to learn about tribal history, mythology and rituals (Hund, 2003).

Interviews were done in three rural areas during field work trips. Two of the areas in which interviews were conducted, were selected based on discussions with people who work closely with those communities. The founder of an HIV/AIDS program in KwaZulu-Natal, recommended a young man who lives in the Hlabisa area and works part-time for the HIV/AIDS project. He knew the area and the people well and set up a number of interviews. He also acted as a translator during the interviews.

In the Northern Cape, three people who are involved in community upliftment projects with the Khomani San, set up interviews with members of the Witdraai Khomani San community. No translator was needed for this field-work as the Khomani San are all first-language Afrikaans speakers – only one of the remaining elders could still speak the community's original San language.

The third community was a Pedi village in the vicinity of Mokopane in Limpopo. Interviews were arranged by an engineering student that came from the village and still regards it as her home. She identified suitable elders and *sangoma*s in three villages in the area and acted as my guide and translator.

A final set of interviews was done with final year engineering students. The aim was to determine whether the views of people with an education in basic sciences and engineering and living an urban lifestyle, differed from those in rural communities. No translator was used since all the interview participants were fluent English speakers.

The method that was used for the data was that interviews were recorded. The recordings were translated and transcribed by student assistants. The transcriptions were reviewed and statements on perceptions about lightning and precautions that people take during electric storms were recorded and classified. A sample of a transcription and a translation are given in Appendix B.

Two sets of structured interviews were conducted at the University of the Witwatersrand, one with a first year mining engineering class and another with a first year group of electrical engineering students.

The questionnaires completed by the electrical engineering students were not used in this study, as the group was large and unruly. They sat close to each other on long benches and there I observed much conversation, joking and collusion in responding to the questionnaire.

The conditions for administering the questionnaire to the mining engineering students, however, were ideal, since the students were in a drawing hall, where they were seated at individual desks. It was possible to supervise strictly and to ensure that there was no talking or comparing of answers while they were completing the questionnaire. 172 students completed the questionnaire. For admission to the Faculty of Engineering at Wits University, students are required to meet a minimum requirement in Physics and Mathematics in their Matric final examinations, so this group could be regarded as representative of school-leavers with a Maths and Physics background.

All the questions in the questionnaire were structured so that respondents could tick one of three boxes labeled *Yes*, *No* and *Don't know.* Results from the questionnaire were analysed in a spreadsheet and represented in pie charts. The questionnaire and the analysis spreadsheet are shown in Appendix C. This information constitutes the quantitative data used in the study.

Media sources

Contrary to fears around the world regarding the decline of printed newspapers, the tabloid newspaper the *Daily Sun* has taken South Africa by storm with a circulation of 494 875 and a readership of 3 831 000 (www.dailysun.co.za, 2011).

Wasserman (2010) writes that the tabloids gave the poor majority of South Africans a print media outlet for the first time following the end of apartheid that expressed their opinions and views. The tabloids in general, and the high circulation *Daily Sun* in particular could therefore be potential source of current popular myths and beliefs, therefore these newspapers were included in the study as cultural texts. During the period July 2010 to April 2011 every day's newspaper was browsed and units of narrative that had been repeated in other sources were identified. There are references to several stories from the *Daily Sun* in Chapter 3.

For other texts from the oral tradition and tabloids, I have focused on narrative units that contain a high level of repetition, indicating that they have been around for a long time (Vansina, 1985) or units of the narrative that are repeated across several data sources.

Media sources were also used to compile Table 1 in Appendix A, that lists reports of lightning deaths for the period from 1 January 2009 until 31 January 2011. The *Daily Sun* and *Volksblad* both have on-line archives of all stories that were published, so a complete search was done on both publications for the period. Archived copies of the *Daily Dispatch* were checked in the public library, but this method is not as reliable as an online search. The Volksblad and the Daily Dispatch were selected because they are smaller regional newspapers that serve the Bloemfontein and Eastern Cape areas respectively. The thinking was that a smaller, regional newspaper would be more likely to carry local reports of lightning deaths than the larger national newspapers.

IOL News and news24 are websites that contain a selection of stories from the print versions from the Independent Group and Media 24 newspaper stables respectively and online searches were done on both sites.

Other media sources include *Beeld, Sunday Times* and *Daily Maverick*, but the nature of data from these sources is random stories upon which I stumbled.

2.4 Engineering design methodology

In spite of the marked differences between qualitative and quantitative research, the methodology used for this study should not strike engineers as very odd, since it closely resembles a typical engineering methodology that stops at the design phase without proceeding to implementation, and in particular the initial stages of a software development methodology.

Requirements engineering	Preliminary ideas	Analysis	Detailed design (synthesis)	Implementation	Testing
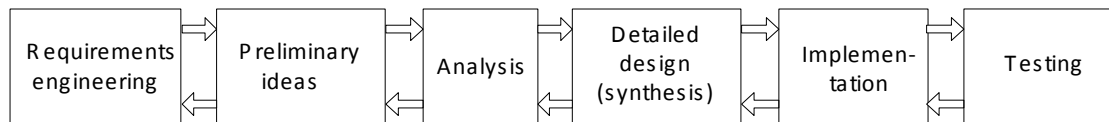
Figure 2.3: A typical engineering design process

As shown in Figure 2.3, a typical engineering design process consists of a requirements engineering phase, which involves doing research to gain an understanding of the problem. From this information, a number of preliminary ideas are developed that could present solutions to the problem. It is good engineering practice to consider a number of alternative possible solutions, rather than just generating a single idea and pursuing it. In the analysis phase, all the ideas are investigated for feasibility and the best solution is selected, based on sound reasoning. A detailed design of the chosen solution may include a mathematical model, but almost always comprises a graphical representation, such as detailed construction drawings, or in the case of a software project, a use-case model, that represents core blocks of functionality of the proposed system and all external agents that interact with it.

The data collection process used in this study closely resembles the requirements elicitation phase of a software development project, as described in most standard software engineering textbooks, like those by Van Vliet (2008) and Pressman (2004). In a software development project, the development team's field of expertise is software development, but a team typically designs and builds a product that must operate in an environment outside its area of expertise. A team skilled in software development would, for example, have to build software to automate the operation of radiation therapy equipment or a university student admission system or the processes in a chemical plant. In order to develop effective software, the team member

responsible for the requirements elicitation needs to immerse him/herself in the client's universe of discourse and build a rich picture of that universe, just as rich data is required by qualitative research approaches.

3 Some South African lightning myths and beliefs

This section describes and analyses the myths and beliefs that were documented in the course of this research project. Only those myths and beliefs that occurred in more than one of the sources (described in Section 2) have been included. This does not purport to be an exhaustive account of all southern African lightning myths and beliefs, but they were the most common ones in different sources.

3.1 Witchcraft and *Muthi*

Nobel peace prize laureate Archbishop Desmond Tutu coined the phrase "rainbow nation" to describe the mix of cultures and languages that make up the South African nation. Within this diverse society, there are many who believe that witches can control lightning. Harnischfeger states that: "Almost every Zulu, Xhosa or Venda person in South Africa knows that witches have the power to send lightning, kill livestock or burn houses, including the inhabitants" (Harnischfeger, 2003:46). It is significant that Harnischfeger uses the word *know* because unlike matters of faith, where there can be room for doubt and debate, knowing means that it is a certainty, a fact, in that person's universe. The use of traditional medicine or *muthi* is considered to be the only antidote to lightning sent by a witch.

Witchcraft is, however, not an uncontroversial topic in South Africa. Some people do not believe that witchcraft and magic exist and a small minority group of adherents of paganism regards witches as agents of good rather than evil. An article in a weekly newspaper (Mogakane, 2010) demonstrates the chasm between different belief systems. It reported that the national coordinator of the Traditional Healers' Organisation, Phepsile Maseko, blamed *muthi* murders on "heartless witches". A *muthi* murder is when somebody is murdered so that the body parts can be used in traditional medicine. The director of the South African Pagan Rights Alliance accused Maseko of defaming witches. Maseko's responded: "Publicly calling yourself a witch in South Africa smacks of white privilege. In a village or township, you'd be dead even before completing your proclamation." This section

focuses on past and current South African beliefs with respect to lightning, witchcraft and traditional medicine.

3.1.1 Background on witches and witchcraft in South Africa today

A *sangoma* is a shaman or clairvoyant who communicates with ancestral spirits, amongst other things to diagnose illnesses. The experiences of *sangoma* are relevant to this study, since part of their training is to learn about tribal history, mythology and rituals (Hund, 2003), (Reeder, 2011) and they can thus be regarded as custodians of local beliefs and traditions. *Inyanga* is a traditional healer that heals people using medicine (*muthi*) made from different parts of plants and animal[2]. Traditional herbalists use plants to heal illnesses.

Sangoma, *inyanga* and herbalists are sometimes erroneously referred to as witchdoctors by people whose cultures do not encompass clairvoyance. *Sangoma*s use clairvoyance and magic to help people and to protect them against evil. To channel communications from their ancestral spirits, they often throw bones and interpret messages from the ancestors from the way in which the bones fall. Sometimes a *sangoma* is used to diagnose an illness by consulting the ancestors and throwing the bones. An *inyanga* or herbalist then prepares medicine based on the *sangoma*'s diagnosis. Many *sangoma*s do both: they diagnose using clairvoyance and make the traditional medicine for the clients too.

In many southern African cultures like the Zulu and Pedi traditions, witches, on the other hand, use their magic for evil (Delius, 2001), (Berglund, 1976). Witches can be men or women. They work in secret and use potions and concoctions to kill their victims, but they can also control lightning to kill their victims or damage their property. When somebody dies in a way that leads the community to suspect that it was the work of a witch, a *sangoma* is often consulted to try to identify the witch. The witch is then driven from the community or even killed.

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[2] *Isangoma*, *inyanga* and *umuthi* are terms from the Zulu language. For the sake of clarity, the Zulu terms will be used throughout, even when discussing other groups, like the Pedi, that use different words in the Pedi language for the same concepts.

The spread of Christianity has, however, affected communities' views of magic and clairvoyance, as churches branded such practices as heathen. In interviews[3] conducted in Mapela, a Pedi village in Limpopo province, four traditional healers said that many people in the area publicly disavowed traditional healing due to their Christian faith, but nevertheless visited them secretly under cover of darkness during the night.

The biography of *sangoma* Elliot Ndlovu (Reeder, 2011) describes how Ndlovu's aunt, No Mawashi was called to become a traditional healer, but rejected the calling because her Christian faith lead to a rejection of her Zulu spiritual beliefs.

Initially, traditional courts dealt with accusations of witchcraft, until the government implemented the South African Suppression of Witchcraft Act in 1957. The act makes it illegal to:

- accuse somebody of being a witch or of using witchcraft to cause harm;
- say that you have used or know how to use witchcraft to cause harm;
- employ somebody to find a witch;
- act on the advice of a witch in a way that is calculated to cause harm;
- use witchcraft to find something that has been stolen or lost.

Witch killings unfortunately do not belong to South Africa's distant past. According to police reports, 312 people were killed in witchcraft-related violence in Limpopo between 1985 and 1995 (Harnischfeger, 2003).

3.1.2 Current beliefs related to lightning and witchcraft

A review of the South African tabloid *Daily Sun* shows that belief in witchcraft is alive and well in South Africa today.

Daily Sun stories regularly mention witchcraft, often employing exclamation marks and bold typeface. A front page story in February 2010, for example, has a headline that reads "The most evil muthi of all" (Sobuwa, 2010). The

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[3] Interviews were conducted in accordance with the ethics clearance protocol number H1 10226 of the University of the Witwatersrand's Human Research Ethics Committee.

story tells of a family that had already lost two sons when they got a *sangoma* to help them. The *sangoma* found evil *muthi* consisting of the skins of a snake and a lizard and the jaws of a porcupine buried in a corner of their shack. He is quoted as saying: "The person who is bewitching you wanted all of you dead…".

In August 2010, the front page lead story of the *Daily Sun* reported on a village in Mpumalanga province that offers a safe haven to people who have had to flee their homes due to accusations of witchcraft. About 600 people live in the village called Ebatsakatsini, which means Place of Witches (African Eye News Service, 2010).

These are just selected examples to illustrate that witchcraft and bewitching potions are real to many South Africans today.

In their research with school goers, Pabale (2006) in Limpopo and Maselwa (2004) in the Eastern Cape both found most pupils believed that witches could control lightning.

The KwaZulu-Natal Member of the Executive Council (MEC) for co-operative governance and traditional affairs, Nomsa Dube, visited a village where seven people were killed by lightning in January 2011. After the visit, Ms Dube was ridiculed in the local press for saying: "We will do an investigation and talk to the department of science and technology on what is the cause of the lightning." (SAPA, 2011), (Khumalo, 2011). Commenting on the statement, well-known columnist Fred Khumalo (2011) said that Dube's statement "…betrays a sense of someone who is desperate to create a mythology of something sinister." The implication is that the MEC seems to believe that the lightning might have been caused by witchcraft. This is hardly surprising, given the background sketched here of a country in which many people believe that witches can control lightning and send it to harm people. In the daily newspaper *Sowetan*, a reader wrote in a letter that the MEC's ignorance was embarrassing and that to suggest investigating a natural disaster was foolish (Wa Mokoena, 2011).

Interviews were conducted with *sangoma*s as part of this project. In Hlabisa, a rural town in KwaZulu-Natal, five interviews[4] were conducted with traditional healers. Four of the five said that there are two kinds of lightning: natural lightning and man-made lightning.

In other parts of southern Africa, lightning is associated with witchcraft too. Dlamini (2009) states that culturally, Swazis believe that lightning is caused either by witchcraft or the wrath of a god or gods. Swaziland is a small land-locked kingdom in southern Africa.

It would be a mistake to think that belief in witchcraft and man-made lightning is confined to the rural areas or to people who are not well educated. In interviews with three final-year electrical engineering students at the University of the Witwatersrand, Johannesburg, all from Zulu families, all three asserted that there are two kinds of lightning: natural lightning and man-made lightning. Their conviction that there is such a thing as man-made lightning is so firm, that it would not be strong enough to say they believe it exists – they *know* it exists.

From a Eurocentric, evolutionist point of view, a belief in witchcraft is often seen as belonging to a more primitive, undeveloped society. However, it is important to understand that in southern Africa, believing in witchcraft and being modern, literate and educated, are not mutually exclusive. This is a point made by Finnegan in her seminal work on oral literature in Africa (Finnegan, 1970) when she explains that oral literature is not a step in the evolution towards a written tradition – the two can and do coexist.

3.1.3 ‡kagara and !haunu

The connection between witchcraft and lightning is illuminated by the San story about two men, ‡kagara and !haunu[5], who fight each other by directing

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[4] Interviews were conducted in accordance with the ethics clearance protocol number H1 10226 of the University of the Witwatersrand's Human Research Ethics Committee.

[5] The use of the symbols ‡ and ! in the names ‡kagara and !haunu is explained in the preface to *Specimens of Bushman Folklore* (Bleek, 1968). Spoken San comprised a number of click sounds that were not used in any written language at the time, so symbols were used to represent them. The ‡

lightning bolts and using them as weapons (Bleek, 1968). The story of ‡kagara and !haunu forms part of the Bleek and Lloyd collection (see section in Chapter 2 on oral tradition). Although the San have nearly disappeared, with only small groups left in the Northern Cape, Botswana and Namibia, different groups were often in contact with each other and themes and stories passed from one group to another (Biesele, 1993). In particular, some bits of San beliefs are said to have become part of the cultures of other African groups like the Nguni of the Drakensberg region of KwaZulu-Natal (Reeder, 2011). It is possible that a belief in witches that can control lightning, could have filtered through to other groups that came into contact with the San.

In this story, ‡kagara fetches his younger sister from her husband !haunu, to take her back to her parents. !haunu follows them. ‡kagara tries to hurry his sister along and in the process, roughly touches the burden that she is carrying. When !haunu sees ‡kagara touching his possessions in that way, he starts to bleed from the nose and throws a lightning bolt at ‡kagara – the tale says that he "stealthily lightened at his brother-in-law" (Bleek, 1968). ‡kagara manages to fend off his brother-in-law's lightning and a lightning duel ensues, which only ends when ‡kagara resorts to using "black light-ning", which picks !haunu up and throws him down a small distance away, where he dies.

A footnote in Bleek's notes explains that black lightning is the lightning that kills. His San raconteur said that you do not see black lightning coming: "…it resembles a gun, we are merely startled by the clouds' thundering, while the other man lies, shriveled up lies."

He concluded the story by saying that his grandmother used to say that it was ‡kagara and !haunu whenever there were heavy clouds and lightning in the East.

Comments on and interpretation of the tale:

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symbol denotes a palatal click, made by pressing the tip of the tongue to the front of the palate, where it meets the gums, and withdrawing it quickly. The ! symbol indicates a cerebral click, made by curling the tip of the tongue against the roof of the palate and withdrawing it quickly.

The most striking feature of the story is the way in which ‡kagara and !haunu are able to direct lightning bolts, so that they can use them as weapons. The reference to !haunu's nose bleeding just prior to harnessing the lightning is significant, because in his detailed and internationally acknowledged analysis of southern African rock art, David Lewis-Williams explains that a nose bleed was a sign that a San shaman was entering into a trance state (Lewis-Williams, 2002). One of the ways in which San shamans would enter into a trance state was through the ritual of dance. The San women would form a circle around a fire, singing and clapping rhythmically. The men would form an outer circle and would stamp to the rhythm. The shamans "induce an altered state of consciousness by intense concentration, audio-driving, prolonged rhythmic movement, and hyperventilation (Lewis-Williams 2002, p141). The belief was that the spirit of a shaman in a trance, traveled in the spirit realms above and below the earth to gain special insights there. They also learned things unknown to ordinary people by possessing or becoming animals. Some San rock paintings show people with antelope heads, that have partially transformed into an animal. There were some shamans who could heal, and others who were rainmakers.

In the story of ‡kagara and !haunu, Deacon interprets the reference to !haunu's nose bleeding as an explicit reference to trance state (Deacon, 1996). It is in a trance state that !haunu is able to control lightning. Biesele says: "Often a concrete detail, merely mentioned in passing, is enough to give a social clue with enormous ramifications". Thus this single mention of people controlling lightning, does not necessarily indicate that it was an insignificant opinion in San society. Hewitt (2001) confirms the view that the San stories were often educational and were a repository of the community's knowledge, including explanations of customs and beliefs.

The social clue that can be obtained from this story is that it may have been a commonly held view that people could enter a trance state and control lightning.

None of the community members interviewed in the pilot study made any reference to the story of ‡kagara and !haunu. It is possible that the story was

lost from their culture as a result of the persecutions and displacements to which the San people were subjected.

The tale is, however, relevant in the context of lightning myths and beliefs in Southern Africa in the sense that it refers to people that are able to control lightning.

A historian is interested in whether the purpose of an oral tale is to recount something that happened in the past (Vansina, 1985), but from the perspective of popular beliefs, it is only important whether the story was commonly told and whether it reflects some commonly held beliefs or values. According to Vansina, an oral communication is significant in the community in which it is told, otherwise it would not have been communicated in the first place.

If one reads the transcription of the story, there are many repeated phrases, for example "while !haunu lay thundering; he thundered there", "Then he stealthily lightened at his younger sister's husband with black lightening, he, lightening…"and "he had rubbed them (i.e. himself and his younger sister) with buchu, buchu, buchu, buchu…". In these sections, the words *thundering*, *lightening* and *buchu* are repeated. This is an indication that it was a story that was told often over time, as an oral rendition of a story typically has more redundancy built into it to convey its message than a written story (Vansina, 1985).

3.1.4 *Brooding Clouds* as a study of current beliefs related to witchcraft and lightning

Phaswane Mpe is a South African writer best known for his only novel *Welcome to our Hillbrow*. He died in 2004 at the age of 34. His story *Brooding Clouds* (Mpe, 2008) forms part of a collection of short stories and poems of the same name, which was published posthumously. The story is analysed here, as it offers some interesting insights into the complexity of current South African beliefs regarding lightning and witchcraft. Mpe wrote the story while he was still a student, but was reluctant to publish it, because shortly after completing it, his own mother was injured in a lightning strike and he thought that to publish it would "be like tempting fate" (www.artsmart.co.za, 2011).

The story is set in Tiragalong, a small rural village in Limpopo province. Makgolo is an old woman who has been accused by the village youth of using witchcraft to send the lightning that killed Tshepo. She sits in her hut and waits for the youths, the comrades, to come and burn her to death for being a witch.

The historical context for the story can be understood from Delius' detailed account (Delius, 1996) of the revolt of 1986 in Sekhukhuneland, part of present day Limpopo province. Delius describes the rapid formation and growth of youth movements in villages in the mid 1980's aimed at spreading political awareness while the apartheid government was still in place. They called themselves the *comrades*. They organized rallies that moved through villages singing and chanting. They revolted against the local government system run by chiefs and against the schooling system, resulting in major disruptions of schooling. Delius writes: "In the context of the collapse of the legitimacy of local forms of authority and national revolt, the youth took control in the villages." (Delius, 1996: p203). Groups of young people demanded food and money from villagers and hijacked minibus taxis to move around. They also set up so-called peoples' courts that dispensed justice to their elders for offences ranging from "speaking ill of the organization" to serious crimes like rape.

Against this backdrop, the youth in the villages identified the issue of witchcraft as a problem. They had grown up in homes where witches were blamed for all kinds of disasters, like the illness, anomalous death or disappearance of children (Niehaus, 2005). The actions of the youth had led to tension between themselves and the older generation, but on the issue of witchcraft they agreed that it would lead to a better society if witches could be eradicated. Delius gives a detailed account of four incidents in which somebody was killed or injured by lightning, the youth subsequently identified the witch who was responsible and killed him/her either by barricading them in their huts and setting them alight, or by necklacing them: putting a tyre around their necks, dousing them in petrol and setting them alight.

The links between the recent history of Limpopo province and Phaswane Mpe's story are clear:

- Both occur in villages in Limpopo;

- The village youths call themselves the Comrades;

- Somebody is killed by lightning and it is suspected to be the work of a witch;

- A diviner is consulted and based on this information a witch is identified and killed.

Mpe describes the songs that the comrades sing as "songs that freedom fighters used to sing in the apartheid era", (Mpe, 2008:8), so it is set in the post-apartheid era, yet the short story closely mirrors events from the 1980's. Perhaps this implies that people living in rural villages are stuck in the past or maybe he is just using an extreme example similar to past atrocities to draw attention to practices that continue. Either way, Mpe's story must be seen as a commentary or reflection on current beliefs regarding witchcraft in general and the link between witchcraft and lightning in particular.

The name of Mpe's village, Tiragalong, means place of the grandfathers/ancestors - perhaps it also indicates a place stuck in the past.

The description of landscape presages the death and destruction in the story. The land is prematurely dying from drought – Mpe writes: "It is autumn, but this year the fields show no sign of life. Mealie plants are grey – grey like ash" and the livestock are "merely a collection of bones". Similarly, Makgolo has died inside even before the mob kills her – her eyes are vacant and she seems unaware that the fire in her fireplace has gone out. The only thought that fills her head is: "They say I am a witch…" and she understands that in a rural village in Limpopo, that is a death sentence.

Makgolo is a childless widow and was deserted by her husband for "years and years". She took care of herself and had a relationship with Kereng, who "in addition to looking after his large family, did whatever manly deed was necessary in Makgolo's compound." The whispers of witchcraft only start when Makgolo's absconded husband returns and falls sick after a few days. Makgolo refuses to take him to a herbalist and, within two weeks, he dies. Shortly afterwards, Kereng also dies and these unexplained circumstances

are enough to turn a rumour of witchcraft into a fact. By the time the successful young student Tshepo is killed by lightning, the "witch" Makgolo is naturally blamed. To confirm their suspicion, the comrades consult diviners in other villages and the verdict is that Tshepo was bewitched by "an old woman to the east of his homestead". The vague message confirms the comrades' preconceived idea. The community fears the comrades, so nobody speaks out in defense of Makgolo.

Two issues are raised in the story that are confirmed in other sources and in the interviews that formed part of this study and are dealt with more fully elsewhere:

- Jealousy is regarded as a common motive for resorting to witchcraft and in this story. The comrades suspect the childless Makgolo of being jealous of Tshepo's mother for having a talented, successful child.

- When lightning strikes Tshepo, there are clouds, but no rain. In interviews, more than one participant seemed to associate weather conditions where there was lightning but no rain, with witchcraft.

Children in the village used to love listening to Makgolo's stories – "stories of witchcraft and ordinary lives, of poverty and abundance, of wars and peace". It is clear that her stories are fiction, as they almost always start with: "Long, long ago, when stones were still soft and edible and trees could walk…". This fits in with scholarship that attribute storytelling in the oral tradition to women, whilst historical storytelling was more of a male domain (Hofmeyr, 2001). These creative tales are juxtaposed to the mindless mob of comrades, that takes some unexplained events, spins a rumour of witchcraft around them and then accepts their own rumour as a fact.

The story has a strong feminist line. Makgolo is depicted as strong, wise, compassionate and creative. She is described as "open-handed" toward the children who came to listen to her stories. Tshepo's mother is also depicted as wise and caring. This is juxtaposed by the sexist attitudes of men in the village. Rumours started that Makgolo had bewitched her long absent husband when she refused to observe the protocols of patriarchy when he returned. Elsewhere in the story, Tshepo also behaves in a chauvinist man-

ner, determined not to cry in front of his mother because "… he was not circumcised for nothing. …But there he was now, his tears betraying him before a woman."

Gender division played an important role in southern African societies – men were in charge of the cattle and women were responsible for planting and harvesting of food. Since cattle constituted a form of "storable wealth" (Hofmeyr, 1993:27), women could never accumulate wealth. As a result, they remained dependant and subordinate and were expected to be obedient wives. In contrast to their subordinate status in society, however, many households in rural villages in South Africa are headed by women, since the men migrate to the cities to earn money. Delius explains the tension that this created as follows (Delius 1996: p203 – 203): "… young men, who had been raised to expect to exercise control over women, instead found themselves in social limbo and unable to assert either male or adult authority. … This context ensured that some youths rounding up witches reveled in the exercise of power and the opportunity to enforce both respect from their elders and authority over women."

Events in the story fit this description: Makgolo is an old woman and the comrades are historically predominantly young men (Delius 1996). The description makes it clear that the mob revels in the exercise of power over the old woman. Their self-righteous triumph rings from the repeated phrase: "Witchcraft shall be no more!".

Makgolo also fits Pelgrim's (Pelgrim, 2003:4) description of people who are often targeted in witch hunts, namely "… the practice of witch-purging is mostly aimed at the most vulnerable members sections of society, i.e. women, elderly people, and those that display exceptional behaviour".

The lens of the story is zoomed in on the victim Makgolo, who is described in some detail. When describing the comrades, however, the narrator zooms out and all we are shown is a depersonalized group of youths – we do not know their names, backgrounds, personalities, likes or dislikes. It is only at the end of the story, when the mob scatters after killing Makgolo, that the

narrator focuses in and shows the reader two of the comrades in more detail. The story concludes with this conversation:

""Was she really a witch? Did she send lightning to strike Tshepo?"

"Who knows?" is all Sammy can offer."

There can be little doubt that Mpe harshly judges the mob killing described in his story. When describing the drought-stricken landscape, he says: "…when harvest time knocks on the doors of the villagers, there shall be nothing to reap." And so, the mob also has nothing to reap after sowing death: they have to flee from the police and, as the faceless crowd disintegrates into individuals, the bravado of the mob has disappeared and Sammy and Professor display disgust and doubt about what they have done. The mob's thoughtlessness is indicated by them singing freedom songs in "bad isiZulu", a language with which they themselves are unfamiliar. They are being swept along by songs that they do not even understand properly, songs about bringing democracy to South Africa - ironic, because they are behaving in an autocratic way.

Mpe does not judge all that is traditional, but he rejects that which is done unthinkingly. He does not reject ideas that witchcraft exists, or that it is valid to consult with a "bone thrower", but he condemns the way in which a group of people made a decision based on rumour, without following a process with proper checks and balances that ended somebody's life. Mpe's open-mindedness toward traditional values are apparent in his decision to abandon his doctorate in the final weeks of his life – he planned to become apprenticed to a traditional healer (McGregor, 2004).

The story demonstrates the complexity that the South African traditional belief in witchcraft adds to death or injury due to lightning, namely the identification and persecution of witches. It illustrates how fraught the issue of identifying a witch can be: the diviner provides information that is vague enough to fit in with the preconceived notions of the young men who want to blame a witch for a lightning death. The story engages with tradition and demonstrates how traditional ideas (like those about a lightning death) can be taken up in very different ways.

51

The young men see tradition in a narrow way. The story endorses those who ___ on, like Makgolo and her storytelling. The story ___ ntning on different levels – both as a widely held ___ structural literary device, as a way of comment- ___ blems, like mob rule. The ideas of lightning form ___ ngages with in his story, rather like a European ___ ths of Adam and Eve or Odysseus. The use of the myth in the story points to the continued sway that it holds in a society, even if the writer himself doesn't subscribe to the belief.
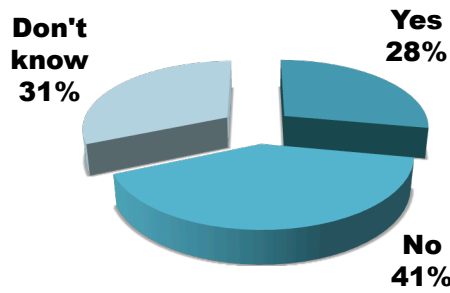
Don't know 31%

Yes 28%

No 41%

Figure 3.1: Responses to "Are there people who can control lightning?"

3.1.5 Stories of lightning and witchcraft encountered in interviews

During interviews conducted for this project, several interviewees told stories about somebody killed by lightning that was sent by a witch. The following are extracts, each from a different interview:

- A boy in Hlabisa stole a witchdoctor's car. The witchdoctor told him that he would strike him with lightning and that is exactly what happened.

- A boy's father had two wives. The boy was the second wife's youngest child and he would one day inherit all his father's possessions. The first wife was jealous that her son would not inherit anything, so she sent lightning that killed the boy while he was herding his father's cattle in the fields and she also sent lightning that destroyed their house.

- In Mokopane, a house was struck by lightning and burnt down. People said that the lightning had been sent by a witch, so everybody in the street gave some money to consult a traditional healer to find out who the witch was, but they never found out. She said: "Whoever knew the truth, died

with it."

In a questionnaire given to a group of first year Mining Engineering students, one of the questions was: "Can a person with particular abilities make lightning strike a house?"

Respondents could tick one of three boxes labeled *Yes*, *No* and *Don't know*. As shown in Figure 3.1, 28% of the students believe that somebody with special abilities could send lightning to strike a particular house. Although they do not form a majority, it is still a significant number in a class of engineering students that required good marks in Maths and Physics for admission to Mining Engineering.

3.1.6 Current beliefs regarding *Muthi* to protect against lightning

Muthi is the Zulu word for traditional medicine, made from a variety of materials, but mainly parts of plants, like bark, bulbs, roots and leaves, as well as animal fat and other animal parts.

There is a thriving *muthi* street market in the KwaZulu-Natal town of Mthubathuba, where herbalists sell the ingredients for traditional medicines. The wares of one of the stalls are shown in Figure 3.2. In conversations with three herbalists at the market, all of them said that they could make medicine to protect their clients against both sent and natural lightning. The medicine to protect against natural lightning and man-made lightning are different. The recipe of one of the herbalists for general lightning protection *muthi'* is given in Appendix D.

Muthi markets are not just a rural phenomenon - in Johannesburg, there is a large *muthi* market in the city centre and in Diagonal Street, there is a well-known *muthi* shop that has been there for many years.

Each of the five traditional healers interviewed in Hlabisa had their own recipe for *muthi* to protect homes against lightning. The *muthi* is made from animal bones and different parts of plants. Other ingredients of different mixtures were burnt and ground rubber from a tyre, a common household disinfectant and sea water. The *muthi* is buried in the ground, typically in four places around the house.

Two of the *sangomas* ... *umsuzwane (Lippia javanica)*, shown in Figure 3.3. It i... is part of the same family as mint. They plant the... ...omes. One of the *sangomas* said that if you rub... ...e leaves it will protect you against lightning.

Figure 3.3: *Umsuzwane* (JSTOR, 2005)

Figure 3.2: A stall at the Mthubathuba muthi market

Umsuzwane is also used for coughs, colds, influenza and headaches (Hutchings, 2007). Hutchings also reported that it is used in funeral rites and as an insect repellant. It is used to prevent odours in toilets, with corpses and with meat that could not be stored in a refrigerator and started to smell.

In a biography, the *sangoma* Elliot Ndlovu (Reeder, 2011) says that two plants, namely *Clivia* and cycads, picked in the light of the full moon, can be used as protection against witchcraft, evil and lightning.

Bishop Henry Callaway reported that the Zulu heaven doctors would dig where lightning struck the ground where they would find "something resembling an assegai" (Callaway 1886a:381) which they would use in *muthi* (an assegai is a traditional Zulu fighting spear). This is interesting, because it

clearly refers to fulgurites, that sometimes form when lightning strikes the ground and melts sand to form a glass-like formation.

3.1.7 Adrian Boshier's lightning *muthi*

Adrian Boshier was trained as a *ngaka* or traditional doctor in Limpopo. In his account of Boshier's life, Lyall Watson (1983) tells a story that illustrates the belief that some people can control lightning and that the one with the most powerful traditional doctor, will triumph. The story tells of a feud between two families in Makgabeng valley. One of the families employed Rakumaku to cast a spell to send lightning to the village of their opponent Phuti. A week later, lightning struck and killed all the goats in Phuti's kraal. Lightning also struck his cattle kraal. Phuti asked Boshier to help, so Boshier made a *muthi* using every plant that was said to have some connection with lightning and put it in a big snail shell. He took the *muthi* and preformed a ritual at Phuthi's home, while Rakumaku and many villagers watched. Boshier was a skilled snake handler and used a venomous snake in his ritual. When he held the snake close to Rakumaku's face, Rakumaku fled, signaling the superiority of Boshier's magic.

3.1.8 Controlling the weather

Southern Africa is an area where crops can fail due to droughts, resulting in food shortages and hardship for rural people that depend on subsistence farming. It is therefore not surprising that many rainmaking traditions and rites have been recorded there. Anthropologist Isaac Schapera devoted a whole book to the rainmaking rituals of the Kgatla people (Schapera, 1971), which is one of the Tswana tribes in Botswana. In fieldwork done between 1929 and 1932, Schapera the Kgatla believed that the chief had the power to both make and to withhold rain. Before Christianity was introduced, they regarded the chief as an intermediary who had to intercede with the ances-tors to ask for rain on behalf of the tribe.

The San also believed that some of their shamans were rainmakers. Rain-makers would typically go to a spring, capture a rain animal and lead it across the veld where rain was needed, before killing it (Hewitt, 2001). Several examples of rock art show rain animals or rain bulls.

The best-known rain-making tradition in South Africa today, is that of the rain-queen Modjadji, of the Balobedu tribe, which spans about 150 rural villages in Limpopo province. The Bolabedu clan is a matriarchal kingdom, where the crown and the secrets of making rain are passed down from mother to daughter. The queen performs an annual rainmaking ceremony, but the tribe is quite secretive and it is difficult to gain access to the Queen's kraal and to the Queen herself. According to tradition, the queen is not allowed to marry, but lives with a number of "wives" in her kraal. The wives' children are regarded as the Queen's children. To continue the matriarchal line, a council of elders chooses a suitable man with whom she is to have a child.

Queen Makobo Modjadji VI became the rain queen in April 2003 after the death of her grandmother, Queen Mokope Modjadji V (Khangale, 2005), (Nkosi, 2010). Queen Modjadji VI died at the age of 27 in 2005. Her daughter Masalanabo was only three months old when Queen Modjadji VI died (Louw, 2005) and thus too young to assume the throne. Since 2005, there has been no rain queen and the late queen's brother has assumed leadership of the Balobedu people.

In addition to the rainmakers, however, another category of people is said to have the power to control weather, namely the ability to control lightning. Some of the old texts refer to heaven herds, that could chase lightning away. Whereas witches send lightning bolts to harm people and their possessions, a heaven herd is somebody who can control the weather to the benefit of their communities.

A whole section of Bishop Henry Callaway's book (1886a), is devoted to heaven herds. The task of a heaven herd is to protect the village where (s)he lives against lightning and hail. The text contains an explanation of why they are called heaven *herds*. Their job is like that of a cattle herd, as described by one of Callaway's informants: "…if he goes into the cattle pen with his weapons and is silent, the cattle cannot go out; but by whistling the cattle understand that he tells them to go out of the pen. And the herd that herds the lightning does the same as the herder of the cattle; he does as he does by whistling; he says, 'Tshui-i-i. Depart, and go yonder; do not come here again.'" (1970:384).

According to Berglund (Berglund, 1976), men who have had a close encounter with lightning are believed suitable to become heaven herds. A heaven herd uses tools and medicines in rituals to drive away storms and lightning. Heaven herds and herbalists can prepare various types of medicine to ward [off lightning. Some m]edicines are made from black stone that comes from [a tree that was stru]ck by lightning. Another method of protection is to [cover a stick with sh]eep's fat and medicine and to poke the stick into the

Figure 3.4: Heaven-herd with his *muthi* horns

thatch of a hut.

Werner (1933) also refers to the belief that heaven herds are able to turn away hail and lightning by "scolding" the heavens. She and Berglund both describe a ritual of how a person becomes a heaven herd – a trained heaven herd makes incisions all over the trainee's body and rubs medicine into them.

There are still people in South Africa today who claim that they can control the weather. One of the interview participants, an traditional healer in Hlabisa, said that he was able to control lightning and make it change direction. When a storm approaches, he fills two antelope horns, shown in Figure 3.4, with black *muthi* made from stones, bones and plant roots and stems. He

stands on the hilltop and uses the horns to change the course of the lightning. He said: "When I see the lightning coming, I point (sic) the other direction so that it does not strike my neighborhood but strikes somewhere else. In that way I am able to protect myself, my family and my entire neighborhood."

Sangoma Elliot Ndlovu (Reeder, 2011) is described as chewing a particular leaf and spitting it into the wind while reprimanding a storm. He too chases the storms away to protect his area against hail and lightning that could damage crops and homes in his area.

3.1.9 Evaluation of witchcraft, *muthi* and heaven herds

The basic physics of lightning is well-understood and has been confirmed by a variety of experiments, including photography with very high-speed cameras. There are three types of lightning, namely cloud-to-cloud (inter-cloud), intra-cloud (within a cloud) and cloud-to-ground lightning. Only cloud-to-ground lightning is considered here. Cloud-to-ground lightning can be categorised as downward negative, downward positive, upward negative or upward positive lightning (Rakov *et al*, 2003). Of these, negative downward lightning is the most common, accounting for 90% of lightning flashes (Uman, 1987). At a very high level of abstraction, the basic physics of lightning can be explained as follows:

- A thundercloud forms when positively charged icy bits are separated from negatively charged water droplets. This creates an electric dipole in the thundercloud (Uman, 1987);
- A preliminary breakdown of charge within the cloud creates the conditions necessary for the formation of a downward stepped leader (Uman, 1987), indicated in Figure 3.5. The downward leader is a charged channel that moves towards the ground (Rakov *et al*, 2003) and can have an electric potential of more than 10^7 V (Uman, 1987);
- In response to the downward leader, an opposing charge accumulates on the ground. Higher electric fields are associated with tall objects, like towers, and at sharp edges, like the corners of buildings. This electric field

Figure 3.5: The basic physics of a cloud-to-ground lightning strike
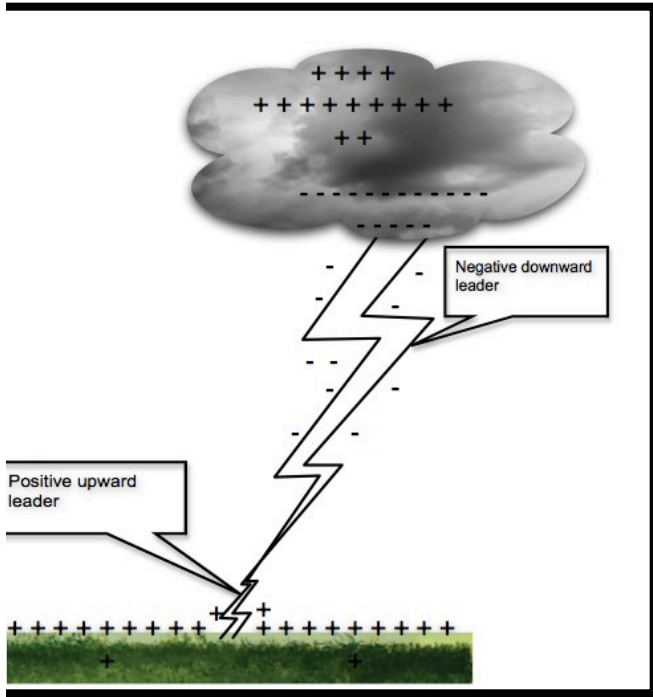
rd leader, shown in Figure 3.5, is formed. This is ᵗment process;

s is completed when the upward and downward

c current from the earth to the cloud, called the

s the downward leader's charge;

the channel, creating radiation that results in a

The return stroke also creates pressure that ex-

ting a shock wave that accounts for the sound of

03);

experts on lightning, Christian Bouquegneau and

ᵇiguously in their book that "no method would

nce of lightning discharges from thunderclouds"

(Bouquegneau, 2010). This implies that not only would it be impossible to prevent lightning from striking the earth, but it would also be impossible to divert lightning to prevent it from striking another place. One must conclude, therefore, that it is physically impossible for a heaven herd or *sangoma* to chase away lightning that would otherwise have struck their village or home-

stead. There are two possible explanations for the apparent success of heaven herds. Firstly, there might be topographical or meteorological quirks in the particular geographical areas where the heaven herds work, that make a lightning strike there unlikely. The alternative explanation is that the heaven herds possess an intuitive understanding or indigenous knowledge to predict the weather. They could appear to be chasing away the lightning, but their knowledge of the weather would allow them to know that the lightning storm was moving away. The old ethnographies (Werner, 1933), (Berglund, 1976) give accounts of new heaven herds being trained and initiated by experienced heaven herds. The training might have been the opportunity for passing on indigenous weather predicting knowledge.

In terms of the current understanding of lightning physics, however, standing outdoors on top of a hill during a lightning storm would be considered very dangerous.

The belief that witches can create man-made lightning that differs from natural lightning, is something that is impossible to disprove. Lightning is said to be sent by witches for evil purposes, but nobody would ever confess to being a witch or to being able to send lightning, because they would run the risk of being killed or driven out of their community.

One of the details that was included in several of the interviews and conversations conducted in the course of this research, was that lightning must have been sent by a witch, because it struck and killed somebody even though it was not raining, or the clouds were far away, or it was a sunny day and it suddenly became a dark electric storm, for example a person in Hlabisa said: "It was sunny that day, but it suddenly changed. The clouds were black and it started to rain and the lightning pointed to VM (name omitted to preserve anonymity). He lied (sic) down. That was the end of his life.'

Lightning, however, often occurs at the perimeters of storm systems, so lightning can strike while the storm is still approaching or when the storm has already passed. At a tree plantation in South Africa, a worker working in the sapling plantation was killed by lightning even though the storm was 25 km away (Jandrell, 2012). It is therefore possible, that lightning ascribed to

witches, that appears to be a supernatural bolt from the blue, is simply [obscured] ...ding over a long distance or occurring at the edge of a
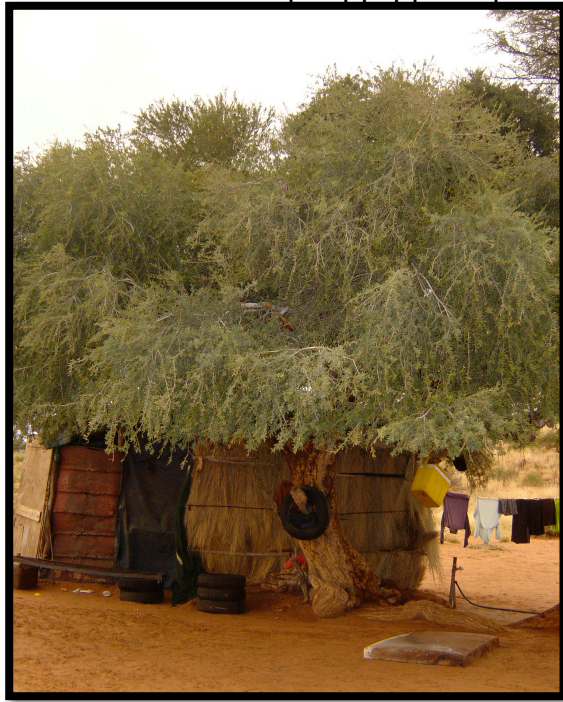
...ree

...ern Africa that believe that a specific trees offer protec-... strikes, so if you shelter under those types of trees, ... you.

...the Northern Cape are the descendants of the original ... that lived in the Kalahari. They were evicted from their ...after the formation of the Kalahari Gemsbok National ...nan-Dodd, 2004) (now the Kgalagadi Transfrontier

Figure 3.6: Khomani San house built under a large *boscia albitrunca*

Park).

Colonialism and apartheid scattered the San people and all but destroyed their language and culture (Holden, 2007). At present, one of the remaining groups of Khomani San lives at Witdraai and Blinkwater, just outside the Kgalagadi Transfrontier Park.

The most striking feature of the interviews and conversations conducted during a field trip to the Northern Cape was the firm conviction that the *witgat* tree is never struck by lightning. The *witgat* tree is the *boscia albitrunca*, also called a Shepherd's Bush. When asked what people would do if they were out in the veld and they were caught in a lightning storm, all agreed that if there were a *witgat* tree nearby, they would shelter under it, as it is never struck by lightning. One of the members of the community built his house under a *witgat* tree, as shown in Figure 3.6.

Mutshiyalo and Siebert mention different groups in southern Africa attribute the ability to protect against lightning to the *boscia albitrunca,* as well as the *ziziphus mucronata* and *gardenia volkensii* (Mutshinyalo, 2010). Dlamini (2009) reports that the Swazi people believe that several species of trees repel lightning and they would thus shelter under those kinds of trees during an electric storm. He specifically mentions the sausage tree *kigelia africana* and the Cape plane tree *ochna arborea*.

In his biography of Adrian Boshier, an Englishman who was trained as a Sotho *ngaka,* (a traditional healer and diviner, Lyall Watson (1983) describes Boshier collecting herbs for a ceremony, including *mafiroane* or baboon tail, which was said to protect against lightning.

Evaluation of the Lightning Tree myth

An investigation was done to establish whether there might be any scientific foundation for their view that the *boscia albitrunca* is never struck by lightning.

One of the reasons why the *boscia albitrunca* might be less susceptible to lightning might be as simple as its natural distribution. Driving through the arid Northern Cape landscape of rolling dunes, it is evident that the most commonly occurring tree is the *acacia erioloba* or Camel Thorn tree. In general, the Camel Thorn trees observed during the field trip were tall trees that grew to heights of more than 6 meters, whereas the *boscia albitrunca* tended to be shorter, stockier trees. Driving or walking around, it is easy to observe examples of Camel Thorn trees that appear to have been struck by

lightning. However, this would not be sufficient to explain why the *witgat* tree is never struck by lightning.

The hydraulic lift effect might contribute to making the *witgat* tree less prone to lightning strikes. Some tree species that grow in arid areas like the Northern Cape can survive minimal rainfall by sending roots so deep into the soil that they can obtain water from the permanent water table. In the Kalahari, a *witgat* tree has been known to have roots to a depth of 68m; a Camel Thorn with roots to a depth of 60m has been observed (Canadell, 1996). In their paper, Canadell *et al* briefly review the work done by others on the hydraulic lift effect of deep roots. Hydraulic lift is a mechanism whereby deep roots absorb water during the night from deep soil layers, which is then released back into the soil by shallow roots, effectively re-hydrating the shallow soil layers.

The mechanism most likely to cause injury or death to people and animals in the vicinity of the tree would be a step potential (step potentials are described more fully in Section 4). A step potential is a high voltage gradient in the ground radiating from the point of strike (Carte, 2002). Soil resistivity plays an important role in the magnitude of the step potentials around a point of lightning impact. The lower the soil resistivity, the lower the step potentials around the point of strike. Soil resistivity varies for different types of soil. It is defined as the resistance between opposite faces of a one-meter cube of soil (www.megger.com, 2009). Typically, the resistivity of sandy soil in arid areas is much higher than that of clay soils (www.smeter.net, 2009). Soil resistivity is very dependent on moisture content (Geldenhuys, 1990) – the more moist the soil, the lower its resistivity.

One hypothesis is that the hydraulic lift effect of the root systems of the *boscia albitrunca* might keep the surrounding soil moister than other soil in the same area. If so, then it would be safer under a Shepherds' Tree than in the open veld. This hypothesis was tested by conducting soil resistivity tests in the Kalahari. The experimental setup was as follows:

• The Wenner four-pin-method was used. This is a standard method of soil resistivity measurement.
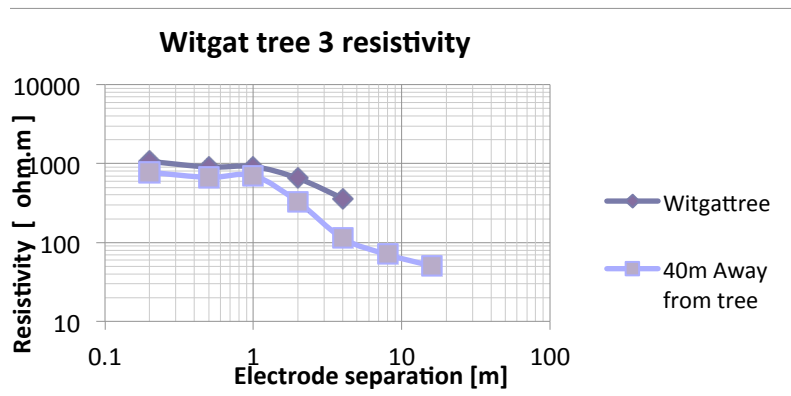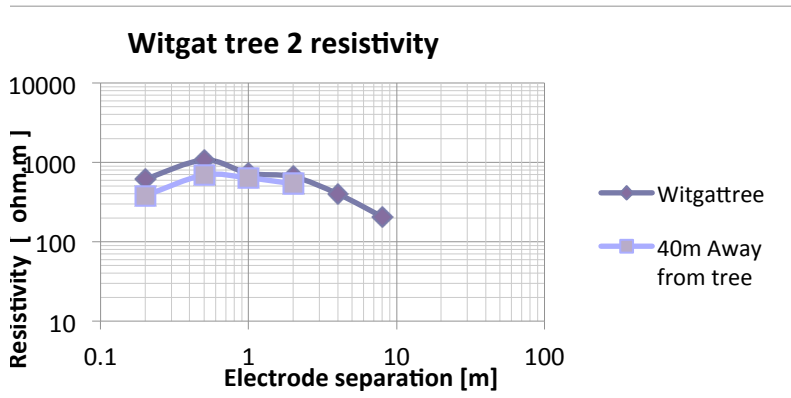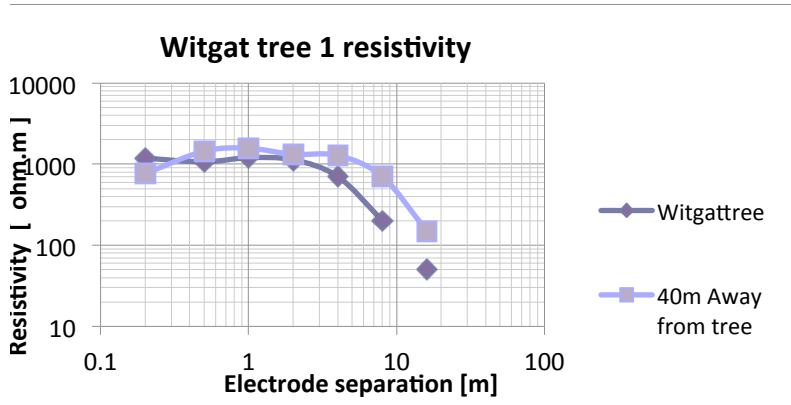
gure 3.7: Charts showing the soil resistivity under *boscia albitrunca* and 40 m away from tree

- Soil resistivity is calculated using the equation $\rho = 2\pi aR$, where a is the separation between adjacent electrodes of the soil resistivity measuring instrument, $\pi = 3.141593$ and R is the resistance measured between electrodes in Ω.

- A set of measurements were taken under several *boscia albitrunca* trees and at a distance of 40m away from each tree. Three sets of measurements are shown in Figure 3.7.

- Measurements were taken for electrode separations of 0.2m, 0.5m, 1m, 2m, 4m, 8m, 16m and 32m.

- Water was poured onto the electrodes to ensure a better connection in the sandy soil.

A greater electrode separation implies a larger soil volume and thus a deeper measurement. The measurements indicate that the soil resistivity drops off sharply in deeper layers of soil. This probably indicates that deeper levels of soil are moister.

It can be seen from the charts in Figure 3.7 that there is the soil resistivity measurements taken beneath the *boscia albitrunca* and those taken 40m away track each other approximately. However, the soil resistivity beneath the *boscia albitrunca* does not appear to provide more protection against a step potential in the event of a lightning strike than standing in the open veld. Hence, one must conclude that it would be just as dangerous to shelter beneath a *boscia albitrunca* during a lightning storm as it would be to shelter beneath any other tree. This misconception places people at a great risk and it should be addressed in any formal awareness effort.

3.3   The Lightning Bird

References to the lightning bird and lightning's eggs (also implying that lightning is a bird) are quite common.

Mozambique was ravaged by a civil war that started in the 1970's and only ended in the 1990's. A legacy of that war was many areas were riddled with land mines, which still render potential farmlands unusable today. In the short story entitled *The Day Mabata-bata Exploded*, by Mozambican writer Mia Couto (1986), a rural boy takes his family's cattle out to a nearby hill to graze. He sees how a bright flash kills one of his cows and immediately attributes it to the "lightning bird".

He is unaware that it was a land mine that killed his cow – he does not know about land mines, but tales about the lightning bird are familiar to him and therefore he confuses the detonation of a land mine with the lightning bird appearing to him in a blinding flash.

...i the Ox (Bourke, ±1948) is part of a collection ...recorded by Myles Bourke and contains a ...tning bird by Stella Bailey. The volume is not

gure 3.8: The lightning bird speaks to Magena

dated, but Google Books (http://books.google.co.za, 2012) indicates that it was published in 1948, shown in Figure 3.8.

In the story, a young cattle herd called Magena, was out in the veld one day herding his cattle and making oxen from clay, when the other herds warned him that a big storm was coming and he should take his cattle home. He did not heed their warning and carried on playing and suddenly the malevolent storm was upon him. Magena could sing beautifully and play on his string instrument called an uhadi. He felt very frightened and decided to sing a song

in which he begged the lightning bird to spare him and his cattle. The rain bucketed down and the thunder and lightning were fierce. Lightning struck the tree under which Magena was sheltering and suddenly the storm was over. He heard a voice speaking to him, looked up and saw that it was the lightning bird: its breast, eyes, beak, legs and talons were the colour of flames, its back and neck were all the colours of the rainbow. The bird said that he had intended to kill Magena, but liked his song so much that he decided to spare him and his cattle. The bird also promised to give Magena his own ox. It flew up, dove into the nearby river with a flash and a crash of thunder and Badoli, the magical white ox, emerged from the water. The rest of the story is about the adventures of Magena and his magical ox. The story's description of the lightning bird sounds very similar to that given by Bishop Henry Callaway (1886:119) who wrote that it had a red bill, red legs, bright and dazzling feathers and a short red tail.

In both *Badoli the Ox* and *The Day Mabata-bata Exploded*, the lightning bird represents the destructive and deadly power of lightning. In Couto's story, the only thing the boy knows that can kill in a blinding flash, is lightning. In *Badoli the Ox*, Magena knows that the lightning bird has the power to kill him and his cattle, but it is his beautiful song that dissuades the bird from destroying them.

One of Bishop Callaway's informants describe the lightning bird as follows (1886a:383) : "…its feathers glisten. A man may think that it is red; again he sees that it is not so, it is green." A man told Berglund that he has seen the lightning bird and described it thus (Berglund, 1976:39): "The feathers were white, burning. The beak and legs were red with fire and the tail was something else, like burning green or like the colour of the sky."

Watson (1983) identifies the *Scopus umbretta* or hamerkop as the lightning bird – followed by wind and rain and a herald of thunderstorms.

The Kgatla in Botswana believed that the lightning bird brought rain-bearing clouds from the sea. Its feathers, flesh and dung were included in the ingredients that were made into a paste and kept in a rain horn, to be used in rainmaking ceremonies (Schapera, 1971). Schapera analysed one of the

lightning charms, said to be the dung of a battaleur eagle, but it turned out to be chalk.

In Sotho and Tswana, the Milky Way is known as *Molalatladi*, which means the resting place of the lightning bird (Watson, 1983), (Snedegar, 1995).

An interviewee in Mokopane said: "… the bird feeds on the chameleon that would be on the tree. We do not know its name, we just call it lightning bird."

The Zulus believe that lightning is fire brought to the earth by a bird, the *impundulu* or a hen *inyoni yezulu* and it strikes the earth when the *inyoni yezulu* wants to lay its eggs. There are various beliefs surrounding the eggs of the lightning bird.

The Southern Rhodesia Native Affairs Department Annual (Nada) of 1924 (Mbizo, 1924) contains a story entitled "The Lightning Doctor", which tells of a tree that was struck by lightning. The local people believed that if a tree was struck, it meant that the lightning has laid its eggs in the ground nearby, and would return to fetch them, therefore a lightning doctor had to find the eggs and destroy them. The lightning bird was called the *isivolovolo*, which is also the name of the white-necked fish eagle. The lightning doctor found a nest about two feet under the ground, with two eggs in it. The writer was skeptical and suspected the lightning doctor of slipping the eggs into the nest, but the eggs were doctored and thrown into a deep pool. The author said the incident had occurred 15 years earlier and lightning had not struck the place again since.

In a footnote to the story, Nada editor Guy A Taylor wrote that he had an earthernware egg, found while plowing. He showed it to people of the Batanga and Baila tribes and everybody agreed that it was an egg laid by lightning.

The story of the lightning that will return to the same place to fetch its eggs, is echoed in a story told by one of the Khomani San elders in an interview. She said that when lightning strikes a tree, it breaks it to pieces with a small, smooth bullet "and the weather will turn away, and it's bullet is there. Then it comes again, the cloud comes again. It comes to take it out…It comes to take its bullet out. So that it can use it again."

gure 3.9: Photograph by Yu-Chieh Liu of a lightning flash that looks like a bird

Schonland (1950) devotes about two pages of his book *The Flight of the Thunderbolts* to South African lightning myths. He writes that some South African tribes believe that lightning is made by the thunder-bird Umpundulo. He also writes that sometimes, witch-doctors have the duty of chasing away storms and some witch-doctors are said to be able to control lightning. Bouquegneau (2010) mentions that in some South African languages, the phrase for being struck by lightning can be translated as *being lacerated by the thunderbird's claws*. He also mentions that in some South African traditions, lightning is personified as a magical bird.

Evaluation of the myths of the Lightning Bird

During her research on 3-dimensional modeling of lightning at the University of the Witwatersrand, Yu-Chieh Liu used a high-speed camera to capture images of lightning in Johannesburg. One of her pictures, shown in Figure 3.9, is a lightning flash that looks very much like a bird darting out of the sky and striking the earth with its beak. It makes one realize why people might characterize lightning as a bird.

Personifying lightning as a bird or even believing that it is a bird, or a bird of fire, seem to be ways of making sense of lightning by describing it in terms of something familiar and understandable. The stories recounted here all make it clear that although lightning is characterized as a bird, it is a frightening and [obscured] not increase the believers' risk with [obscured] ghtning bird and would presumably

e 3.10: Clay models of the *inkanyamba*. Photograph reproduced with the permission of
Felicity Wood

3.4   The Lightning Snake

In southern Africa, snakes have been associated with rain for a long time. In semi-arid areas, snakes appear after it has rained and in San thought, cobras and puffadders are associated with rain (Lewis-Williams, 2004).

In his book on Tswana rainmaking rites, Schapera (1971) gives a description of the rain snake as huge, bigger than a python, with glittering eyes, that lived in a cave. He recorded that the Kgatla people of Botswana believed if the dung of the rain snake was burnt in a fire, then it would prevent lightning from striking the town.

The *inkanyamba* is a mythical Zulu snake that lives in deep water pools (Reeder, 2011), sometimes described as a snake with many heads. Two Zulu interviewees said that when the *inkanyamba* wants to find a mate, it flies through the sky in a malevolent storm cloud, accompanied by lightning. When it sees a glinting pool, it dives down to see whether there is a mate in the water. The *inkanyamba* could mistake a shiny corrugated tin roof for a water pool and dive down from the sky hence many Zulus believe that one should paint a corrugated tin roof.

A story that appeared in the Daily Sun (Magagula, 2010) describes how a lightning storm, accompanied by a strong wind, ripped the roof off a school in Vlaklaagte, in Mpumalanga province. One of the local villagers is quoted as saying: "People here are starting to believe the Nkayamba, the River Snake, is behind all this. I suspect that the river snake is very angry but we don't know what it wants."

In an interview done in Johannesburg with a young Zulu woman, she said that she could remember when she was a child, that some researchers came to the rural village where she was living, to find the eggs of the lightning snake. They found some eggs in a pool nearby and took them back with them. When the lightning snake realized that somebody had taken its eggs, it became very angry and vented its wrath in a terrible storm that destroyed some houses and overturned a tractor.

The *inkanyamba* is also associated with tornadoes. In 1998, a tornado struck the eastern Cape village of Hogsback and subsequently, the local Xhosa artists started making clay models of the *inkanyamba*. Two of them are shown in Figure 3.10.

Evaluation of lightning snake myths

As discussed in 1.3 regarding the lightning bird, personifying lightning as a snake, does not increase the believers' risk with regard to lightning, since people fear the lightning snake and would presumably avoid an encounter with it.

3.5   Lightning symbolism in praise poetry

Praise poetry is a traditional form of oral performance that is still practiced in South Africa today. Praise poems are much more than exaggerated praises for chiefs and other dignitaries – they also give an account of important events and daily life during the rule of a particular chief (Jordan, 1973). There are also several collections of praise poems that provide some insight into the genre, even though they lack a performance's spontaneity and the poet's ability to improvise.

The lightning imagery used in praise poetry illustrate the different ways in which lightning is regarded by different people.

In Sotho, Tswana and Hlubi praise poems, one encounters lightning used as a metaphor to express a chief's power as a warrior in battle and the destruction caused by battles.

In 1880, Jonathan became chief of the Sotho royal family, but his brother Joel disputed his chieftainship (Damane, 1974). The dispute escalated into a war in which Jonathan defeated Joel and set fire to his village. A praise poet twice used lightning as a metaphor to describe the burning of Joel's village (Damane, 1974:173-174, 179):

" The extraordinary lightning of the Camp

Struck Qalo, it struck Sebothane

It was everywhere suddenly, it struck Mathokoane.

Burnt was the mountain, it was turned to ashes,

Burnt were the pegs at the back of the house,

Burnt were Hoatane and Kolojane!

The men from Masopha's tried vainly to quench it,

To calm down the blaze, to calm down the flames,

The sorcery of burning grass in the winter:

Burnt were the people, burnt too were the horses,

Ablaze were the saddles too!"

…

" The heavens of the chief's son flashed,

Out they hurled their lightning:

Here on the plain of Mathakoane,

People have caught glittering flashes on the plain."

In these two passages, the poet confers upon Jonathan a god-like power of controlling the elements to smite his enemies. As described in the first sec-

tion of this chapter, many South Africans believe that there are witches that can control lightning. The poet reinforces that belief by calling the fire 'The sorcery of burning grass…"

In a Tswana praise poem on the topic of the Boer campaign against Mokopane in 1854, a warrior is described as (Schapera 1965:67):

"Lightning, brother of Nthwalwe and Seole,

lightning of Nthwalwe, strike the fallow fields,

strike the caves if the Mokopane tribe;"

Singing the praises of Ramono, who became chief of the Kgatla clan in 1903, the poet said (Schapera, 1965:99-100):

"No one surpasses me, the forked lightning,

The lightning of Morekwe and Mapidiwe,

which strikes twice in one day,

and once struck repeatedly.

Having just struck at Marico,

and then struck at Lemonyana hill,

it next struck at Maratadiba….

….Not only today has it been striking;

the Kwena, too, tell of it.

They had looted at Mmotso,

the lightning followed behind them;

when they got to Mothlabatse,

it roused the valley with thunder,

it snatched up and showered hot embers upon them,

and threw some men into thorny hedges."

The legendary Zulu king Shaka, probably the most famous warrior in South African history, is also likened to a thunderstorm in his praises (Cope,Trevor 1968:100):

"The sky that rumbled, the sky of Mageba,

That thundered above Nomangci mountain,

It thundered behind the kraal at Kuqhobekeni and struck,

It took the shields of the Maphela and the Mankayiya…"He who points with a stick

The Hlubi tribe, now dispersed, was one of the Nguni tribes. Mpangazitha, the Hlubi chief during the time of the Shaka (Jordan, 1973) is described in a praise poem as follows:

"He is the clearing-and-frowning skies,

A thunderer like the heavens above,

Ever smiting man, but never decried;"

In a Zulu praise poem to Henry Francis Fynn, his gun is described as follows (Cope, 1968:194):

"He who points with a stick and thunder and lightning come forth…"

In contrast with this imagery of violence and destruction, Shona love poems focus on the beauty of lightning, as can be seen from the following two examples (Cope, 1968:38):

"Let your smile light up like lightning,

Beaming to tell me of your joy.

and (Cope, 1968:209):

"My dear one, close as a bead belt;

Whose gait is as the planting of ground-peas,

And whose laughter is like lightning in the rain."

3.6 Lightning in Afrikaans poetry

Two very well-known Afrikaans poems treat lightning in two very different _____ g can play in people's _____ elcome herald of rain in _____ her hand, lightning kills.

_____ *an die Reën* (The rain's _____ o a wedding feast as a _____ s shyly over the moun- _____ s to dance confidently _____ lets and her sparkling

_____ by the poet Totius tells _____ ghtning, ran to him and _____ hor for the searing pain that rips through him at the loss of his child.

Figure 3.11: A man outside his house with tyres on the roof to protect against lightning

3.7 A tyre on the roof

Very many South Africans believe that if you put an old car tyre on the roof of your house, it will protect the house against being struck by lightning – an example is shown in Figure 3.11. When questioned, people do not know how the tyre protects the house. Some say that the rubber absorbs the lightning. Others say that just like a car's tyres protect you when lightning strikes a car, it protects the house in the same way. It is clear that the tyre on the roof is a myth that people follow, believing that it works, but this demonstrates that they have little understanding of the physics of lightning, since a tyre on the roof cannot do anything to protect a dwelling against lightning.

Pabale (2006) and Maselwa (2004) found that parents commonly told their children that a tyre on the roof protects against lightning.

A story in the tabloid *Daily Sun* (Sizani, 2009) perpetuates the myth that a tyre on the roof will protect a house against lightning. The story was unrelated to any news event. It was entitled "*They're used to fight lightning",* referring to tyres on roofs.

3.8 Mirrors and lightning

One of the most common misconceptions in South Africa is that mirrors attract lightning. Many people of all the different cultural and language groups have recollections of their grandmothers covering the mirrors during a thunderstorm.

Most of the interview participants said that they cover up the mirrors when there is lightning. A few said that this was because a mirror could reflect the lightning and the reflected lightning could kill you.

In a questionnaire administered to a group of first year Mining Engineering students, one of the questions was: "Do mirrors attract lightning?" Respondents could tick one of three boxes labeled *Yes*, *No* and *Don't know*. As shown in Figure 3.12, 65% of the 172 respondents believe that mirrors attract lightning.

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In their research with school learners, Pabale (2006) in Limpopo and Maselwa (2004) in the Eastern Cape both found most pupils believed that they should cover the mirrors during a lightning storm.

There is no scientific rationale to the belief that mirrors attract lightning and covering mirrors does not in any way protect a person against being injured or killed by lightning.
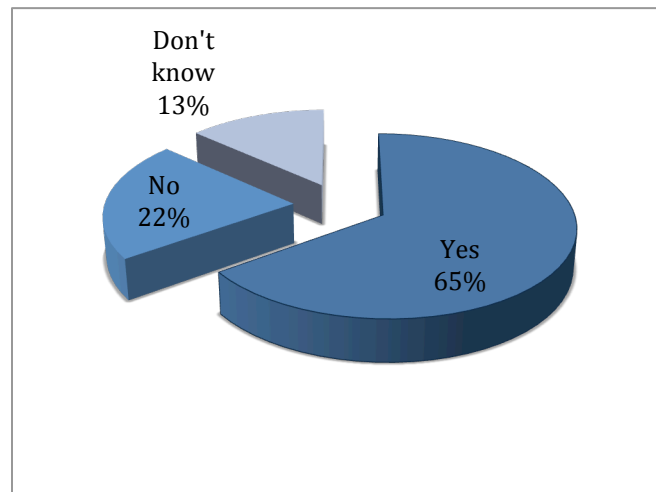
Figure 3.12: Do mirrors attract lightning?

3.9   Mobile telephones attract lightning

There is a common belief in South Africa that it is dangerous to speak on a cellular (mobile) telephone during a lightning storm, because people think that a cell phone attracts lightning. A *sangoma* interviewed in Hlabisa told two stories to illustrate this belief. She said that during a thunderstorm, there was a meeting of the Shembe Church in Hlabisa. There was a great flash of lightning and then all the cell phones that had been on, were black and did not work any more. She was not at the meeting, but heard this story and believes it to be true.
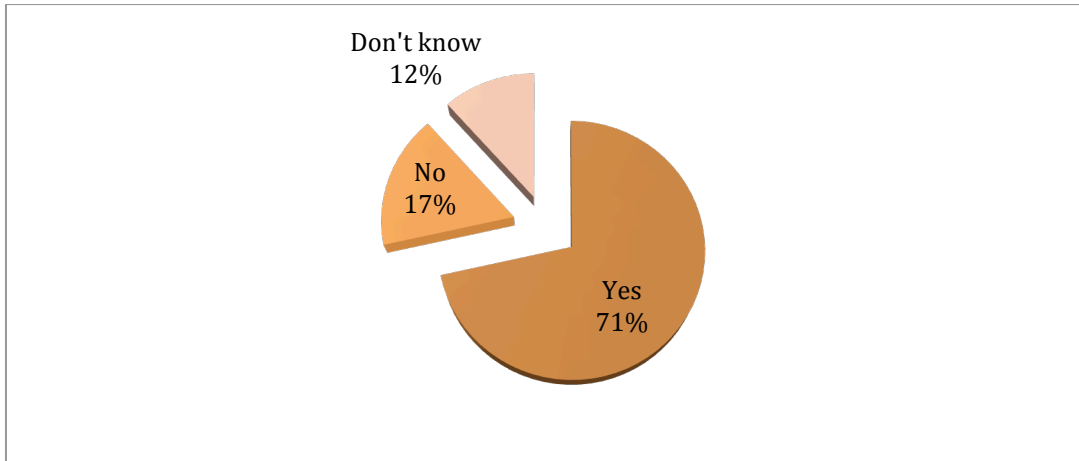
Figure 3.13: Is it dangerous to talk on a cell phone during a lightning storm?

Her other story was that a woman was visiting them in 2009 and she stepped outside to speak on her cell phone while a thunderstorm was approaching. While speaking on the phone, she was struck by lightning and critically injured. She died in hospital a while later.

Most of the other interview participants confirmed that they thought it dangerous to speak on a cell phone during a lightning storm.

In a questionnaire administered to a group of first year Mining Engineering students, one of the questions was: "Is it dangerous to talk on a cell phone during a lightning storm?" Respondents could tick one of three boxes labeled *Yes*, *No* and *Don't know*. As shown in Figure 3.13, the overwhelming belief is that it is dangerous to speak on a mobile telephone during a lightning storm.

It is an unfounded myth that it is dangerous to speak on a mobile telephone during a thunderstorm. The electromagnetic waves transmitted to and from a cell phone do not cause ionization of the surrounding air and hence do not create a preferential path for lightning.

3.10 Sitting indoors quietly

Some of people expressed the belief that the appropriate thing to do during a lightning storm, is to stay indoors and be quiet until the storm passes. Some believe that family members must stay on their beds for the duration of the storm.

A Khomani San interview participant in Blinkwater said that when there is a lightning storm, the whole family sits in the *kooi* (old-fashioned Afrikaans

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word for a bed) until it passes. One of the tales in the Bleek and Lloyd collection of the San oral tradition supports this belief. In *The Thunderstorm* (Bleek, 2007), the narrator tells how he was playing a musical instrument called a goura during a storm. He kept playing, even though his mother told him to stop and he knew that he should not play during a storm.

There was a lightning flash and he said that saw that "that the rain had intended to kill us, on account of my doings."

Although being quite cannot make any difference to whether lightning strikes or not, it is recommended that people stay indoors during a lightning storm.

3.11 Ball lightning

Four interviewees described having seen a ball of lightning coming into their house.

One woman in Hlabisa said that there was a storm one night. She and husband and two grandchildren were inside their thatched hut. Rainwater ran into the house and the power was cut off. She saw something enter the house "like a ball with different kinds of colours" and then she called out to her granddaughter who was on the bed, but she had been killed.

Another explained that somebody was killed when lightning that looked like "a white round-shaped thing" came in through the door. The third person said: "Something like a ball entered the house and goes (sic) to the corner. It burst and the house was on fire. That ball was pushed by lightning."

Another woman in Mokopane said that she saw lightning strike a house on her street one night: "After a short while there was a lightning strike and there was a big ball of fire."

In the leading textbook on lightning, Uman and Rakov (Rakov, 2003) state that ball lightning is a well-documented phenomenon, but as yet, there is no widely accepted theory how ball lightning occurs and it has never been successfully simulated under laboratory conditions.

4 Lightning awareness

Lightning awareness is an ongoing concern in the international lightning research community.

There are two types of basic information that should form part of any attempt at creating lightning awareness and education namely:

- The ways in which lightning can kill or injure a person, referred to as the mechanisms of lightning injury;

- The steps that somebody can take to minimize the risk being hurt or killed.

This section sets out the different mechanisms of lightning injury and the information that people should know to minimize the risk of death or injury. This is followed by an analysis, where the myths and beliefs presented in the previous section are categorized according to how they affect people's risk of being killed or injured by lightning. An analysis of whether or not it is appropriate to address any of the myths and beliefs in future lightning awareness or education efforts is presented. The section concludes with background on lightning awareness and education efforts in other countries and a critique on the appropriateness of each type of campaign for South African conditions.

4.1 Mechanisms of lightning injury

There are currently five generally accepted mechanisms of lightning death and injury, namely a direct strike, a touch voltage, a side flash, a step potential and upward streamers (Cooper, 2010), (Cooray, 2003), (Anderson, 2002), (Carte, 2002), (Dlamini, 2009), (Jandrell, 2009). Each mechanism will be explained in some detail below.

4.1.1 Direct strike

Death or injury due to a direct strike, graphically represented in Figure 4.1, occurs when a lightning stroke connects directly with a person. Due to the potential difference between the point where lightning strikes the person and his/her feet, current flows through the body into the earth. Although one might

imagine that this would be the greatest cause, it only accounts for 3 – 5% of lightning injuries (Cooper, 2010).

Figure 4.1: Injury due to a direct lightning strike

4.1.2 Touch voltage

A touch voltage, as shown in Figure 4.2, occurs when lightning strikes an object while a person is touching it. It is also called a touch potential or contact potential. If lightning strikes something like a telephone wire or an electrical conductor, a person can be injured even if the lightning strikes quite far away but s(he) is touching something connected to the point of strike, for example a landline telephone or an electrical appliance.
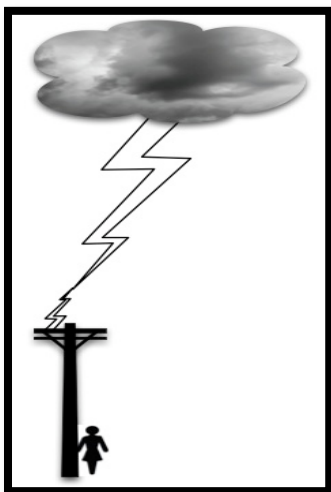
Figure 4.2: Death or injury due to a touch voltage   Figure 4.3: Harm due to a side flash
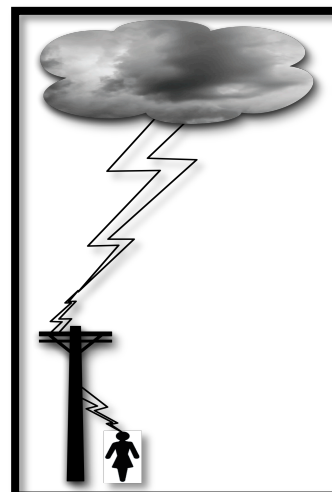
4.1.3 Side flash

A side flash can harm somebody standing close to an object that is struck by lightning. Part of the downward leader will keep traveling down to the ground along that object, but part of it jumps to the nearby person and travels to ground through the person, as shown in Figure 4.3.
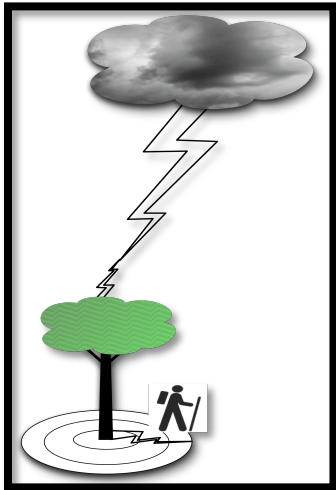
Figure 4.4: Step potential
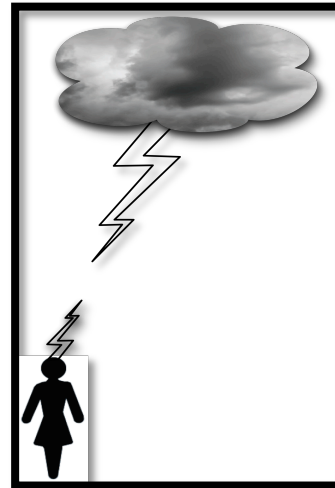
Figure 4.5: Upward streamers

4.1.4 Step potential

When lightning strikes an object, for example a tree, the lightning current goes into the earth. As the current spreads out through the earth, from a higher to a lower concentration of negative charge, as shown in Figure 4.4, it could happen that a person has one foot is placed in an area of higher charge than the other foot. If the person's body constitutes a path with lower resistance than the ground, the lightning will travel through that body, as illustrated in Figure 4.4. This also happens to animals, for example cattle and sheep – with lightning current traveling through their bodies between their forelegs and hind legs. The story in the tabloid Daily Sun, shown in Figure 1.3, reported that 15 goats were killed in a lightning storm. This was most likely caused by step potentials.

4.1.5 Upward leaders

During thunderstorm conditions, upward leader start to form from points on the ground, attracted by the opposing charge of the cloud. A lightning flash occurs when the downward leader and the upward leader connect and form a channel for the lightning discharge. An upward leader could form from a person's body, typically from the top of the head of somebody standing upright, as shown in Figure 4.5. Even if the upward and downward leaders never connect to complete a full lightning strike, the upward leader can be so strong that a person could still be hurt. That is what happened during a football match in 1998 between Moroka Swallows and Jomo Cosmos in Johannesburg (Anderson, 2002) - lightning struck nearby and several players were injured by upward leaders.

4.2 Basic information that a lightning awareness campaign should address

In South Africa, many people have limited literacy (see discussion in section 4.4) and it is a society with many different languages, so the information in any lightning campaign should be expressed as simply as possible. The following content is suggested for lightning awareness and education purposes, written in the kind of simple language that is recommended:

- When thunder roars, go indoors. You are safer indoors than outdoors. Choose a sturdy permanent structure, not something open like a bus shelter and not something temporary like a wooden guard hut.

- Use the 30-second rule: If you can count 30 seconds or less between seeing the lightning flash and hearing thunder, you should go to a safe place.

- If you are outdoors, squat down to keep your height as small as possible. Make your contact with the ground as small as possible, so do not lie down on the ground.

- Don't touch metal objects like electric wires, fences, or plugged-in electrical appliances like a washing machine.

- Don't take a bath or shower, wash dishes or wash your hands.

- Don't lie down on the ground.

- Don't talk on a landline telephone, like a Telkom phone.

- If you use a fire for cooking, put it out.

- Don't stand under or near a tree (Holle, 2012).

- You are safe in a car, taxi or bus as long as you keep the windows closed.

4.3   Lightning awareness campaigns in other countries

This section deals with lightning awareness campaigns that have been conducted in other countries and critiques them from the point of view of whether the approaches would be appropriate in South Africa or not.

In the United States, the decrease in the number of lightning deaths over the past ten years, is partly attributed to the work done to increase lightning safety awareness (Cooper 2010), (Lengyel, 2010). In the United States, there is a lot of information available on lightning safety on the web pages of the National Weather Service at http://www.lightningsafety.noaa.gov/ and it has promoted an annual national Lightning Safety Week, that has been running annually since 2000. One of the photographs on the events page of the Lightning Safety Week shows a regional television news channel weatherman (www.lightningsafety.noaa.gov, 2012) talking about lightning safety.

In Sri Lanka, school programs were used to create lightning awareness. A report lists five workshops that were held at schools during 2005 (Gomes *et al*, 2005), attended by a total of 930 learners and 28 teachers.

In Bangladesh, school teachers were given lectures on lightning awareness, but in the rural areas with low literacy rates, folk songs, theatre, dance and story-telling were used (Gomes *et al*, 2011), as well as printed material like brochures, newspaper articles and, occasionally, billboards.

Lightning safety awareness has also been addressed in the following ways (Cooper, 2010):

- Street theatre has been used in Bangladesh;

- Community education in Nepal;

- Educating soccer coaches in countries where soccer is popular.

4.4   Critique from the South African point of view

Gomes *et al* (2006) propose a model for lightning awareness in third world countries based on literacy levels. They suggest that in areas where the literacy is above 90%, the internet can be used as one of the ways of creating lightning safety awareness.

In southern Africa, however, an internet-based model would not be appropriate for these reasons:

- The literacy rate of South Africa is not necessarily a good indicator. The literacy rate is 93% (Statistics SA, 2010). This figure is based on completing school up to Grade 7, which does not take into account the disparities in education during Apartheid (Posel, 2011). The democratically elected government, that has been in power in South Africa since 1994, unfortunately has not succeeded in rectifying the disparities and corruption in regional government is also proving to be an obstacle. Every year the media abound with stories about school that do not have books, desks and chairs for learners. On 17 May 2012, the Limpopo Department of Education was ordered by the High Court to provide textbooks to learners – they had not yet received textbooks for the school year that started in January 2012.

- Increasingly, schooling is becoming an unreliable barometer of actual ability. In the School of Electrical and Information Engineering at Wits University, it has been found that students' final school marks are not a good indicator of success at university. Similarly, schooling up to Grade 7 might no longer be a reliable indicator of literacy.

- Literacy is not a good indicator of access to information technology in Africa. An internet-based campaign would not reach the millions of people living in

rural areas, since the majority are not connected to the world wide web (Johnson, 2011).

- The South African Weather Service (SAWS) is moving increasingly towards a business model of users paying for weather information, hence it is unlikely that SAWS would invest money in this type of public service.

Regarding lectures at schools, a more cost effective way of reaching a large audience would be to direct one's efforts at incorporating lightning education and safety into the national or regional school curricula, instead of targeting a small number of individual schools, spread out over a large geographical area.

Similarly, public performances like song, drama and story-telling, would only reach small groups of people. Furthermore, many rural villages in South Africa are spread out over a large geographical area, with small clusters of houses, sometimes quite far from each other, making it difficult to attract a large percentage of the population to an event.

Billboard displays could make an impact, particularly if one could obtain the financial support of a large corporation that has a public service policy.

4.5 Lightning warning systems

There are many types of lightning warning systems in existence already. Only a few examples will be mentioned here.

The South African Weather Service (www.weathersa.co.za, 2012)) provides an SMS service that notifies users of unusual weather and storms and provides provincial storm tracking. The service, however, is only available to subscribers, with the cheapest option costing R40 per month (approximately US$4.80 per month). This may seem inexpensive, but in impoverished communities that are hardest hit by lightning deaths in South Africa, this is unaffordable.

Smart phone apps (applications) for example WeatherBug, provides real-time warnings of thunderstorms and lightning strikes. In South Africa, however, smart phones are limited to the privileged class. A service that would bridge the digital divide to be available to all classes, would have to be SMS-based – SMS is an

acronym for short message service, which is a message that comprises text only, and contains no pictures, video clips or sound.

In the United States, a Wireless Emergency Alerts service is to be launched in 2012 (National Oceanic and Atmospheric Administration, 2012). Extreme weather warnings will be sent automatically to the mobile phones of subscribers of participating networks. The service will be free, geographically targeted and although they are text-like, messages will use a technology different to SMS technology so that they will not be subject to congestion and delays on the mobile network (www.ctia.org, 2012). Exactly this kind of service would be ideal for South Africa. It would require the participation of a weather forecasting service and the three major local mobile networks, Vodacom, MTN and Cell C. It would also require the United States consortium that is responsible for the Wireless Emergency Alerts to be willing to share the technology that they are using to send the alerts.

There are a number of portable lightning detectors that have been developed, for example using a narrowband receiver tuned to 1MHz, proposed by Mäkelä *et al* (2009) and electric field mills (López *et al*, 2012). Investigating such methods is beyond the scope of this work, but would provide a promising avenue of research for future work.

4.6   Categorization of myths and beliefs according to risk

One of the research questions that this thesis attempts to address, is how people's myths and beliefs about lightning in southern Africa affects their risk of death or injury during an electric storm. The most prevalent myths and beliefs were presented in the Chapter 3. In this section the myths will be analysed in terms of the risk associated with each one and the likelihood of each risk occurring, as well as an evaluation of whether it should be addressed in a lightning awareness effort. Both the risk and the likelihood have been categorized as high, medium or low. The findings are summarized in Table 4.1.

Witchcraft:

The belief that witches can send lightning to selectively kill people or destroy their property poses a high risk to anybody suspected of being a witch. There is a moderate risk of this occurring due to a fairly common view that witches should be killed, drawn from various sources in Chapter 3. The rationale is that the belief is quite widespread in southern Africa and those at risk are people who are accused of being witches.

Table 4.1: Risks associated with myths and beliefs

Myth/Belief	Risk factor	Likelihood	Lightning awareness
Witchcraft	High	Medium	Steer clear
Use of muthi	Medium	Medium	Encourage people to take additional precautions
Heaven herd	High	Low	Steer clear
The lightning tree	High	Low	Warn in awareness material
The lightning bird	Low	Low	No action needed
The lightning snake	Low	Low	No action needed
Covering mirrors	Low	Medium	Harmless: no action needed
A tyre on the roof	Medium	Medium	Warn in awareness material
Sitting indoors quietly	Low	Low	Encourage this
Cell phones	Low	High	Harmless: no action needed

There is a fundamental division between the paradigms of people who believe in witchcraft and those that do not. People with this worldview, however, accept that there is also natural lightning. A lightning awareness program should ad-

dress education and safety with regard to natural lightning and should steer clear of beliefs around man-made, sent lightning.

Muthi:

The risk associated with using *muthi* to protect a person or dwelling against lightning, is categorized as medium, as it might give somebody a false sense of safety. The likelihood is categorized as medium, since it seems as if the use of *muthi* is quite widespread and people who believe in witchcraft are very likely to use *muthi*. It would be advisable to encourage people to take other precautions too, like staying indoors and there would be no point in trying to dissuade people from using *muthi* in addition to taking other safety steps.

Heaven herds:

The risk of being struck by lightning while standing on a hilltop, outdoors during a thunderstorm, is high. However, being a heaven herd is regarded as a special calling and there seem to be very few heaven herds, hence the likelihood is low. Since heaven herds believe that it is a calling and a part of their worldview, it would be pointless (and would probably be considered offensive) for an aware-ness effort to attempt to address this belief.

The lightning tree:

Believing that you are safe under any tree during a lightning storm, is extremely dangerous. The likelihood of this occurring, however, is very low since this belief seems to be restricted to particular areas and groups, like the Khomani San in the Northern Cape.
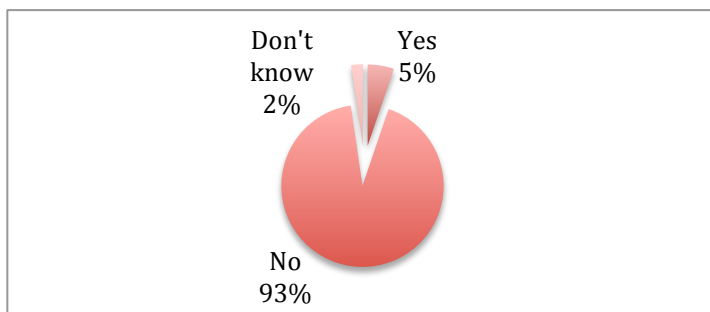
Figure 4.6: Questionnaire: Would it be safe under a tree in a thunderstorm?

Mining engineering students completed a questionnaire in which one of the questions was: "Would sheltering under a tree during a storm protect you against lightning?" Respondents could tick one of three boxes labeled *Yes*, *No* and *Don't know*. Figure 4.6 shows that an overwhelming majority of the 172 respondents know that it would not be safe under a tree during an electric storm.

A warning that sheltering under a tree during a thunderstorm, should be included in any lightning education effort. This would serve the dual purpose of warning those groups that think that it is safe under certain trees and it would create awareness under the general population that shelter under trees when it is raining.

The lightning bird and the lightning snake:

The myths of the lightning bird are more common in the old ethnographical studies and are not so common any more. The myths regarding the lightning snake are also quite uncommon, so in both cases the likelihood is low. The risk connected to both myths is also very low, since the bird and the snake are depicted as dangerous and to be avoided, hence no information in this regard need be included in a lightning awareness program.

Covering mirrors and avoiding cell phone use:

Although it seems to be very common practices to cover mirrors and to avoid using a cell phone during a thunderstorm, they are both harmless and hence it is not necessary to do anything to dispel these habits.

Putting a tyre on the roof:

There is a medium risk associated with putting a tyre on the roof as lightning protection, as this practice offers no protection and might give people a false sense of safety during a thunderstorm. In rural areas, this is quite a common practice and lightning awareness information should dispel this myth.

Sitting quietly indoors:

This belief was not articulated by many people, so the likelihood is low, but it is a behaviour that should be encouraged.

5 Using mobile telephones for lightning education and awareness: a proposal

Mobile telephones have transformed and revolutionised communication in Africa in a way that is radically different to the impact that they have had in the developed world. Not only have mobile phones changed Africa, but Africans have appropriated the technology by finding innovative ways of using it, with a large focus on low-cost usage and texting. This emergence of a pervasive mobile phone and texting culture in Africa might provide an opportunity to disseminate lightning awareness information and weather warnings in areas where it could reduce the number of annual lightning fatalities. For users in the developed world, a mobile phone merely supplements the efficient and ubiquitous fixed-line telephone and internet communication infrastructures. In Africa, however, millions of people living in rural areas have never had any infrastructure: no fixed-line telephone infrastructure, not even electrical power, hence no computer communications.

There is a need for a lightning awareness and education campaign in South Africa (Jandrell, 2009), since there are still many lightning deaths annually. Reports in the lay press indicate that there were 84 lightning fatalities in South Africa between January 2009 and November 2010 (Trengove, 2011). Wide news coverage was given to an incident in January 2010 when lightning struck a marquee tent in Pongola, killing 7 people and injuring 40.

Although the need has been identified, there is no strategy in place yet for a lightning awareness or education drive. This section provides a first attempt at a proposal for the format that it could take by leveraging the exponential growth of a mobile culture in Africa by designing a mobile telephone text-based service in Africa that can provide both a lightning warning and a lightning awareness/education system.

Rural communities in Africa face the highest risk of death or injury as a result of lightning. Typically, these communities have been difficult to reach, but

mobile phones could change that. In the course of research on Southern African lightning myths and beliefs (Trengove, 2011), the pervasiveness of mobile telephones, even in remote rural areas, became evident. An interview was done with a traditional healer living in a simple thatched hut, with no furniture except two animal skins on the floor, but she had a mobile telephone.

5.1 The emerging mobile culture in Africa

Mobile telephone services have made telecommunication accessible to many people in Africa in areas where there is no fixed-line infrastructure and vast distances made communication difficult. Southwood describes Africa before the advent of mobile phones as a place of "…a lot of walking and not much talking" (Southwood, 2008).

During his 2011 state of the nation address, the South African president, Jacob Zuma responded to a message posted on his Facebook page by Portia Busisiwe Mrwetyana. Her message expressed her dissatisfaction about the inequalities in Bekkersdal, where an informal settlement which has no services, lies alongside a suburb across the road with all amenities. She asked: "What I wanna know is why treat us differently, but we give you the same vote, WHY?" (Zuma, 2011). Ms Mrwetyana serves as a good illustration of the African culture of texting – although she has no electricity, telephone line or running water in her house, she was able to communicate with the President via a text message sent from her mobile phone.

Mobile phones are used differently in Africa. The majority of subscribers have pre-paid contracts, i.e. some credit is bought upfront, rather than post-paid, where a user is debited at the end of the month for calls made (Southwood, 2008). In many townships, there are shops (sometimes called point shops) that offer mobile network "public phones" where customers can phone on a

pay-per-call basis. People often share mobile phones, using different SIM (subscriber identity model) cards in one device (Chiumbu, 2012).

Many users just keep a small amount of credit on their mobile contract and use the phone mainly for flashing (Wasserman, 2011), (Chiumbu, 2012), (De Bruijn, 2009). Flashing is a way of indicating that you want somebody to phone you: you dial the other person's number, let it ring once or twice, but you hanging up before the other person answers. The other person's mobile phone will display a text message indicating a missed call from you. This is a way to convey a message to the other person to phone you, without you having to pay the airtime costs of speaking on the phone or sending a text message. Chiumbu (2012) explains that the practice of flashing lead to such congestion on the mobile networks that network companies introduced the *please-call-me*, a free SMS (short message service) that asks the recipient to call you. The *please-call-me* messages contain sponsored advertisements, that make the service profitable to the mobile network companies.

Mobile phones are used for checking market prices, political activism, transferring money, public health messages, communicating with customers of small businesses, (Southwood, 2008), (Wasserman, 2011), and social justice movements use them to organize and mobilize people (Chiumbu, 2012) predominantly through the use of text messages.

The proliferation of mobile phones in Africa has been phenomenal. In South Africa, 87% of the population owns a mobile phone and for 450 000 of these users, the mobile phones is their primary form of access to the internet (Wasserman, 2011), (Chiumbu, 2012).

Wasserman reports that from 2003 to 2008 there was an increase of 550% in the number of mobile subscribers in Africa, representing more 350 million connected people (Wasserman, 2011). It has been predicted that by 2012, only 10% of Africa's population will not own a mobile phone (Kreutz, 2010).
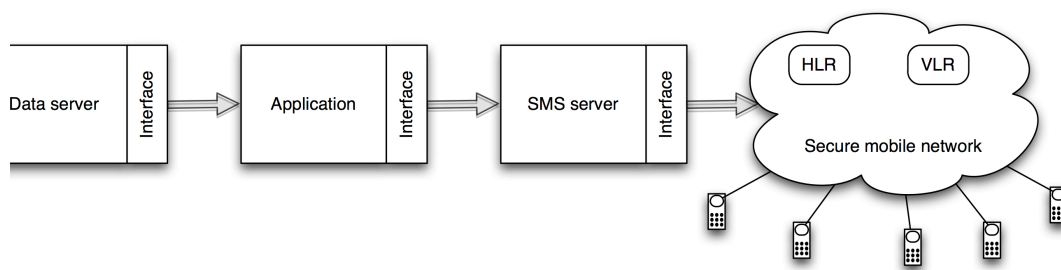
Figure 5.1: Components of an SMS warning system

5.2   A possible model

This section examines a way in which texting on mobile phones is used in Africa and suggests that this method might be adapted to disseminate lightning warnings and safety information.

There are examples in the literature on the proliferation of mobile phones and the use of bulk SMS services in Africa that can serve as models. FrontlineSMS is as an example of such a service – it is open-source software that allows an organization to send bulk SMSs with just a laptop and a mobile phone – no internet connection is needed as the service uses the GSM (Global System for Mobile Communications) network (http://www.frontlinesms.com/the-software/, 2012). The creator of FrontlineSMS, Ken Banks (Banks, 2010) describes how an NGO (non-governmental organisation) delivers healthcare to 250 000 rural Malawians with just a laptop, 100 recycled mobile phones and FrontlineSMS. In Afghanistan, it is used to send security alerts to the fieldworkers of a local NGO. FrontlineSMS is used by most social justice movements in Africa (Chiumbu, 2012).

Figure 5.1 shows a block diagram of how such an SMS lightning warning and awareness service could work. The data server would contain the weather

forecasting data, which will constantly be updated by a weather forecasting service. The application will convert the data into lightning warning information. Weather warnings could also contain lightning education messages, for example advising readers to go indoors or to avoid sheltering under a tree during a lightning storm. The application could be based on the open-source FrontlineSMS software. Mobile networks contain a Home Location Register (HLR) and a Visitor Location Register (VLR), where the HLR maintains the detailed information on subscribers and the VLR contains the last known geographical location of the subscriber (Hanrahan, 2012). In this context, subscribers include contract and pay-as-you-go users. The VLR is updated approximately every 6 seconds.

A lightning warning and education system based on this model, would only be feasible if the local mobile service providers agreed to participate. Since the networks can track the geographical locations of subscribers, warnings could target users in the particular area where a thunderstorm is approaching. A system that sends out warnings countrywide instead of targeting specific areas would be pointless and its messages are likely to be ignored as spam SMS's by users. Many services that send information via text messages, require users to subscribe to the service. Providing a service to subscribers only, would defeat the purpose of delivering a general public service and would create a barrier to receiving the warnings. Perhaps lightning text messages could be sponsored by including advertisements, as was done in the case of *please-call-me* text messages.

5.3   Legal restrictions in South Africa

A South African lightning warning service would have to obtain either the cooperation or permission of the South African Weather Service (SAWS). The South African parliament is currently considering a draft amendment to the South African Weather Service Act of 2001 (Vegter, 2012), (Modise, 2012). In terms of the amendment, anybody who issues a "severe weather or air

pollution-related warning" without the South African Weather Service's (SAWS) permission, could face a fine of up to R10-million (US $1.28-million) or a maximum of 10 years imprisonment.

The act does not specify what constitutes a "severe weather warning," but lightning warnings could possibly be construed as falling in that category. That would have to be investigated.

Alternatively, permission should be sought from SAWS or perhaps a service could be set up in co-operation with SAWS, but the SAWS business model of charging for weather information, makes this seem unlikely. The notion of a single entity having a monopoly on weather information is very undesirable and it would be worthwhile to lobby against the draft amendment.

At present, the author is unaware of similar restrictions elsewhere in Africa, but that would have to be investigated.

6 Conclusion

The aim of this work was to investigate the hypothesis of the thesis that the things that people believe about lightning could affect their chances of being killed or injured during an electric storm.

A number of myths and beliefs were documented and discussed and the risk associated with each was evaluated. They fall into four categories:

1. Some are harmless and do not affect people's safety, like the myths of the lightning bird and the *inkanyamba*.

2. Two of the beliefs could lull people into a false sense that they are protected against lightning, namely that the use of *muthi* and putting a tyre on the roof of a dwelling will protect a person against being struck by lightning. Lightning awareness material should explicitly encourage people to take additional precautions during a thunderstorm.

3. There is a high risk associated with two of the beliefs, namely that witches can harness lightning to kill others or to destroy their property and that heaven herds can chase lightning away.

   The belief in witchcraft poses a danger to those accused of being witches. Heaven herds endanger themselves by being outdoors during a thunderstorm. Both of these issues, however, are evidence of a worldview that is very different to the current understanding of the physics of lightning in the broad lightning research community. It is important to respect their view. A lightning awareness program should not attempt to convince them otherwise and should make it clear that it is addressing only natural lightning.

4. The belief that you would be safe under a particular tree during a thunderstorm has a high risk associated with it and should be addressed in a lightning awareness or education program.

Lightning awareness efforts in other countries were evaluated from the South African perspective. A well-known lightning safety slogan is: "When thunder roars, go indoors." In South Africa, however, people in rural areas are often killed by lightning while in their houses. It is more likely to happen in areas where there is no electrical, water or sewerage reticulation or where dwellings are constructed in a flimsy way, for example the many thousands of corrugated iron shacks in informal settlements. This raises a concern that should be addressed in future work, namely whether the slogan "When thunder roars, go indoors" is appropriate in South Africa and, if not, what are the safe alternatives. Future work could also be done to design an inexpensive and easy-to-assemble kit that could give some protection to a small dwelling against lightning.

As the research into lightning myths and beliefs unfolded, it became apparent that the growing mobile telephone and texting culture might present a useful opportunity for providing lightning warnings and education.

The advantages of using mobile phone texting for lightning warnings and education, are that:

- It would reach a large number of people;

- It would reach rural people;

- It would bridge the digital divide by providing the same service to rich and poor;

- Existing mobile telephone infrastructure could be used;

- If the cooperation of the mobile networks could be enlisted, lightning warning messages could be geographically targeted;

- The technology needed to set up a texting service need not be expensive.

A high level design for such a system was proposed.

Future work could comprise creating a prototype of a lightning warning system for mobile networks and collaborating with other disciplines to ensure that the interface of the system is easy to use and to understand irrespective of literacy levels, language and culture.

The disadvantage is that the system, even if relatively inexpensive, would require funding and the collaboration of the major mobile network companies. It is likely to be difficult to obtain funding since the number of people killed by lightning is relatively small compared, for example, to the number of deaths due to AIDS (acquired immune deficiency syndrome) or road fatalities in South Africa. The Treatment Action Campaign (TAC), an HIV/AIDS activist organization, puts the number of AIDS deaths in South Africa in 2011 at 400 000 (Treatment Action Campaign, 2012). In the six-week summer holiday season from 1 December 2011 until 11 January 2012, a total of 1475 people were killed in fatal car crashes on South Africa's roads (Road Traffic Management Corporation, 2012).

An attitude often encountered in the course of this project is one of "Why worry about it when the number of deaths is so small?". For everybody working in the area of lightning protection, however, even one lightning death per year is one too many.

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Appendix A

Table1: Press reports of lightning deaths in South Africa: Jan 2009 - Jan 2011[1]

Publication date	Number of deaths	Places of occurance
03/04-01-2009	4	Emalangeni reserve (KZN)
05-01-2009	5	Kwamashu (KZN)
09-01-2009	1	Petrusville (Freestate)
09-01-2009	3	Lusikisiki (EC)
11-01-2009	1	Bhamshela (KZN)
02-02-2009	3	Majabe Village (EC)
19-02-2009	1	Dundee (KZN)
16-03-2009	2	Mthatha (EC)
01-10-2009	1	Mvimvane (EC)
30-10-2009	1	Dobsonville (Gauteng)
24-11-2009	3	Flagstaff (EC)
26-11-2009	2	Elliotdale (EC)
26-11-2009	2	Mquandile (EC)
26-11-2009	1	Enqcobo (EC)
26-11-2009	14	Transkei (EC)
28-11-2009	2	Mqandule (EC)
28-11-2009	1	Nqobo (EC)
28-11-2009	2	Eiliotdale (EC)
28-11-2009	1	Dumsi (EC)
02-12-2009	1	Vereeniging (Gauteng)
03-12-2009	1	Vaaldriehoek (MPL)
16-12-2009	1	Willowvale (EC)
26-12-2009	1	Mamalidi West (Gauteng)
10-01-2010	1	Nkwenkwana Village (EC)
10-01-2010	1	Mthatha (EC)
11-01-2010	3	Enqcobo (EC)
11-01-2010	1	Qumbu (EC)
12-01-2010	4	Rhodes Village (EC)
12-01-2010	4	Enqcobo (EC)

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[1] The Daily Sun and Volksblad both have on-line archives of all stories that were published, so a complete search was done on both publications for the entire period. Archived copies of the Daily Dispatch were checked in the public library, but this method is not as reliable as an online search. IOL News and news24 are websites that contain a selection of stories from the print versions from the Independent Group and Media 24 newspaper stables respectively and online searches were done on both sites. Other sources are random.

Publication date	Number of deaths	Places of occurance
19-01-2010	2	Qumbu (EC)
20-01-2010	2	Qumbu (EC)
25-01-2010	1	Okhukho (KZN)
25-01-2010	1	Eesterust (Gauteng)
07-02-2010	1	Trompsburg (Freestate)
07-02-2010	1	Libode, Misty Mount Village
18-02-2010	3	Mid-Illovo (KZN)
26-02-2010	6	Jece Village(EC)
16-04-2010	2	Emoyeni (KZN)
07-05-2010	1	Tlhalane (NW)
08-10-2010	1	Mpikwana (EC)
08-10-2010	1	Mthatha (EC)
08-10-2010	1	Midrand (Gauteng)
25-10-2010	1	Tzaneen (Limpopo)
25-10-2010	3	Nkumbi (KZN)
26-10-2010	2	Eersterust (Gauteng)
17-11-2010	1	Makhado (Limpopo)
27-11-2010	7	Pongola (KZN)
30-10-2010	1	Soweto (Gauteng)
04-11-2010	1	Elliotdale (EC)
09-11-2010	1	Soweto (Gauteng)
12-11-2010	1	Thohoyandou (Limpopo)
23-11-2010	4	Port St. John (EC)
10-12-2010	1	Meyerton (Gauteng)
02-01-2011	4	Nyandeni (EC)
03-01-2011	4	Mamolweni (EC)
03-01-2011	7	Eshowe (KZN)
03-01-2011	8	OR Thambo District
22-01-2011	1	Potsdam (EC)
23-01-2011	1	Waterval Boven (Mpumalanga)
25-01-2011	1	East London
	136	

Appendix B

The following is an example of an interview that was conducted in Mokopane. The interview was transcribed and translated by Ms Mankoko Mabusela, an electrical engineering student at the University of the Witwatersrand, Johannesburg. Ms Mabusela was also the translator who was present during the interview. In accordance with Wits University's ethics requirements[1], the name of the interviewee has been removed.

Transcription:

Mrs Trengove: Okay, let's start with the names. 00:00:09-4[2]

Translator: Re kgopela Lebitso le Sefane. 00:00:09-4

Interviewee: ███████████. 00:00:09-2

Mrs Trengove: ███████████? 00:00:14-1

Interviewee: ██████. 00:00:16-4

Mrs Trengove: Okay, how old are you ████? 00:00:23-0

Interviewee: 1944... 00:00:31-4

Mrs Trengove: 1944, okay.. 00:00:44-3

Interviewee: ...4-14. 00:00:44-3

Mrs Trengove: Okay, and how did you become a traditional healer? 00:00:53-1

Interviewee: Go tlile jwang gore lebe ngaka ya sesotho? 00:00:54-3

Interviewee: Go tlile ka bolwetsi. Ke be ke lwala, jwale ge ntse ke lwala, jwale ge ntse ke lwala gwabe gwa fihla mo eleng gore bo-ntatemogolo ba nyaka kebe ngaka. 00:01:14-9

Translator: Okay, she is saying that uhm...like the one yesterday, she was sick for a long time and then she went to a traditional healer seeking for help. Then they told her that the ancestors, the

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[1] Interviews were conducted in accordance with the ethics clearance protocol number H1 10226 of the University of the Witwatersrand's Human Research Ethics Committee.

[2] Numbers refer to the time stamp on the recording device.

grandfather wanted her to be a traditional healer. 00:01:31-2

Mrs Trengove: And, is it in her family? So did she eh... 00:01:46-5

Translator: Ohong, gobe gona le ba bangwe ko marago ba eleng gore le bona ka mo gae... 00:01:53-0

Interviewee: Ka mo lapeng la gesho? 00:01:53-4

Translator: Eng. 00:01:53-4

Interviewee: Eng, ntatemogolo. 00:01:53-4

Translator: She is saying, her grandfather, was a traditional herler thing. It was a generation thing. 00:02:03-4

Mrs Trengove: Okay, i mean how did she learn how to become a traditional healer? What was the process? 00:02:06-6

Translator: Bare le ithutetse kae goba ngaka ya sesotho ka gonna mokgwa wo? 00:02:14-9

Interviewee: Klipgart ko Pretoria. 00:02:14-5

Translator: Ko Pretoria? 00:02:13-8

Interviewee: Eng, 00:02:22-2

Translator: Klipgard in Pretoria. 00:02:22-2

Mrs Trengove: And didi she learn from another traditional healer? How was she trained? 00:02:24-4

Translator: Le be le ruta ke ngaka ye nngwe? Ko ba thwasishang go be gona le ngaka ye nngwe ye e le rutang? 00:02:29-2

Interviewee: Eng. 00:02:32-0

Translator: She is saying yes... 00:02:32-2

Mrs Trengove: Okay, and for what kinds of things do people come and consult with her? 00:02:43-8

Translator: Batho ba batlang mo go lena tlabe ba nyaka thusho e jwang? 00:02:44-6

Interviewee: Ke gore ba nyaka dithusho tse di fapaneng. Ba nyaka thusho ya malwetsi a bana ba dihlogwana, ba nyaka dithusho tsa malwaetsi a maoto, ba nyaka dithusho tsa go kereya goba go thushega ga bana, go tshwara masea, ba nyaka dithusho tsa metse; go ba tshwarela metse ka mo gae. 00:03:14-8

Translator: She is saying for different sicknesses like in children, newborn children. Its is a traditional thing that if a child...after giving birth to a child you have to take them to a traditional healer, and there issome sort of whatever they are treating. Also uhm... 00:03:36-7

Mrs Trengove: Is it like a blessing or purification ritual? 00:03:37-1

Translator: Yah, more like that, for the babies. And for protection of the house; there is something that they do to protect your house... 00:03:56-3

Translator: Kana le rileng le eng? Le rile ya go thekga dintlo, ya ngwana le ya maoto, le efeng? 00:03:54-7

Interviewee: Le ya...go thushega bana. 00:04:01-0

Mrs Trengove: Does she throw the bones...? 00:04:01-0

Translator: Oh, again for women who are baren, that they should have babies. 00:04:10-3

Mrs Trengove: Okay. 00:04:10-3

Translator: What were you saying before? 00:04:10-3

Mrs Trengove: How does she know what uhm...does she throw the bones or how does she find out what to give them or to do? 00:04:18-5

Translator: Bare le tseba jwang gore le ba thusha jwang? Le laola ka ditaola? 00:04:19-2

Interviewee: Re laola ka ditaola. 00:04:21-4

Translator: She does throw bones and they tell her what she ...how she should help them. 00:04:29-2

Mrs Trengove: And her mmedicine? Dows she make it from plant and   roots and ... what does she make it from? 00:04:33-9

Translator: Bare dihlare tsa lena namile, ke tse di jwang? Le di tsea ko kae? 00:04:36-4

Interviewee: Re a epa, ko thabeng. 00:04:43-0

Translator: Ke tsona tse tsa go epiwa le tse di... 00:04:46-7

E: Le tse dingwe re a di reka ko di...gona mo go rekiwang dihlare tsa sesotho. 00:04:56-4

Translator: Mara le tsa medu? 00:04:59-1

Interviewee: Eng, le tsa medu. 00:05:00-0

Translator: Like monstly is thhe roots, from mountains. She is sayong that sometimes she can buy if there is n't that medicine in the mointains then she could buy it from other traditional healers or traditiopnal stores. 00:05:19-7

Mrs Trengove: Uhm, do people come to her to protect themselves from being bewitched? 00:05:35-9

Translator: Bare batho ba a tla mo go lena gore ba iphemele gore batho ba seke ba baloya? 00:05:40-6

Interviewee: Eng, ba a tla. 00:05:41-1

Translator: Yes they do. 00:05:44-9

Mrs Trengove: Does she know of people who get bewitched and get struck by liightning? Is that a way in which peop[le still bewitch others? 00:05:56-6

Translator: Are, go sana le taba tse tsa gore batho ba rathe ke magadima? Le bona tle batle go lena? Ba eleng gore sale ba ratha ke magadima? 00:06:04-4

Interviewee: Aowa, a se ke alafe motho wa go ratha ke legadima. 00:06:07-7

Translator: Asenke? 00:06:07-7

Interviewee: Ga senke ke hlakane le yena wo mo jwalo. Ke dikwa ka mo ntle fela, asenke a tla. 00:06:15-9

Translator: ...a person who was struck by lightning never came to her, but she heard of people who have been   struck by lightning, but no one had ever come to her. 00:06:34-3

Mrs Trengove: So, in this area, had people been struck by lightning? 00:07:13-5

(Exchange greetings) 00:07:33-2

Translator: Bare gona mo ga gona batho ba eleng goere sale ba ratha ke magadima? Goba dintlo, ga nke bare dintlo di swele di fisha ke magadima? 00:08:01-6

E: Ke kgala maan... 00:08:04-6

Translator: Ba nyaka tsona tseo tsa kgale. 00:08:08-9

Interviewee: Ebile ga ke tseba gore... 00:08:11-3

Translator: Ga le gopole? 00:08:10-1

Interviewee: Ke gopola gona kamo go nang le lehu ka ga-Mokagane sale bare ntlo e rathilwe mara ya sebe gore ka nnete e rathile ke legadima. Re kwa ntse go bolelwa... 00:08:27-7

Translator: She is saying that there was a house near by were they suspected that it was hit by a lightning but there was no proof to show that it was lightning for real. 00:08:43-8

Mrs Trengove: Okay, and does she know about the lightning bird? 00:08:48-2

Translator: Le tseba ka ga nonyane ye ya magadima? 00:08:53-1

Interviewee: Nonyane ya legadima? hai, yona ga ke e tsebe botse, ga ke rate go bolela maaka.

00:08:59-5

Translator: Ke yona ntse ba ree botsa ka yona ka mo ntle kamo. 00:09:02-8

Interviewee: Yona botse ke kwa ba e bolela, ase nke ke e bone ka mahlo aka. 00:09:06-6

Translator: She does not know it, ... 00:09:10-9

Mrs Trengove: She has n't heard of it, okay. 00:09:08-8

Translator: No, she has heard of it but she does not know of it. She has never seen it before. 00:09:17-9

Mrs Trengove: Okay...are there other questions you wanna ask? 00:09:22-3

Translator: Ahh, nothing else i guess. 00:09:32-8

Mrs Trengove: Okay, ke a leboga. 00:09:31-7

Interviewee: Eng, go leboga rena.

Translation:

Mrs Trengove: Okay, let's start with the names. 00:00:09-4

Translator: What is your name and surname. 00:00:09-4

Interviewee: ███████████. 00:00:09-2

Mrs Trengove: ████████████? 00:00:14-1

Interviewee: █████. 00:00:16-4

Mrs Trengove: Okay, how old are you Interviewee? 00:00:23-0

Interviewee: 1944... 00:00:31-4

Mrs Trengove: 1944, okay... 00:00:44-3

Interviewee: ...4-14. 00:00:44-3

Mrs Trengove: Okay and how did you become a traditional healer? 00:00:53-1

Interviewee: How did you become a traditional healer? 00:00:54-3

Interviewee: I was first sick because my late grandfather wanted me to become a traditional

healer. <u>00:01:14-9</u>

Translator: Okay, she is saying that...like the one yesterday, she was sick for a long time and then she went to a traditional healer seeking for help. Then they told her that the ancestors, the grandfather wanted her to be a traditional healer. <u>00:01:31-2</u>

Mrs Trengove: And, is it in her family? So did she eh... <u>00:01:46-5</u>

Translator: Was this inherited in your family? <u>00:01:53-0</u>

Interviewee: In my family? <u>00:01:53-4</u>

Translator: Yes. <u>00:01:53-4</u>

Interviewee: Yes, my grandfather was one. <u>00:01:53-4</u>

Translator: She is saying, her grandfather was a traditional healer thing. It was a generation thing. <u>00:02:03-4</u>

Mrs Trengove: Okay, I mean how did she learn how to become a traditional healer? What was the process? <u>00:02:06-6</u>

Translator: Where and how did you learn to become a traditional healer? <u>00:02:14-9</u>

Interviewee: Klipgart in Pretoria. <u>00:02:14-5</u>

Translator: Pretoria? <u>00:02:13-8</u>

Interviewee: Yes. <u>00:02:22-2</u>

Translator: Klipgard in Pretoria. <u>00:02:22-2</u>

Mrs Trengove: And did she learn from another traditional healer? How was she trained? <u>00:02:24-4</u>

Translator:Did you learn from another traditional healer? <u>00:02:29-2</u>

Interviewee: Yes. <u>00:02:32-0</u>

Translator: She is saying yes... <u>00:02:32-2</u>

Mrs Trengove: Okay, and for what kinds of things do people come and consult with her? <u>00:02:43-8</u>

Translator: What kind of help do you offer to people who consult with you? <u>00:02:44-6</u>

Interviewee: They come with different problems. They need help with baby illnesses like "hlogwana", when they have problems with their feet, those who cannot conceive babies, protecting their babies and their houses. <u>00:03:14-8</u>

She is saying for different sicknesses like in children, newborn children. It is a traditional thing that if a child...after giving birth to a child you have to take them to a traditional healer, and there is some sort of whatever they are treating. Also... 00:03:36-7

Mrs Trengove: Is it like a blessing or trifurcation ritual? 00:03:37-1

Translator: Yah, more like that, for the babies. And for protection of the house; there is something that they do to protect your house... 00:03:56-3

Translator: What else did you say you do? You protect the children, houses, help with feet problems and what else? 00:03:54-7

Interviewee: Help barren women to conceive. 00:04:01-0

Mrs Trengove: Does she throw the bones...? 00:04:01-0

Translator: Oh, again for women who are barren, that they should have babies. 00:04:10-3

Mrs Trengove: Okay. 00:04:10-3

Translator: What were you saying before? 00:04:10-3

Mrs Trengove: How does she know what...does she throw the bones or how does she find out what to give them or to do? 00:04:18-5

Translator: How do you know how to help these people? Do you throw bones? 00:04:19-2

Interviewee: I throw bones. 00:04:21-4

Translator: She does throw bones and they tell her what she ...how she should help them. 00:04:29-2

Mrs Trengove: And her medicine? Does she make it from plant and   roots and ... what does she make it from? 00:04:33-9

Translator :What about your medicines, what are they made of and where do you get them? 00:04:36-4

Interviewee: I dig them from the mountains. 00:04:43-0

Translator: Do you cook them and … 00:04:46-7

Interviewee: I also buy some at the traditional medicine stores. 00:04:56-4

Translator: Are they plants roots? 00:04:59-1

Interviewee: Yes, roots. 00:05:00-0

Translator: Like mostly are the roots, from mountains. She is saying that sometimes she can buy if there isn't that medicine in the mountains then she could buy it from other traditional healers or traditional stores. 00:05:19-7

Mrs Trengove: Do people come to her to protect themselves from being bewitched? 00:05:35-9

Translator: Do people come to you to protect themselves from being bewitched? 00:05:40-6

Interviewee: Yes, they do come. 00:05:41-1

Translator: Yes they do. 00:05:44-9

Mrs Trengove: Does she know of people who get bewitched and get struck by lightning? Is that a way in which people still bewitching others? 00:05:56-6

Translator: Do people get struck by lightning? Do those people also come to you? 00:06:04-4

Interviewee: No. I had never healed a person who was struck by lightning. 00:06:07-7

Translator: Never? 00:06:07-7

Interviewee: I had never met such a person. I have heard of them but never seen one. 00:06:15-9

Translator: ...A person who was struck by lightning never came to her, but she heard of people who have been   struck by lightning, but no one had ever come to her. 00:06:34-3

Mrs Trengove: So, in this area, had people been struck by lightning? 00:07:13-5

(Exchange greetings) 00:07:33-2

Translator: Has there ever been a person who was struck by lightning in this area? Or houses that were struck and burned by lightning maybe? 00:08:01-6

Interviewee: A very long time ago... 00:08:04-6

Translator: That's what she wants you to tell her about. 00:08:08-9

Interviewee: I don't even recall clearly... 00:08:11-3

Translator: You can't remember? 00:08:10-1

Interviewee: There is a house nearby, there is a funeral now though, their house was struck but we did not know for sure if it was lightning. We just hear rumors… 00:08:27-7

Translator: She is saying that there was a house nearby were they suspected that it was hit by a lightning but there was no proof to show that it was lightning for real. 00:08:43-8

Mrs Trengove: Okay, and does she know about the lightning bird? 00:08:48-2

Translator: Do you know of the lightning bird? 00:08:53-1

Interviewee: Lightning bird? I do not know it; I do not want to lie. 00:08:59-5

Translator: We had people telling us about it yesterday. 00:09:02-8

Interviewee:I have heard of people talking about it but I had never seen it with my own eyes. 00:09:06-6

Translator: She does not know it ... 00:09:10-9

Mrs Trengove: She hasn't heard of it, okay. 00:09:08-8

Translator: No, she has heard of it but she does not know of it. She has never seen it before. 00:09:17-9

Mrs Trengove: Okay...are there other questions you want to ask? 00:09:22-3

Translator: Ahh, nothing else I guess. 00:09:32-8

Mrs Trengove: Okay, thank you. 00:09:31-7

Interviewee: Yes, you are welcome.

Appendix C

School of Electrical and Information Engineering
University of the Witwatersrand, Johannesburg
Lightning Study Questionnaire

1. Is lightning more strongly attracted by white objects than by black objects?

    Yes ☐   No ☐   Don't know ☐

2. Is lightning more strongly attracted to water than to land?

    Yes ☐   No ☐   Don't know ☐

3. Is it dangerous to talk on a cell phone during a lightning storm?

    Yes ☐   No ☐   Don't know ☐

4. Do mirrors attract lightning?

    Yes ☐   No ☐   Don't know ☐

5. Are there people who can control lightning?

    Yes ☐   No ☐   Don't know ☐

6. If your answer to Question 5 was "Yes", explain who those people are that can control

    lightning. …………………………………………………………………………

    ………………………………………………………………………………….

    …………………………………………………………………………………

7. Do you know of anybody who was killed by lightning that was sent by another person?

    Yes ☐   No ☐   Don't know ☐

8. Do you know of anybody whose house was hit by lightning that was sent by another

    person?   Yes ☐   No ☐   Don't know ☐

9. If your answer to Question 7 or 8 was "Yes", please write what happened (continue on the

    back of the page if you run out of space).

    ………………………………………………………………………….………

    ……………………………………………………………………………………

    ……………………………………………………………………………………

    …………………………………………………………………………………

Student Questionnaire   Revision 4   1

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Questionnaire administered to 1st year Mining Engineering students

	Question	Yes	No	Don't know	Total	
1	More strongly attracted by white objects?					0
2	Dangerous to talk on a cell phone?	123	29	20	172	
3	Do mirrors attract lightning?	112	37	23	172	
4	Are there people who can control lightning?	21	106	45	172	
5	Can people send lightning to strike a house?	48	70	54	172	
6	5 and 6 combined subtotals	69	176	99		
7	Safe to shelter under a tree	9	159	4	172	
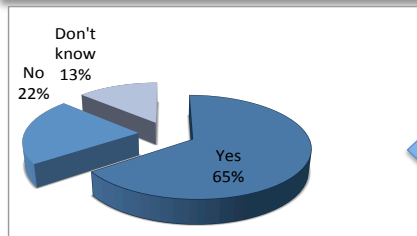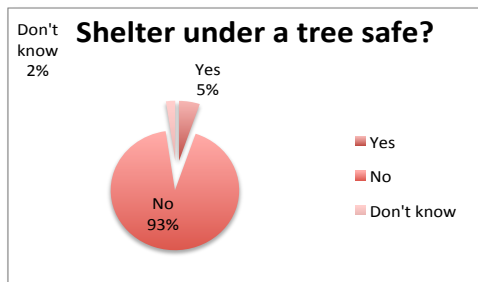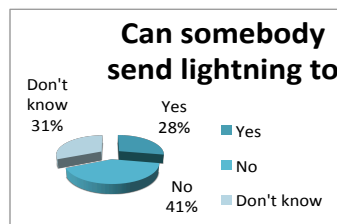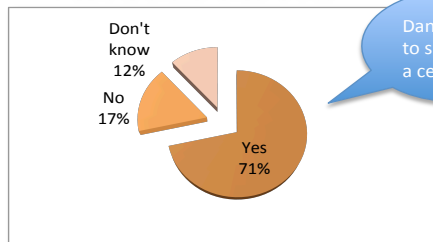
Appendix D

A recipe given by a Mthubathuba herbalist to protect a person against lightning[1]:

- Ugina

- Uphindevuma

- Umakhwenu

- Umabophe: *Alberta magna* or Natal flame bush, a tree with red tubular flowers and the bark is used medicinally (Pooley, 1993).

- Umuzikawush

- Umpikayiboni: *Cephalaria humilis*, widespread in South Africa (SANBI, 2012a);

- Impila: *Callilepis laureola* (SANBI, 2012b);

- Uslephe

- Umashwili

- Ikhathazo: *Alepidea amatyambica*, grows in the grasslands of southern Africa, with small star-shaped white flowers. It is used in *muthi*, amongst others to treat colds and coughs (Nonjinge, 2003);

- *Umvithi:* This is the Zulu name for the *boscia albitrunca* – the tree that the Northern Cape San believe is never struck by lightning, as discussed elsewhere in this section.

- Umgunya

- Indindibala

References:

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[1] Botanical plant names have been included where they could be found in the literature. If I was unable to find the botanical name, the herbalist's name was included in the list using her spelling.

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