

# We Don't Teach Science *We Teach Human Beings*



Dr. Philip J Mirkin

**ESI**



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*We Teach Human Beings*



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## ACKNOWLEDGEMENTS

This book appears before you because of the help of a great many people. Initially it has been my students and colleagues who have brought me the enormous range of experiences that led to the stories presented here. Next, it was my family and friends with whom I discussed these experiences, giving new insights and perspective to the events.

And then, a few years ago I was accepted to do a five-day writing retreat at the University of Pretoria where I began compiling the stories found in this book. I would like to thank the university for not only this writing retreat, but also for all the time and support given to work on the manuscript since then.

In the latter stages, it has been the folk of ESI press who have made the book ready for publication. In particular, I would like to thank Heather Thuynsma who saw the potential of this book and who has been supportive of the project from start to finish. I would also like to thank Katinka Strydom for her interest in this work and for creating the magnificent illustrations seen on the front cover as well as among the many stories.

My love and thanks go to all the wonderful people who have accompanied me on this journey. It will all be worth it if you, the reader, gain some value for your research into deepening the relationship between science and our human development and maturation.

## PREVIEW BY DR SRINI PILLAY

Notwithstanding certain limitations which Philip mentions in *How to read this book*, Philip Mirkin's *We Don't Teach Science, We Teach Human Beings* is nothing short of a revelation in the field of education. It is rare to encounter a book that so masterfully bridges rigorous science, lived experience and the inner life of both teacher and student. Philip reminds us that science is not simply a subject to be delivered, but a rich encounter with what it means to be human.

Drawing on over 35 years of teaching, Philip crafts a work that is both deeply intellectual and profoundly moving. His concept of “wreality”, our personal, evolving experience of reality, offers an original lens through which to see identity, and its interplay with science, culture, religion and personal experience. The idea of “evolution”, a merging of evolution and holism, provides a bold new framework for understanding not only how science progresses, but how humanity itself must grow if we are to meet the challenges of the present.

The strength of this book lies not just in its concepts, but in its stories. Philip's reflections on students—the rebels, the dreamers, the struggling and the gifted—are unforgettable. Each anecdote is more than a tale from the classroom; it is a meditation on life, growth and the responsibility of educators to see beyond the textbook into the heart of each learner. In the physics section, it is the three poems on the mystical nature of light that stood out for me. In chemistry, the periodic table poem impressed me with the chemical elements depicted as beings of different ages, showing how life is embedded in inorganic matter. After seeing how his love and commitment always look to find the hidden life within, I was not surprised to see how mathematics moved Philip to find the presence of God in *e and me*.

Philip's honesty about his own missteps, his humility in acknowledging that students are often his best teachers and his capacity to transform even the most difficult situations into learning moments make this book profoundly authentic.

For science education researchers, this book is a treasure chest of insights and practical wisdom. However, it goes further—it challenges everyone to rethink what education is for. Philip argues, persuasively and with great

clarity, that the true purpose of teaching science is not merely to prepare students for exams or industry. It is to cultivate curiosity, moral responsibility and the courage to engage with all of reality.

Stylistically, the book is accessible, yet deeply scholarly, weaving together philosophy, pedagogy, autoethnography and lived experience with remarkable fluidity. It honours the rigour of science without reducing it to sterile facts, and it honours our humanity without romanticising it. It does this by avoiding the triple imposters of politicised ideological thinking, sentimental feeling and impulsive willing, and replaces them with the earnest seeking for truth, beauty and goodness, the universal properties of reality. The result is a rare synthesis that is both intellectually rigorous and spiritually nourishing.

*We Don't Teach Science, We Teach Human Beings* is not just a book for science education researchers, it is a book for anyone who cares about the future of education, the integration of science and humanity and the possibilities of human growth. Philip has written a work that reaches down into the heart of both science and the human condition, making this book an indispensable guide for every educator, researcher and policymaker.

It is difficult to overstate the impact of this book. This book is courageous, original and transformative. Philip Mirkin has given us not only a philosophy of science education, but also a philosophy of life.

The discerning reader will recognise this book as a true masterpiece.

**Dr Srinii Pillay, M.D.**

Harvard-trained psychiatrist, brain researcher, CEO of NeuroBusiness Group, Chief Medical Officer and Co-Founder of Reulay, and Author of *Tinker Dabble Doodle Try: Unlock the Power of the Unfocused Mind*

## HOW TO READ THIS BOOK AND WHAT TO EXPECT

This is a scholarly book that needs to be viewed from a distance; it was, after all, written from the distance of over 35 years of teaching.

The reader is requested to critique it using a holistic lens, a lens that does not over-emphasise the details or analysis of any single story, but one that allows the rational and intuitive mind to create an image of the whole using each story as a brush stroke.

In this way it is not a deductive work that tries to prove any hypothesis. It is an inductive one that raises several hypotheses about the history and nature of science, science education, the human being and the evolution of human consciousness. The summary of ideas presented in Section 4, the intuited conclusion from my science education journey, should also be read as a hypothesis. Each reader is asked to wrestle with the content and decide on its authenticity for themselves. Do they agree with the ideas presented, do the experiences and assumptions of the author seem plausible, sensible or rational and are they generalisable?

This requires the presentation of every story to be an honest and personalised account of events and ideas, so that each reader's imagination is free to make associations of its own, free from the author's confines of definitions and paradigms.

This approach has led to the book having several weaknesses and challenges which the reader should be aware of from the outset. Among these, this book presents novel concepts, such as 'wreality' and 'evholution', that have not been thoroughly defined or academically argued here. Some stories raise ethical and health and safety issues such as sexual attraction between teacher and student, drug-usage, outdoor camping with students and labelling some groups of students as "shopping mall kids" or "naughty boys", which it does not frame within any moderating academic context, leading to potential offence or misunderstanding. It also presents a speculative, vague and historically selective super-hero narrative for technology, science, evolution, education and the science teacher.

There are also stories related to unusual events, such as near-death experiences, seeing nature spirits as well as other subjective spiritual

experiences. These experiences are often referred to as pseudo-science, which could be seen to weaken the scientific and academic rigour of this work. Overall, it can be argued, there are so many stories with so many ideas that the reader may find nothing more than a jumbled memoir rather than a book worthy of academia. Readers who are looking for a step by step reasoned and argued progression of ideas will, thus, be likely to find this book disappointing. Readers who, on the other hand, are looking for insights with which to challenge and research their own experiences and ideas of science, technology, education and the human condition will find much food for thought.

The reader should know that many of the concepts and much of the content in this book were academically argued and tested in the PhD where they were originally presented (Mirkin 2021b). To have done a thorough analysis and researched presentation in this book would have greatly lengthened it, detracted from its primary intention and would have altered the experience of reading it as a result. I hope that the reader will accept this reasoning.



## Foreword

Science education usually has its focus on educating and empowering citizens to play a useful role in maintaining and developing a country's industry and economy. Its gaze is thus outwardly focussed on the power of science to create and maintain technology that solves our practical challenges. In the science classroom, however, any teacher will tell you that the wrestle to learn science is an inward or mental one. This book has its focus on the human experience of teaching<sup>1</sup> and learning science. It is thus inward looking. The book draws on the religious/spiritual approach of the ancient Egyptians and Greeks as well as the later Alchemists and Christian theologians who all played their role in giving birth to modern science. They would have framed it as an act of devotion to their God/s, but we can think of it as the work needed to develop the mental skills to become healthy, useful and meaning-rich human beings.

Science students are always challenged to bend and grow their thinking to grasp the content. Science education is the ultimate training ground for the development of strong and clear thinking, because we can test our understanding against the observed behaviour of matter and the laws of mathematics; the proven facts of science. When we muster the mental strength required to succeed, we gain the capacity to think objectively, rationally, practically and abstractly, empowering individuals towards becoming healthy functioning adults. It can feed into a loop of growing confidence in our ability to solve the practical and human challenges of life.

There is, however, a downside. When we struggle to understand science, we may think of ourselves as "stupid". Even when we can do science, we may still reject it as irrelevant to our lives because it doesn't align with our way of thinking (Coyne 2018; Denessen et al. 2015). Then there are others who continue studying in these fields while doubting its meaningfulness (Glynn et al. 2011; Jenkins and Nelson 2005). This is because classroom science is mentally challenging, and so abstract that it may seem to have no relation to our daily lives.

In each case it is our inner life that is stimulated and challenged by the

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1 Physics, chemistry and mathematics are collectively referred to here as science. Mathematics is a very different field from science, but its challenge for us to develop the mental powers of rational logic, objectivity, and abstraction have made it indispensable in science and science education. Further, I have taught all these subjects and do not wish to keep referring to them separately in the book.

powerful conceptualisations required by science. Physics, chemistry and mathematics are collectively referred to here as science. This is because I have taught all these related subjects and do not wish to keep referring to them separately in this book. As science teachers it is our job to help our students to gradually develop trust in their mental abilities to wrestle through to an understanding of reality that they can defend.

This book is the fruits of my reflections from over 35 years of teaching science. I have encountered an enormous range of student responses, all of which have challenged me to grow my understanding of science and of the human being. In the process I came to understand that the key to teaching these subjects is to be an expert in the subject matter, and to know our students. Just as science demands of students to step into its logic and worldview, teaching it demands that we shape the content into a form that can engage meaningfully with our students' "wreality".<sup>2</sup> [See the concept clarification of wreality that follows]

The researched stories presented here are intended for use as a resource for science education researchers. They offer an approach to researching the challenge of meaningfully integrating the universal world of science and the personal world of being human.



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2 "Wreality" is our individualised reality; each person's picture of reality. See the concept clarification that follows.

# CLARIFICATION OF KEY CONCEPTS AND ACADEMIC PROCESS

## **Wreality: Our reality within**

There has been no existing term that refers to the specific construct of reality that each of us develops through life. Wreality is a term used to denote the everchanging way in which an individual links ideas and uses them to make sense of themselves and their world. This is different from a worldview which is a shared or collective understanding of reality. Science, culture and religion are all worldviews, and individuals create their wreality out of a combination of these, based on their life experience.

When we are confronted by different and potentially conflicting worldviews, such as science, indigeneity, culture and religion, we are challenged to rework our wreality to integrate the new with the old. Our wreality, which includes our identity, is thus always a work in progress.

There is a fundamental difference between a person who simply allows the events of life shape their wreality and someone who makes it their task to test it. Plato regarded it as an essential task for us to test our wreality. Plato's attitude is summed up with the saying, 'Is the unexamined life worth living?' (Plato 1966). We can think of Plato's examined life as a thoroughly tested wreality.

Science is a practice that empowers everyone to determine the facts of reality for themselves. Scientists do not rely on what anyone else thinks, feels or believes. What scientists believe, must fit the facts, and these facts can be tested by anyone. In this way, science is the perfect training ground for one to develop the skills and practice for developing a tested and defensible wreality. The only difference between the scientist and the wreality wrestler is that the latter includes their personal experiences and all knowledge streams in their deliberations. This enables them to cross-reference their personal experiences with science, psychology, indigeneity, religion and more, making for a robust wreality.

The learning theory of constructivism is the academic ground upon which the concept and development of wreality stands. Constructivism is the idea

that we are all in the process of constructing our identity and relationship to the world (Rochat 2021; Vygotsky and Cole 2018); that we are all busy constructing our wreality.

## **Autoethnography**

Autoethnography is the study (graphy) of a person's (auto) relationship to their ethnographic (ethno) or cultural background (Ellis and Bochner 2000; Luitel and Dahal 2021).

The research that led to the writing of this book used the methodology of autoethnography. In it I explored my wrestle for wreality within the dualistic ethnographic environment of dogmatic religion and materialistic scientific thinking (Mirkin 2021b). By the time I left school I had rejected the first and embraced the second. During my undergraduate engineering degree, I had several significant personal experiences that shook my atheist and scientific perspective to the core. They made me realise that I had entirely ignored the subtleties of my inner life. I thus shifted my studies from engineering to a Bachelor of Science to become a science teacher, where science and humanity meet.

Autoethnography uses verisimilitude and reflexivity to give academic rigour to a study (Chang 2008; Denshire 2014; Ellis and Bochner 2000). The facts of personal life-stories can be difficult to prove, therefore, we use verisimilitude to give them some form of verification. This is obtained from people who were present at the related events, who have heard firsthand of the events around the time when they occurred, or who know the people involved in those events. Verisimilitude can also be gained from the literature that explores similar or related events to gain a sense of their plausibility. Verisimilitude is, thus, outward looking to find reasonable support for the story. Reflexivity on the other hand is inward looking. It is the need for the individual to reflect critically, contextually and honestly on their story (Chang 2008) and how it relates to their wreality. Many pieces presented in this work contain elements of verisimilitude and reflexivity to encourage their use in science education research.

# Evolution

Evolution is based on two key ideas: evolution and holism.

At its root, the theory of evolution gives us the ground-breaking idea that everything is in a process of change, and that this change is always done in relation to the environment. Evolution is traditionally applied only to biological changes in living organisms, with the idea that these changes are random, and that only those that are best suited to the environment will persist while the others will become extinct (Denshire 2014).

Holism, like evolution, is based on the idea that everything is intimately related to everything else, but takes a much broader view than does our current theory of evolution. Holism sees energy, matter, life, mind and the human personality as the different levels or substances of manifest reality (Hesse-Biber and Leavy 2006). Although these levels are studied in separate disciplines because they obey different laws, holism sees them as part of a developing sequence of substances that have emerged out of [or into] the others as evolution progressed. By looking at them as a developing sequence, various patterns and trends can be observed which show that although the human being may be the current pinnacle of evolution, further developments can be expected (Hesse-Biber and Leavy 2006). Two key trends of Smuts's holistic evolution relevant to this book are, 1) that all levels of evolution are intimately related with each other, so they seamlessly interpenetrate to support the functioning of the whole and 2) that evolution will only be able to manifest the next level or substance when the human personality (the latest addition to evolution) has reached a sufficiently mature stability to selflessly serve and support the functioning of the new. In the same way as energy, matter, life and mind serve us human personalities in growing our wreality, thus, holism says that the next level of evolution will emerge when our wreality is in harmony with all other levels to support the manifestation of a new substance or level (Hesse-Biber and Leavy 2006). Plato would have agreed that the thorough challenging of one's wreality is the path to the future, and to not do so is to allow oneself to be left behind in evolution (Plato 1966).

In evolution, with the inclusion of holism, the seeming randomness of evolution is given a definite direction and trajectory. It is this inclusion

that helps evolution to become a bridge between materialistic science and indigenous or religious beliefs and practices. It sees how evolution began with energy and matter which are now relatively perfected and so behave in predictable and understandable ways. When matter was still developing in primal stars, there was so much energy in the environment that none of the chemistry that we study on earth was able to manifest in any stable form. Only when the outer conditions had settled down, was chemistry possible. Similarly, only when the conditions of chemistry were right, could life emerge on Earth.

Evolution sees the human personality as the current cutting edge of evolution and in its early developmental stages. It is thus behaving as the elements did in the primal stars and will continue to do so until its inner conditions have matured. This explains why we do not yet behave in reliable or stable ways, why our identity is so fluid, why we often feel so out of touch with ourselves and our world and why we need to keep growing our wreality.

The word evolution is a marriage of holism and evolution, formed by the addition of an h into evolution to form the “hol”. Evolution looks to science to study the laws of stable, predictable and evolutionarily mature substances. It then looks to culture, psychology and religion, among others, to identify the yet-to-become-manifest laws that will lead to the mature human personality. These laws are often referred to as moral laws. When we have reached a mature state, evolution postulates that humans will once again become harmoniously intimate with the rest of nature. Only then will we unite fully with our true nature and take our place in supporting the manifesting of a new substance into evolution.

Evolution, then called holism evolution, is the conceptual framework that was used in the original research that led to the writing of this book.

## **Ethics**

Ethical concerns are very important in any academic enterprise. In this book, names of living people have been changed to keep their identities anonymous. In two cases, names of living people were used with their permission so that the reader can look up their work. Where possible, I communicated with the individuals concerned to obtain their permission to publish their story, as

well as to give verisimilitude to the story from their perspective.

There are some stories that may seem to flout ethical principles and health and safety protocols. The naming of groups of students as “naughty boys” or “shopping mall kids” may appear judgemental and offensive. There are also stories like ‘*no 8 wire*’ and ‘*survival camp with shopping mall kids*’, that express reluctance towards such principles and protocols. Many of these stories are from the start of my career, when bureaucratic demands for ethical practices were almost non-existent, because they were expected to be common sense. These stories should be read as indicators of my responses to the changing expectations of my ethnographic environment. They are not intended as a rejection of ethical expectations in research. The stories are intended to be data that tells the reader about my scientific tendency to “group and classify”, as well as to experiment and test everything. They also show the changing ethics expectations on teachers in South Africa and New Zealand over the years.

Ethics approval for this study was given by the University of Pretoria before any research took place, and the required processes were carried out without exception. The ethical clearance number is EDU075/19.

## Introduction

When wandering in nature, children find stones and seashells, flowers and feathers, rivers and rain clouds. Each becomes a source of stimulation and investigation. Beautiful, ugly and unusual objects get collected and examined. Other children join in and soon they have shared adventures. Perhaps they go catching tadpoles and frogs in the stream at the local park, exploring rock pools on the seashore at low tide, basking in the warm sunshine or splashing through puddles after a storm! And what of the never-ending joy watching ants or bees at work, or noticing the many seasonal changes of nature. These activities form the backbone of the most serious of human endeavours, children at play. Such play never feels like work, because it is always driven from within by our natural curiosity to discover our world and understand ourselves.

Nature is full of surprises. It is free and unpredictable and as such, is the ultimate playground for children and adults alike. Even in the cities, nature is always at hand. Rain and sun, storms and calm, stimulate life in various ways. At its worst, rats, cockroaches and flies, or rot, mould and decay challenge us. Even then it is the unrelenting presence of nature responding to prevailing conditions. A clean and well-maintained home will discourage such challenges from making their home in yours. Through all our joys and challenges, nature reminds us that we live in an intimate and inseparable relationship with her.

Our inner nature is no different. Its joys and challenges are like a landscape of its own, and the courageous spirit of adventure seeks to explore our human personal experiences with the same interest as it does outer objects and phenomena. The full range of personal experiences goes beyond what any one of us can have, so a reasoned examination of unusual or novel testimonies is yet another world open for serious adventures.

During the Reformation, Martin Luther and other Protestant Christian leaders believed that everyone should become literate so that they could read the Bible and determine for themselves what to believe (Darwin 1859). This was done in opposition to the Roman Catholic church which had imposed a singular interpretation of reality from the Bible. This impulse led to the massification of literacy in much of Europe (Smuts 1926). Modern science

was born out of the same fierce belief in the independence of each human being to determine reality for themselves; to develop tested, robust realities. In the process, almost worldwide, education now aims to enable our mental faculties to become so empowered that we can liberate ourselves from all historical attachments. Race, culture, tribe, nationality, gender, religion and even family, are all aspects which we can love and respect without regarding them as our primary identity. Science education has played a significant role in enabling this empowerment and liberation of the individual and their reality from popular or historical norms and beliefs.

Most societies have encouraged this development in their citizens so that their country can remain competitive in the modern economy. This is because the group with the most powerful technology has always been able to retain their independence and even to dominate others. Getting one's citizens to become scientifically and economically literate, however, can threaten enormous changes to cultural life. It is often a struggle for societies to adapt. We may see a panic at the lost social norms that kept society stable. This is partly due to certain new ideas trying to establish themselves into the old society, however, I suspect that it is mostly because change is hard. It is uncomfortable to adapt to new ways of doing things, and those who bring the changes are always initially in the minority and are almost always persecuted (Kaufmann 2023). Because the development of individuals needs to happen in conjunction with societal development, it is important that education should upskill individuals to move in an empowered way towards the new state of being.

Science has progressed through many stages as people worked to solve practical problems. From the time of Comte (1798–1857), science has limited its attention to objectively observable phenomena, and become an extremely powerful tool for manipulating our physical world to serve our purposes (Mosher 2016). The positive contribution it has made to the health and wellbeing of all of humanity is beyond question. However, the damage it has caused to communities, cultures and beliefs is also without parallel. It seems that it is the very things that science ignores, that suffer the most. Is it therefore time to open our scientific gaze once again to these worlds?

My career as a science teacher has never felt like work. It's been more like a continuation of serious child-play. Matter and mind have been realms that

I needed to explore to do my job properly, where each student presented me with a novel world to understand. After all, we can learn science through books containing practicals, theories and rational logic, but we can only understand human beings by interacting with them. That is why this book contains stories of personal experience.

This book is a collection of personal experiences that have been key to the forming of my ever-changing wreality, where most of the learning has come from my teaching. The stories are intended to be a source of stimulation for science education researchers in their work. As a science educator and researcher for many years, I have personally wrestled for a wreality that integrates all streams of knowledge. In my wreality, the wisdom from science, religion and indigenous knowledge has become infused with my own personal experiences. The more than 90 separate pieces of writing in this book form a kaleidoscope of impressions that, when woven together, represent most of the meaningful fruits from my teaching career to date. They are offered in the same spirit as that of Sir Isaac Newton, who imagined himself in his scientific work as standing on the seashore playing with all the magnificent things that got washed up (Dyson 2007).

Evholution places the development of our personal wreality at the cutting edge of evolution. As with my teaching, an evholutionary approach uses the facts and findings of science, religion and indigenous knowledge to develop a holistic grasp of evolution. As a science teacher we are often expected to limit our use of evidence to that which is empirical, that which is physically detectible and measurable. An evholutionary approach, the fruits of which are embedded in the stories of this book, expands our perspective in the science classroom to allow teachers and students to treat everything as valid material to be explored and tested. In these stories I hope that you will recognise the honouring of our intrinsic human need to explore, challenge and test our wreality in an open and scientific manner.

This book is dedicated to the development of our human spirit and its evholutionary need to form a broadly defensible wreality. I hope that it will stimulate your education research journey with the sometimes unusual and possibly unsettling ideas and events of which you will read.

## About the Author

In the space of two weeks in 2023, I had three interesting chance encounters. I met a man who was born Catholic, but who spoke of vivid memories of being a 60-year-old Jewish man who had been killed in a Nazi concentration camp. He believed that he was this man in a previous life. Another man shared his two near-death experiences 'of being in a world of blessedness and bliss' and lastly, a woman told me in all seriousness that her cats communicate with her telepathically. None of these people could have known of my interest in unusual human perceptions, some of which are still often regarded as delusions. Despite these stories being beyond my own experiences, I choose to accept them all as real and to wrestle with them in my serious game of wrealty-construction. I accept that subjective personal experiences are as real as any objective facts of science. In attempting to integrate such phenomena into my evolutionary wrealty, I test and cross-reference them with different knowledge streams, to tease from them their essential elements.

I am always seeking new information to use in my ever-expanding set of teaching and research tools. As a science teacher, I always look for new and inspiring ideas to add to the content, so that my students have more food for their wrealty. As a result, I have taught in eight different schools in South Africa and New Zealand. I have taught in Government, Waldorf/Steiner and Montessori schools, always in search of new ways to keep my understanding and teaching fresh and real and meaningful for me and my students. I currently train future science teachers at a university in South Africa, to pursue my learning further.

Nature, personal stories, conversations, music, movies, sport, novels, podcasts, poetry, creative writing and more, all stimulate me in what I use in my teaching practice. I draw on anything that moves me emotionally and intellectually at the same time. I want my students to be similarly moved in my classroom. I want them to touch the face of reality in the same way as worshipers seek to experience God. I would love my current students to have the courageous spirit to make their future science classrooms places filled with their wrestle for an enriching and vibrant wrealty. I would love their students to then do the same. In this way, science education will begin to fulfil its true promise of not just solving our practical challenges, but of enriching

our human evolutionary development (Bell 2019; Comte 1976; Kaufmann 2023; Plato 1966).

In this book I share some personal experiences that I believe have occurred because of my deep investment in both science and religion. Some will be stories of unusual events that may challenge your reality. They are shared with no other intention than to stimulate your thinking into how science education research can be linked to our broader evolutionary needs.

Ultimately, I share my life in science education and research in the hope that it will encourage you to find deeper meaning in your work and have the courage to manifest your magic.

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## **SECTION 1:**

### **WE TEACH HUMAN BEINGS**

Over my years of teaching, I have had close interactions with approximately 5 000 students and colleagues from enormously varied backgrounds. That is enough of a sample to get a fairly good idea about humanity.

Each person, each school and each community is different and has taught me something. Some things are learned from extraordinary or sudden events that challenge or awaken me in the moment. Most of my learning, however, seems to have happened slowly over time, as my subconscious worked to make sense of repeated or similar experiences that gradually gave rise to a deeper understanding of some kind. Stories of awakenings to our human condition will be shared in this section.

This section starts with the individual. There are two reasons for this. The first is that even in a lecture hall with 250 students, you are still always dealing with individuals. When you realise this, large groups become no more intimidating than dealing closely with one person. Secondly, each individual presents us with a unique picture of our shared humanity. By getting to know many people, we gradually build an understanding that can give us confidence and trust in our dealings with ourselves as well as with others.

The second part of this section deals with groups. This is because we always gather ourselves into groups. We tend to attach ourselves to others who are the same as us, like herd or pack animals. We often gather around family, school, religious, cultural, language, racial, sex, gender, political, national and other identities as though without them we are nothing. This is obviously not true, however, as educators we must respect each of these identities as the substance out of which individuals build their independent identity. It seems to me that without our rootedness in groups, we would not be able to develop our individual identity.

Some stories in the second part are written in the present tense. This is because it was how they were originally written and I chose to leave them like this despite the discomfort that it may cause some readers to move from one tense to another in adjoining pieces. I hope the reader will accept this without too much difficulty.







## WE DON'T TEACH SCIENCE; WE TEACH HUMAN BEINGS

Science is a very rational and sensible subject. Facts are explored and discussed in a practical and logical manner. In education we try to bring students to develop these skills because they are powerful tools not just for understanding the world, but also for keeping a balance in life.

Children, on the other hand, are complex and multilayered in their relationship to life. They come into the classroom from different backgrounds with different attitudes and skills. Finding a way to engage them all in class requires a lot more than being an expert in the subject. It requires a knowledge of humanity and one's different stages of development. It also requires a working knowledge of the multiple ways in which we learn, and that every individual will be a particular personality with a unique wreality. In each moment of each day the child manifests themselves differently. Rudolf Steiner, founder of the Waldorf schools, put it best when he challenged his teachers to ... [This is the translation that I know]

*Solve the riddle of each child*

*From day to day*

*From hour to hour (Wiechert 2021).*



This task requires a very different orientation from that of doing science. It challenges science teachers to recognise that they do not teach science, they teach human beings, and this awareness makes all the difference.

The title of this book could be inverted to mean that we place so much emphasis on teaching human beings that we forget to teach the essence of science. If science education were to lose its focus on challenging students to

develop the skills of selfless, disciplined observation, reason and evidence-based problem-solving, the gifts of science would be lost. It is, therefore, the task of the science teacher to stay focussed on the science, but to make the learning of science personally meaningful for their students.

## **PAUSE AND COUNT TO THREE, AND OTHER MAGIC**

New teachers usually suffer an enormously steep learning curve in their first year. They need to learn the culture of the school, who to approach for all the multiple little daily needs, how to teach each subject, how to prepare good lessons, how to deal with parents, how to complete all the administration requirements, how to set appropriate assessments and so on. Beyond all these practical concerns, teachers must learn how to create a positive learning environment.

The events of this story took place in my first year of teaching and gifted me with four important teaching tools that I still use today. I needed the shock of this story to realise that these tools exist and are needed. They all centre around the birth of my awareness that I need to understand the wreality of the human beings in my care.

### **The four teaching tools**

The first is possibly the most important, hence the title of this piece; the need to pause before doing something crazy. It helps us to change our poorly considered outer activity into focussed inner activity. I have heard someone calling it a “turn-around” strategy, where it stops us from charging like a bull in one direction and gives us a chance to take a different and more considered course of action. The need to pause, later became my “count to three before you do something stupid” rule. I have needed it on many occasions, and it has helped me to find real solutions instead of compounding problems. One of my biggest challenges is that I easily become impatient and then rush ahead into action. As a result, I have many strong memories of which I am not proud, reminding me that I REALLY need to pause.

In class it is both the teacher and the students who need a moment to make sense of what’s going on before they are ready to act. If students do not act immediately to an instruction, I count aloud and slowly to three, keeping my attention on them. They are almost always ready by the time I get to three. If they are not, then I know there is some other problem, and I should address it straight away.

The second is that everyone is unique. What is right and healthy for one student may be harmful for another. This became my rule that fairness in class is not that everyone should be treated the same, but that everyone should get what they need. If a student who always does their work to a high standard tells me that they are not feeling well, I let them take a rest and do whatever they need. If a student who often fails tests or does not submit work says the same, I will push them to make some extra effort first. Once they get “into the work” they often no longer need the break and are grateful for the supportive push.

Thirdly, I learnt that students are not going to all be naturally ready to learn just because the lesson has started. We can try to force them to be ready with threats of punishment or temptations of rewards. These are both useful tools in certain situations, but are actually manipulative because they remove from the student the right to develop their powers of independent thought and action (Rosenberg and Chopra 2015). Activating our will to work is possibly the most important skill needed for life. Science with its inherent facts and logic as well as its obviously useful fruits, is perfectly positioned to help us find the needed motivation. We can use this to create the right conditions for encouraging student learning-readiness before plunging into the work.

Fourthly, and most importantly for me, it started the never-ending journey of learning to not sabotage my teaching with my oversensitive little ego. I learned that unless I can put myself aside, I will probably mess up. I realised that to do my best teaching, I need to do my best learning. [After over 25 years of further teaching I realised that I had turned these learnings into my single overriding rule for teaching. You can read about it in the piece, *Whirl wind: what is real, what is needed*.]



In my Grade 9 class [thirteen/fourteen year-olds] during my first year of teaching, was Merrick, a bright, spirited and naughty boy who took every opportunity to distract the class for a laugh.

On some serious occasion, I was disciplining the class for a reason I cannot now recall. With simple one-liners and facial gestures Merrick repeatedly destroyed the effect I was trying to create. My temperature rose and my pride

smarted as I moved ever closer to him; to physically dominate him! To shut him up! Eventually, not realising that I was cornering myself, I bent down in fury with just two centimetres between our noses. It felt like I had no next move other than to kill him if he continued.

Ignoring the imminent danger, Merrick broke into a joker smile, sticking out his tongue and wiggling his eyebrows. The air in the room froze as the whole class knew that the final line had been crossed. Something had to give.

In the moment that followed, a miracle occurred. A vision of killing Merrick flashed before my eyes. I don't know if the vision gave me the moment of pause, or if the pause gave me the moment of vision. Blessedly, the only death in that moment was of my pride and anger. In my horror at what I inwardly saw, my outer vision changed, and I now saw the unfiltered reality of what was in front of me. I saw a beautiful young man who was fearlessly asking, carelessly demanding actually, to be given the right to be himself in class without guilt or manipulation.

Inwardly I gave it all to him. Despite the enormous change that had taken place, I don't think it was more than a few seconds before I moved away and finished my moralising in a much-changed tone and then continued with the lesson. Somehow the class accepted this course of events and got on with the lesson as though nothing had happened.

The following weekend, while having lunch in town with my new girlfriend, I heard a noise from the far side of the restaurant that seemed to be coming closer to where I was sitting. I turned and saw Merrick pulling his reluctant father towards me, knocking into chairs and tables on the way. My horror at this sight vanished when I saw the beaming look on Merrick's face. By the time he got to me I had made eye contact with his father who was looking rather apologetic, and this comforted me further. Merrick pulled up a chair from another table and forced his father to sit down. Before father or I could say a word, Merrick said, 'Dad, I want you to meet the best teacher I've ever had.' I cannot recall anything else of our interaction other than that our meeting was fortunately very short, but very warm. I can also say that it had a very positive effect on my girlfriend.

Merrick, however, had got it all wrong. All I had managed in class was to not become a murderer. It was Merrick who had been my best teacher. He taught me that I do my best teaching when I'm doing my best learning.



## MEETING THE REBELS

Among my favourite students are what many teachers would call the class rebels. These are generally strong-spirited students who are direct and unafraid of conflict. They don't stand for fools, and when you encounter them in the middle school, between the ages of about 12 and 14, they are very challenging. Merrick of the previous piece was such a student, and having learned so many important lessons from him, I still value the opportunities that such students present.

Teachers who prefer that all students should behave and let the teacher do what they need, are missing an important idea. The young teenager is approaching adulthood, and needs to test the adults around them. If they do not do this, then they will not develop the needed forces for their adult wrestle for wreality. They will also not develop the capacity for independent thought, and independent thought is the basis of democracy. Democracy is just a box-ticking exercise when the individuals within it do not have the training and practice of thinking for themselves. They will be puppets of the prevailing ideas around them and then their country becomes a democracy in word, but a dictatorship in practice.

Here are three stories from various times in my teaching career. They give an idea of ways in which young students may challenge us and how we can help to guide them in an evholutionarily healthy way.



### Julie the bully

Julie was big and strong, but not a bully. It was an affectionate name that spontaneously arose during one of our interactions, and it helped her to calm down when dealing with her frustrations.

We were having an assembly at the start of the day, and the school principal was complaining to the whole school body about something that a few students had done wrong. His lecture went on for too long and I got very annoyed because he was treating the whole school as though they were guilty. After assembly each class went to their homeroom to get further messages

from their teacher, and for roll call. I had already finished the messages and roll call with my class when Julie entered the room. She stood powerful and proud in the doorway, put her hands on her hips, and loudly called out, 'Mr V [the principal] is such an idiot'. This was totally out of the norm at the school, and the whole class looked at me in shock to see what I would do. I certainly could not tell her that I agreed with her. Instead, I said, 'Julie, you cannot say things like that. Stay behind after I dismiss the class!' This seemed to satisfy the class as they imagined that I would punish her in some way.

Once the class had left, I told her that I happened to agree with her, that the principal had overdone things that morning, but that she could not go around shouting about it. All teachers have a duty to punish her if she does.

Having had her position affirmed, I then let her have her say on what she had experienced. We then agreed that should something like this happen again, she should come to me, and we would talk about it. Over the next year she came about three further times to complain about various teachers, and I helped her to find constructive strategies for managing her frustrations.

I left that school at the end of the year. I later heard that Julie had been expelled about six months later. This struck me as a real tragedy, one that could have been so easily avoided if only she had found another adult listening ear.

## **The naughty boys**

In the Grade 9 class that is described in the piece titled *Grade 9c*, there were a group of boys whom I called 'the naughty boys'. They loved this term because it was part of their identity to always disrupt the class for a laugh, and they were good at it. In class I never addressed them as a group but always spoke to them one-on-one. They were like a hydra and if it was not one, then it would be another who would pop up and cause a distraction. I learned to know who the current leader of the pack was, because they were the boyfriend of one strong-spirited girl, and she would drop the old one when a new one took over. The interesting thing about this is that the leader would become less disruptive and more settled when they were going out with her, making space for another to take over. On the day that I discovered her pattern, I simply reflected to her, 'You like naughty boys, don't you'. She responded with a sweet smile, and we never spoke of it again. I left the school at the end of that

year, and when I returned to say hello two years later, she came running to me to tell me that she was cured of the naughty boys and was now working hard and doing well. I was delighted to hear it. However, this story is about the naughty boys and not their girlfriends.

These boys demanded so much of my time that I got to know them all very well. One day I was teaching a different class when I heard a commotion in the playground downstairs. I rushed down to see what was going on. A large crowd of students were gathered and they were clearly angry about something. They were throwing papers at the student-leaders who were trying to get them to go to class, and it looked like things were escalating to the point of physical violence. It seemed to be mostly Grade 11 students who I did not know, but then I saw that it was my Grade 9 naughty boys who were in the centre of the crowd causing the trouble. As soon as we made eye contact, I walked into the centre of the crowd and looked at them with the question, 'What are you doing?' They all gathered around and looked at me with slightly sheepish looks. No one said a word, but we all knew that they were just wanting to have some fun so had roused the older students into causing trouble by exploiting their unhappiness about something trivial. We continued looking at each other for a little longer and then, without a word from most, but a quiet 'sorry' from some, the entire group went calmly to class.

To this day I have no idea what the problem was, but I know that the solution was created over many months of building a trusting and respectful understanding with the naughty boys.

## **Forget Thomas the doubter, here comes Charles the challenger**

In most Waldorf/Steiner schools the school day starts with a mainlesson. A mainlesson is often 90 minutes long and is given every day for about three weeks on the same topic. This means that I would sometimes teach a class for three weeks and then not see them for six months or more.

Mainlessons with one such class always began in the same way. During our first session together, Charles would pick on something that I was saying and throw a curveball question to me. His tone would always be challenging,

and he would lean back in his chair with his arms folded, looking at me with an arrogant smirk when he was done. At this point the whole class would be quiet, waiting to see what I would do. It was clear that if I could not meet the challenge, then the whole class would follow Charles's lead and know that neither I nor my lessons needed to be respected.

Charles clearly followed popular science in the news. His questions were always about some aspect of what he had read or heard, but asked out of context. Having learned to take a pause before responding, I could fairly easily sidestep my smarting pride at being so rudely addressed. What was harder to do was to find a way to earn his trust while not getting sidetracked from the focus of the lesson. The way to earn his respect was to show that I knew more about what he was asking than him. This would let him know that he was being arrogant, but it could make him resentful and more challenging in the future. I also needed to show that what he was asking was interesting and relevant in some form. This would let him know that I appreciate his interest in science and that I would like him to bring his questions to class in a respectful way when he is genuinely interested in discussing the topic, and not to prove how stupid teachers are.

Having achieved enough self-mastery in these moments I managed to earn Charles's respect. The rest of our time together would be fun and mutually enriching, where the whole class would engage with the work and feel free to ask all manner of questions, even ones which could be personally embarrassing. The ease with which we got on with our studies made me realise that this was no ordinary class of students.

I saw that they had a very respectful and trusting relationship with each other. Most of them had come through primary school together, and the new ones that joined had slotted smoothly into this happy and comfortable group. They knew and trusted each other to the extent that they felt safe to be vulnerable in class. It seems that they possibly used Charles to test new teachers to see if they could be trusted. What I initially took to be just a young teenage challenge may have been a lot more than that.



Situations like these made me aware that every class has a certain proportion

of what I call “the intelligentsia”, those who have the confidence to trust their wreality and are not afraid to test it against the adults of their world. If we can win the respect of the intelligentsia, the “rabble” will follow, and a potential revolution can be averted. Not all middle school classes present this challenge, but we need to win over the intelligentsia of those that do. If we succeed, we will not need to worry about discipline in that class from then on. This is because the rabble will always look to the intelligentsia when they do something disruptive. If the intelligentsia don’t give them a disapproving look, they will take it as licence to cause mayhem. If we win the respect of the intelligentsia, they will just give the rabble a look that says, “This is meaningful, and you will prove that you are a fool if you disrupt it”, and the nonsense will immediately stop. If we are not sure who the intelligentsia are, just see who the others look at when something disruptive happens in class.

## IT ALWAYS HELPS TO ASK

If we teach four or five classes of 20 to 35 students, our teaching day will involve more human interactions than anyone can keep track of. At times of stress or lack of energy it can be very tempting to snap, simply because we have been stretched beyond our limits. This is no excuse of course. We are duty bound to always be professional. I simply say this so that we can have compassion for ourselves and our colleagues when we mess up. And we will mess up at least a little every single day. The trick is to recognise this as soon as possible. The easiest way to know if we have messed up is if our conscience won't let us rest in the evening. I've had a case-of-the-conscience so bad at times that I hardly sleep and then make sure that I get to school so early that I meet the affected student as they enter the school grounds and apologise. It is my experience that students will always accept our apology if it is sincere (Pierson 2013). They treat us the way that we treat them, which is why some teachers can make big mistakes and be readily forgiven while others are not forgiven for the smallest slight. When needed, a sincere apology or greeting can be very powerful.

One trick to not messing up is to ask them what is going on. Even a 'How are you?' can go a long way. Here are three short stories that illustrate the power of asking, 'How are you?'



About 22 years ago my school held a fair with stalls and games and lots of food. It was a festive affair, and I was feeling particularly happy with its success. At some point I saw a student who I had not seen for some time, sitting at a food stall. Naively I walked up to her and greeted her, wanting to find out why I had not seen her in so long.

She looked distastefully up at me for a while before asking, 'Why are you saying hello to me?'

I was taken aback at her direct confrontation but responded with, 'I haven't seen you for some time and was wondering how you are?'

She then reminded me of something I had forgotten. ‘Do you remember the last thing you said to me?’ I braced myself for the worst and shook my head. With daggers in her eyes she said, ‘You said, “Get out of my school! You do not belong in this school!”’

I didn’t know what to say. I had no recollection of the event but could see that she was still livid about it. It is possible that she mistook me for another teacher, but it was also something I knew I was capable of, so chose to accept that it was me. I kept eye contact and said, ‘I am really sorry. I can see that this was a terrible thing to say. I am truly sorry.’ And then after a pause, seeing that she was not ready to accept my apology, I continued, ‘But it is nice to see you and I hope you have a good time at the fair. Go well.’ and moved on.

I made a strong mental note to make sure that this never happens again.

A different student who had been away for a six-month foreign exchange returned to find that the world she had left behind had been left behind. She found it unbearable and blamed everyone for her discomfort after her liberating time away. On an occasion, after seeing her deep unhappiness one time too many, and even though I knew why she was unhappy, my teacher instinct kicked in and I stopped her after class and sincerely asked her how she was. She replied that she was unhappy! And wasn’t it obvious!

I said that it was obvious and that was why I was asking. I said that I was asking in case there was something that I could do. She did not reply and walked away in a huff. I immediately forgot about it, having another hundred things to do. I know that I forgot because about 10 years later I got a Facebook message from her asking me how I was. I replied that I was well and asked after her and her family. She said that they were all good, and that she was messaging me to say thank you for taking the time to ask her how she was all those years ago. She remembered that she had been rude to me at the time and would like to apologise for her rudeness. She also told me that she is now an engineer and that it is at least partly because of our science classes. I told her that I could recall the event, and that I also remember some of our stimulating times in class.

What struck me from her message is that the simple act of asking her how she was had stayed with her for all those years, and that she could not let it go until she had made good on it. It makes me wonder how many adults there

are with the things that their teachers said, running around in their minds. For better and for worse.

On another occasion, my teacher instinct kicked in when Sharon, a usually loud and boisterous girl in my science class had been quiet and sullen for a whole week. By the end of the week the weight that she was bearing seemed to darken to the point of alarm. She was the kind of person who would probably explode if approached directly on personal matters, so I conjured up a situation to address it. In class I made a big noise about students whose work was not up to standard and kept them in during break [recess].

I deliberately picked Sharon and some of her close friends to stay behind. After the rest of the class had left, I got them all to move into the front row, which they dutifully did. Once they were ready, I stood on the far side of the class from her, and asked, 'Sharon, are you OK? I have not seen you smile the whole week.'

She had looked up before I had spoken, expecting me to start teaching. My question took her by surprise and she folded-in with heavy tears. Her friends immediately gathered around and I abandoned our session. I instructed them to take good care of her as she was clearly needing a lot of love. I knew that I did not need to say this but did so for Sharon's sake.

A week later Sharon approached me and asked if she could talk. She was with one of her close friends. We went somewhere quiet and sat down. The first thing that she did was to thank me for noticing that she was suffering. She did not tell me what had driven her into such a state of despair, but said that she had lost all hope as nobody seemed to care or be interested in her. As a result, she had got everything ready and had planned her suicide for that evening. I told her how glad I was that she was feeling so much better and that she now knew that she could rely on her friends, and that she must call on them for help if she ever found herself in that kind of despair. Her response reassured me that she was out of trouble, but I nonetheless encouraged her to talk with her parents about it. She said that she had already done that and that they were all giving her the support that she needs.

When last I checked, Sharon was happily married with two lovely children.

By the grace of God, I had acted on my teacher intuition. As a result, a situation that may otherwise have turned out to be a tragedy that would have

haunted me for the rest of my life, was averted. Instead, it strengthened me to always trust and act on my teacher instinct, knowing that something much wiser than myself was guiding my actions.

## DEALING WITH DRUGS

In the piece titled, *e and me*, I share a personal story of my self-medication with marijuana when I was at university. This piece has nothing to do with that, instead, it contains three stories about being a teacher and dealing with marijuana use among my students.

In the early 1990s many schools in South Africa expelled students if they were caught using marijuana. At that time, I was teaching in a Cape Town school where we recognised that students mostly use marijuana as an escape and needed help to get the help they need. If a student was caught using it, they would be suspended from school and sent for counselling. After three visits, the school would then meet with the student, their parents and the counsellor to find a way forward for the student.

There are many different reasons why students turn to alcohol or drugs to self-medicate or numb themselves. And there are many ways to address the problem. Most schools have clear policies on what to do, however, the teacher will often have a say in how it is done.

In roughly my sixth year of teaching, many students in my school were using marijuana. It had suddenly become an issue. It took us a few years to find out that there were dealers who were hanging “around the corner” before and after school. Once they were gone, the problem was substantially reduced.



My homeroom class were in Grade 9 and they were having parties most weekends. After one weekend a student came to tell me that some classmates had been smoking marijuana at the party. This was outside of the school jurisdiction to act upon, and I told the student this, encouraging them to keep themselves and their friends safe. Over the next two weeks the same student reported the same behaviour. On this third occasion I knew that I had to do something.

During one of our homeroom sessions, I opened the topic saying something like the following, ‘I have heard that some of you have been using marijuana over the weekends. I would like to have a conversation about it.

The school has no jurisdiction over what you do on the weekends, so this is not about finding out who is doing it and punishing them. This is about making sure that everyone is safe and getting what they need. But we can only have this conversation if we all agree that whatever is said in this room will be confidential, and not repeated to anyone else. This will make sure that everyone feels safe to tell the truth without fear. Do you all agree?’

This class had been together for several years and the degree of trust was high, despite the many students who were not involved in these parties. I had also been their homeroom teacher for over a year, and we had built up a lot of trust. They all agreed, so I asked them to put up their hands if they had been experimenting with marijuana over the past few weeks. Over half the class raised their hands after looking around at each other and encouraging those who had been involved to be honest. I then asked if this is a problem and if I should be worried about it. They said no, and that they had already decided that the last weekend’s party was going to be the last time that they would do it. They were just experimenting with it and now it was over. The comfort with which the whole group agreed, convinced me that they were telling the truth.

I then asked if there was anyone who felt that they might be addicted in some way, and want to continue smoking it at further parties. Frank put up his hand. He was one of the younger students. I asked him to stay behind so we could talk further about it. He told me that he felt a bit insecure at these parties and that the marijuana made him feel happy and more confident. He said that he would want to keep smoking it. The next party was going to be that weekend, so I asked him if he was prepared to get one of his classmates to help him to not smoke. He agreed, and suggested that Mark, another boy in the class, could help him.

Of all the students in that class, Mark was the last person that I would have trusted to help anybody other than himself. Mark was one of the street-smart kids who had little respect for adults. I would not have been surprised if it was him who had got the whole group to start smoking in the first place. I was taken aback by Frank’s choice, so asked him if he was sure that he wanted Mark to help. Could he rely on Mark for something this important? He was confident that Mark was the man for the job. Fighting my own mistrust, I asked Frank to come back during break with Mark so we could talk through

some strategies. They came during break and Mark was happy to help. He promised to look after Frank that weekend and that they would let me know how it went when they came to school on Monday.

On Monday they came to me first thing in the morning to report their success. Frank looked really proud of himself, and Mark's face and body language were showing leadership qualities that he had kept well hidden behind his rebelliousness. I was so happy for them both and asked if they were willing to continue working together in this way. They were, and they kept at it for some months with some failures, but mostly with success. I had encouraged Frank to tell his parents about it, which he had, and they were supporting him to find alternative strategies to become socially more self-reliant and confident.

The most remarkable aspect of this episode was seeing the change in Mark. From that first weekend of helping Frank, he became one of the most responsible and reliable members of the class, a real leader. It was a shift that made me realise how important it is to give students that I mistrust, a task of responsibility. If nothing else, it gives me the opportunity to have conversations with them about responsibility and the joy that it brings. Mark had clearly had nothing meaningful into which he could previously channel his energies and so had been using them destructively. Once he had found one purpose, he seemed to keep looking for further meaningful things into which he could pour his energy.

Around the same time there was a new student from an older class who would wander off towards the school field and basketball courts after arriving at school in the mornings. I knew this because it was my week to do the welcoming of the students when they arrived at school. One morning, a few minutes after he had wandered off for the third day in a row, I decided to leave my post and follow him. He was on his own on the far side of the basketball courts, and was lighting up, making a lot of thick smoke in the process. Nobody ever went there in the mornings, so he did not look around until I was right behind him. He only turned around when I quietly greeted him. He did not seem to get a shock, but just looked calmly at me. I asked him to hand me the joint, which I put out against the ground and put into a plastic bag. When I stood up again, he was still looking calmly at me. I asked him if he was ready for the consequences that would follow. He did not respond,

but kept looking at me with a calm expression, so I asked him to follow me to the office.

He was suspended and went to counselling but never returned to the school. I thought that he went to another school to avoid making the changes that were needed, and so could keep on with his bad habits.

A few months later I was shopping in a large grocery store near to the school. I never usually shopped there, so was distractedly wandering around searching for the things I needed, when a young man suddenly approached me. I was startled and stepped back because he had come directly at me and was closer than the acceptable “stranger-distance” in a grocery store. When I looked at him, I immediately recognised him from school. He had a warm and calm presence, despite my alarmed state. He said that he wanted to thank me for stopping him that day. He had been in a bad way and was needing help that he did not know how to get. He had lost his trust in adults so had not approached his parents and took up smoking marijuana instead. He said he had been smoking it every morning for a few months before getting caught. He now knew that he could rely on his parents again and was doing really well. He was attending a different school and was working hard and getting good grades.

We teachers almost never know what the consequences of our actions will be. Most of the time we don’t find out because the students move on before the results become evident. But here was feedback that gave me confidence to keep trusting my teacher instinct even when I thought that all hope was lost.

The final story is about a girl who seemed to be permanently angry with the world. She had a few close friends, and terrorised the rest of her classmates as well as her teachers and parents. I tried many ways to get her onboard. Not only did I have no success, but every move led to increasing failure. It felt like she didn’t just disrespect me, she actively hated me. You can imagine my surprise when she came with a gentle smile to speak to me after an assembly talk that I had given.

I had been wrestling with how to address the marijuana problem among the students. What could I say to them that would not be some form of moralising, but that would give them something to think about before buying their next stash. I had already learned that it is often just a single thought that gives us the moment of pause to help us change direction and take a healthier

path instead. I'd also been reading about the drug underworld in the news, and that Cape Town had many areas where gangsterism was rife. One area would be under the control of one gang, and they would be at war with gangs of other areas. This made Cape Town the city with the highest murder rate in the world at the time. I decided that this was the angle I would take.

I began by speaking about how national and provincial governments fund hospitals and care facilities for people who need it. 'How many of you, or people you know, have been helped by such places?' Many hands went up. I spoke of how governments fund the police who keep us safe by stopping criminals from running rampant and robbing everyone at will. 'How many of you have been helped by the police?' Again, many hands went up. I spoke of governmental support for the legal and education systems, and for electricity, water, sewerage, road, traffic, public transport and other systems that make our lives so comfortable and help us to progress as a society. That they do all these basic tasks for us so that we can get on and do what we want.

And then I asked, 'Where does the money come from to pay for all this? It comes from our taxes. Every time we buy something from a shop, some of that money goes to the government. Every time someone gets paid for their work, some of the money goes to the government. We all help to pay for these amazing systems, and we don't even need to know how they work, because others will take care of them for us. What a blessing.'

Once I had milked enough of a sense of gratitude out of them, I turned their gaze in the opposite direction. I then asked something like this, 'And what happens when we buy marijuana? What happens when we buy illegal drugs? Because they are illegal, none of the money that you spend goes to tax. In fact, the money goes to supporting gangs who are doing the illegal activities. These gangs get their money from crime. They don't just get it from selling marijuana, they get it from other criminal activities like mugging, burglaries and so on. And they need to protect themselves against the police and other gangs, so they have knives and guns, and do harm to many people as a result. You may be aware from the news, that Cape Town has the highest murder rate in the world because of gangsterism. They don't just rob, kill and steal, they terrorise their own communities, rape women and girls, and force young men to join their gangs. They poison society. When you buy illegal drugs you fund gangs, you fund the destruction of society.'

I finished the talk by reminding them of how important it is to be grateful to those who run the systems that we tend to take for granted, and to feel a sense of pride in their parents who play their part in creating such an incredible world to live in.

After assembly the teachers gathered in the staffroom for some eats. While there, this girl came walking into the room, much to the shock of those who knew of her tendency to be abusive, and to avoid teachers whenever possible. She walked right into my personal space with a clear and open gaze.

Without a hello she said, 'That is the best assembly talk we've ever had. Nothing I have ever heard before has made me think about drugs like that. I am now seriously considering not smoking marijuana anymore.' With that comfortable confession she looked me warmly in the eye. After I had thanked her for her feedback, she shook my hand, said goodbye, then turned and walked out.

I have no idea if she stopped smoking marijuana. She certainly did not stop terrorising the school, and was eventually expelled for her behaviour. But I am grateful to have this memory of at least one moment when she appreciated having been stopped, and to have thought about the consequences of her actions.

## **DON'T WORRY, EVERYONE IS LISTENING**

One way to become a qualified science teacher in South Africa is to do a teaching diploma after completing an undergraduate Bachelor of Science degree. In 1986, during my teaching diploma, we students were put into groups of about ten, where once a week for about one hour,<sup>3</sup> we would have discussions to stimulate our thinking around education. The only assessment to this module was a long essay on our teaching philosophy to be submitted at the end of the year. Most of these sessions felt like there were only two of us in the group.

Each session took on a similar pattern. The lecturer would raise a theme and we students would say what we think. After about ten minutes of this Paul or I would try to get deeper into the topic by sharing some personal insight or question. The others would respond with their insight and the cross stimulation between us would dominate the rest of our time together. The way we both thought about education always stimulated the others to share old or new insights. We would keep going back and forth, building rich and textured ideas around the given topic which would keep getting more and more interesting for both of us. Our conversations would spill over the limited time of the session, and we became close friends as a result. During one such session, where Paul and I had been the only ones talking for at least twenty minutes, I interrupted our conversation in mid-flight and turned to the rest of the group.

I couldn't bear it any longer. I had always wondered what the others were thinking and so would regularly look around the group to see if they were engaged, which they mostly were. But now I needed to know what the others were thinking! How could they enjoy listening to us going on and on? Why did they not say what they were thinking? Were Paul and I not allowing them to voice their opinions? I had no idea and needed to know.

Each student said what they thought, and I was comforted by the fact that they all found it interesting and just wanted to listen. The lecturer said that he let us keep going because they were all enjoying the debate, but a comment

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3 In my day this was called an HDE, a Higher Diploma in Education. Today it is called a PGCE, a Postgraduate Certificate in Education.

from one of the quietest students is the response that has stayed close to me ever since.

Johan, who always sat next to me, said that he followed the conversations closely. He had his own ideas on what we were saying, but that he never needed to voice them because one of us would always say them for him. I pressed him on this, so he gave a few examples from that very day. He recapped the key ideas from the conversation and what he had been thinking. He then said the thing that impacted me so strongly. He looked at me and said that he didn't need to say what he was thinking because I would say it soon enough. I looked back at him with a questioning look as if to ask if I had heard him correctly. He returned with a look of complete knowing that what he said is what was real. In that moment I was amazed by two things. The one was that he was happy to sit back during our sessions and let me say what he was thinking. And the more amazing thing, that he was aware that this was happening!

His calm conviction convinced me that he was speaking the truth. This was backed up by my recognition that the quality of Johan's thinking as he was speaking felt like the quality of thoughts that I was often having in our class discussions. I could feel how his thinking and mine must have been overlapping at times while Paul and I were holding our discussions. I then became aware that I found the discussions with Paul so interesting not just because Paul gave me new ideas, but because I was getting new ideas from within myself. Johan made me think that perhaps some of these new ideas came from him. This got me thinking whether our thoughts are actually ours. Where do new thoughts come from? And how do they arise?

This reminded me of when I was doing my Waldorf teacher training. I had been having a difficult time and was getting increasingly despondent and depressed. After a week of this, I was in a lesson with our art teacher, Benni Kleynhans. Even though he hardly looked at me, for the entire session I felt that he was talking only to me, addressing the seat of my problems and giving me the light I needed for my way forward. I asked him after the lesson if he was thinking of me as he was talking. It was clear from his response that he had no idea what I was talking about.

I got some almost overwhelming confirmation that the thoughts of some, influence the thoughts of others after the Covid-19 lockdown. I had been teaching groups of around 150 students online for the entire year. I had never

seen what any of them looked like. They could see me and my slides, but the only way they had of communicating with me was through typed messages. During our sessions I would regularly be stimulated to say encouraging words to them about staying motivated despite our terrible isolation from each other. That it was a tragedy to not be able to engage face to face.

When we got back to campus the following year, I kept finding students who I did not know, looking at me with warmth and gratitude. Several of these students came up to me and shared their experiences of our online lectures, and how they would be wrestling with some ideas, and that I would address these ideas as though I had heard them, and was talking to them personally.

I have found other situations where it seems as though this kind of sharing of ideas was happening. Even in a lecture hall with over 250 students, I have noticed how everyone becomes quiet when I hold a conversation with any one student. We will sometimes talk as though it is only the two of us in the room, going back and forth in a sharing, challenging, contemplative or questioning manner, listening closely to what the other is saying. In such moments I trust that everyone is listening, that we are always listening and reading each other's thoughts and feelings, often hearing much more than what is said.

Recent research into mirror neuron activity supports the idea that we are not just listening to each other, but that our own brains can copy the brain activity of others. It seems that this is how we learn to walk and talk as babies, and how we know what other people are thinking and feeling (Cook et al. 2014; Marshall 2014).

## LOVE AND REVULSION

A teacher can fall in love with a student and a student can fall in love with a teacher. It's just a fact and is nothing to be ashamed of. Although it can be very challenging to manage in a healthy way, it can enrich the lives of both. The opposite is also true. A teacher can hate a student, and a student can hate a teacher. These can be more difficult to manage in a healthy way.

I would be hard pressed to say how many of my students I have deeply loved. I could, however, tell you the number of students who I have been in love with. There is an enormous difference between the two. There is a level of attachment and attraction with being in love, and this is what needs our disciplined efforts.

When you get to know your students, it is natural to develop a deep love and respect for them and their struggles. And it is natural for them to love their teachers. This love forms the basis on which deep learning can take place. We can all remember our favourite teachers and how easy it was to learn in their class. We also know that we struggled to learn anything meaningful from the teachers we did not like (Pierson 2013).

As a teacher it is always our responsibility to make sure that our students are safe. We are not there for ourselves. We are there because we have been entrusted to care for our students. This must be an unbreakable rule even when we may feel otherwise. Here are a few stories to highlight some of the important elements to managing our love and hate as teachers.



A young teacher is roughly of the same generation as their students, so challenges arise more readily than when one is older. Two teachers who I have been close to, have had deep personal struggles managing the unbreakable rule. One was an art teacher who was physically attracted to a charismatic, “tall, dark and handsome” eighteen-year-old student. The student would press up to her when she was critiquing his work in class, and he kept staying behind after class, making playful insinuations to her. She was struggling to keep saying no to his advances and talked with me about it. Blessedly, she managed to find the strength to set up clear boundaries between them.

Another friend set himself up for failure by taking a class on an outing which included spending a few nights away with little other adult supervision. While away, he and a girl in his class shared a romantic kiss. Fortunately, he immediately confessed his indiscretion, met with the school leadership and the girl's parents, and then resigned. While there was no further fallout from this event, the potential for all of us to lose trust in teachers and the teaching profession is enormous. When we hear of such events, the temptation to never trust adults with students can become overwhelming.

My most challenging situation happened when I was still a young man. I had already been exposed to the above situations so had had more than enough time to firmly fix the unbreakable rule in my heart and mind.

I had developed a deep love for a Grade 8 girl [13-years-old], and four years later I had fallen in love with her. At this time, she needed my advice on making a difficult decision. Together with her father we decided on what we thought was the best course of action. After a few months of the new dispensation, she could bear it no longer and wanted to reverse her decision. Her father and I again met to make the needed arrangements. Shortly after her return to the old norm, I was walking to the Monday morning assembly from the staffroom. She was standing at the entrance to a classroom and asked me to come inside as she had something for me, to say thank you. As I entered the classroom, she closed the door behind us and held herself against me pressing her mouth onto mine. Her overwhelming gratitude at the change had made her break the rule of teacher student relationships. I would be lying if I said that I had not wanted this, but I had already, blessedly, stamped the unbreakable rule indelibly on my soul. I put my hands on her shoulders and moved her away from me, looking her in the eye. I warmly said how glad I was to see how happy she is about the change. I then reminded her of the commitment she had made in choosing to return to the old situation, and that she must now put all her efforts into making a success of it.

This set the unbreakable rule firmly back in place for the rest of her time at school. That does not mean that I did not deeply wish that I had been one of her peers instead of her teacher.

Indiscretions do happen, and in many cases, they are much worse than anything mentioned here. This is why it is so important to include discussions like these as a part of teacher training, so that teachers can work on embossing the unbreakable rule deeply and unbreakably into themselves. Love is good, but desire needs to be transformed and channelled towards helping the student in their learning efforts. That is why we are teachers.

It was, after all, my deep respect and love for a male primary school teacher that made me want to be a teacher. He had been a religious minister of some kind, and his total devotion to our care enabled me to see how meaningful teaching could be. It made me realise that I wanted that same degree of meaning in my own adult life.

As important as it is to manage our attraction to our students, it is equally important to manage our distaste.

It is fairly common for teachers and students to clash. As a schoolboy I saw how some teachers used their dislike as an excuse to bully the children in their care. As a schoolboy I had cried my fair share of tears at seeing how a teacher's distaste of a student can devastate them. And many of these scars last for the rest of life.



In my final year of schooling, my class was waiting in the upstairs corridor for our teacher to let us in. Looking out the window, we saw such a teacher from our primary years coming into the school directly below. The force of hatred that welled up in us as a group was so fierce that we opened the windows, stuck our faces out and swore terrible words directly into his upturned face. This man who had been such a huge monster to us five or six years earlier, now looked so small and pathetic. Many years later when I was forced to go to the army as part of a two-year conscription, I saw firsthand where he learned such cruelty. He must have hated being treated like that, and yet he enjoyed what he must have believed was his right to practice these skills on us. Even though I still make minor mistakes, that memory stays as a powerful warning to never give my learned-abusive-behaviour, dislike or disrespect for a student any space for unbridled expression.

As a young teacher at a new school, I had noticed that two very pale girls

with jet black straight hair hung around together in places that always seemed like dark corners. All the students and teachers seemed to avoid them. [This was long before the term “emo” was given to those who looked that way, dressed in black hanging clothes, and sometimes subjected themselves to self-harm.]

I asked a colleague about these girls who told me openly that they were satanists. This area had had a few cases of satanism in the press of late, so anyone who looked in a particular way was labelled as a satanist. Their behaviour was so out of the norm that I didn't know what to believe. I had no personal wish to speak to them and was even a bit scared when they were near me, but I knew that I had to. I had to speak to them to overcome my fear, or I would not be able to honour my professional commitment to care for all students in my school. I didn't teach them, so I manufactured a reason to talk with them one day when I was walking around on break duty. Some useful object, which I cannot now recall, was on the ground behind where they were walking, so I picked it up and walked around to where they were. Once I was face to face with them, I asked if either of them had dropped the object, holding it up in front of them. They put their faces together and held onto each other when I spoke. They both smiled shyly and said that it wasn't theirs. One of the girls opened her mouth when she smiled, and I could see her tongue. It was unusually narrow and looked dried and shrivelled on top. I hope that my shock and horror did not show. I kept warm eye contact, smiled and said goodbye, then quickly turned away. My insides were shaking. I didn't know what I was feeling, having no frame of reference for what I had seen. I then stopped in my tracks when I realised that I was almost running away as though running for my life.

I had to go back and give myself another interaction with them to give me something positive to bring to my shock. I turned around and went straight back to them. They were both looking at me as I approached. I looked as warmly up to them as I could muster, held out the object, and said, 'I know it's not yours, but it seems to belong to nobody now. Would you like it?' They were a bit surprised by my offer but quickly broke into a smile, took it and said thank you. Somehow, them accepting the object, as though I had brought a gift, broke my momentary insanity and I saw two sweet girls in front of me, satanists or not. I gave them a genuine smile and walked casually away.

I don't know why my teacher instinct made me offer the object to them, but I trusted it and was rewarded with my fear and revulsion being replaced with calm and care. I certainly would not want to befriend them, but I no longer felt any distaste for them and would have been willing to perform any professional duties on their behalf.

It is really useful to have strategies to shift negative feelings for students in your care.



## EVERY CHILD HAS LOGIC

There are some important lessons that I learned at the start of my career simply because I was a complete novice and had no expectations. Having already learned that I do my best teaching when I am doing my best learning, I became more open to learning from my students than I perhaps would otherwise have been. In this story, it was not just me who did major learning.



Robert was completely useless at maths and the class knew it.

When starting a new section of work, I wrote up three worked examples on the board, and a fourth sum to be solved by a volunteer student. After explaining the new processes using the worked examples, I asked for a volunteer to do the fourth. Robert boldly and enthusiastically came forward to the jeers and laughter of his classmates. When I saw the total confidence on Robert's face, despite my own misgivings, I asked,

'Robert are you sure you know what to do?' 'YES!'

'And you all think he will get it wrong?'

'YES!!!'

'OK. Robert, give it a go.'

Within seconds the class was falling about at the total nonsense on the board, but Robert kept at it with a real conviction. I was amazed at his continued determination despite his classmates' laughter. For this reason, I let him finish and then asked the class,

'You all think this is wrong?' 'YES!!!'

'Robert, you seem confident that you have done this correctly. Please explain what you've done.'

He pointed out a repeating number pattern that I had somehow unconsciously put into all three worked sums AS WELL AS the one to be solved!!! Robert had ignored all the process signs like add, divide and equals, and faithfully completed the values for the pattern he had observed. His explanation was greeted with stunned silence and reverent awe.

'Did any of you spot this pattern?' 'No.'

Neither had I.

Robert never learned to prioritise the mathematical processes above his need to find number patterns, but what he taught us I will never forget. And I will never assume that what looks like an error in thinking is a lack of logic. It may be a different kind of logic from what is needed, but it can be used to understand how the student thinks and to guide them to the logic that is required by the subject.

## PROCESSING STUDENT DEATHS

Classroom teaching involves spending time with the same children almost every day for one year at a time. In the process it is near impossible to not bond deeply with your students on some level. The routine of the connection becomes something like being with family, where you learn to work around each other's idiosyncrasies, and begin to value the role that each one plays in creating the shared space together. When a student is taken from such a class by a sudden death, the shock makes it very difficult to process. It also means that the usual activities need to be put on hold for a while. The challenge is to know how to fill that empty space left by the death so that the normal activities remain meaningful once they are resumed.



Many students have died in schools where I was teaching, and under a great variety of circumstances, but none of these deaths have made such deep lasting memories as the ones taken from my classes.

I have lost three students from classes that I was actively teaching.

When I was teaching at a Waldorf School many years ago, I lost my first student in the St James Church massacre (Geslin 2001). The massacre was politically motivated by members of the Azanian Peoples Liberation Army [APLA] who believed that churches were complicit in stealing Black owned land. In the attack eleven people were killed and another 58 were injured, where many of the victims, like Wesley, were of mixed race. Wesley was attending the service with his older brother when the attackers entered and started shooting and throwing grenades into the congregation. One grenade landed between Wesley and his brother. His brother apparently took the grenade and put it under his chest to protect his brother and others. Wesley was none-the-less killed in the blast. He was 13 years old. Wesley always made us laugh with his bouncy smile and full-rounded joy in life. He made life in the classroom fun.

A few years later an act of nature took Clemens, a German exchange

student. He was walking with his host family on the coastal rocks near Hermanus. He stayed a few moments longer on the edge than the rest. A freak wave swept him off the rocks and trapped him under water. His body was never recovered. Clemens was sixteen years old. Clemens was a quiet, deep-thinking young gentleman who accompanied all class content in such a way that it often became more significant than initially intended.

Roughly 15 years later, Andrew was knocked over by a speeding car just outside his government school in Johannesburg. He and his friend were hit by a security company vehicle while crossing the busy road a short distance from the front of their school. I saw both boys lying on the road, with their shoes carelessly scattered 30 meters away, having been knocked off their feet in the accident. Andrew's broken body lay face down, the wide, thick river of his life blood outpoured. His friend made a full recovery. Andrew was 14 years old. He was a gentle, quiet boy who had established himself as a top academic student and rugby player. Andrew was the person that his classmates would look to for approval, and his presence encouraged a hard-working and happy environment; he and his class were magical to teach.

Three different boys of different age and race. Three utterly different deaths. Yet each one had the effect of awakening their classmates to the reality of our mortality while celebrating the magic brought by the personality that had left. Through a courageous and open mourning process with each bereft class, we learned more about the person, with everyone sharing their experiences and stories with them.

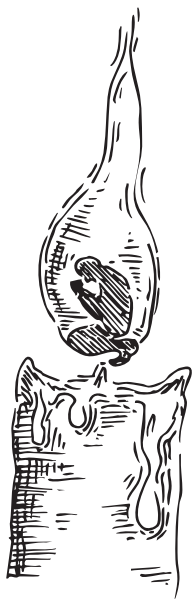
These boys became for us multi-dimensional beings with gifts and faults and humour, that gave us light and comfort as well as strength and courage in the face of death that we did not have before. This painful blessedness brought us the comfort of knowing that death is not the end, and that life is too precious to take for granted.

## THE LITTLE LIGHT

In roughly 2015, I joined the Pretoria Writers Circle, a group of writers who share their poetry and prose to improve. All I had wanted was to receive some feedback on my science poetry but also found great value for my own work through reading and critiquing other's writings. In 2017, the convener of the Circle's poetry section was murdered for the money he had just withdrawn from an ATM. This poem was written in his honour, and in honour of the tens of thousands murdered each year in South Africa.

This poem speaks of feelings of responsibility for the suffering due to murder. Even when we have not committed the crime, if we are honest with ourselves, we will know that as human beings we carry the same murderous impulses within us. The death of this friend awoke in me the need to strengthen our depth of humility if we are to protect the small flame of light in ourselves.

### The Little Light



O Lord!  
Oh Great God!  
What have we done?  
The suffering, deep pain.  
The anguish, pure fear,  
by our own hands.

Every moment their faces echo.  
Crush my Soul.  
Destroy my Spirit.  
Empty my Dreams.  
Oh! Hollow my pride!

This small life deserve I not  
But to heal what I saw not.  
To know my bonded kinship  
To that which I am no

## **EVEN WHEN IT'S PERSONAL DON'T TAKE IT PERSONALLY**

It can be hard to not take it personally when we are verbally attacked by students and parents. In such moments it's important to stay open and to own our mistakes. This does not mean that we should step back and let the tirade pour over us. In such cases it is important to keep a forward momentum, being proactive in owning our errors while staying positive and in control. As the teacher we will always be responsible for what happens in our classes, and if we step back and allow the parent or student to take charge, then we put everything and everyone at risk. This is not the same as being arrogant and dominating for the sake of looking in control, but of an open and honest reflection of what's going on while keeping a strong and selfless focus on the healthy outcome that is needed. In the process we can learn a lot about our weaknesses and our strengths.

The following story involved me trying to gain the support from an unwilling new class. In the process I needed to address the unusual behaviour of a student, Joshua, with Asperger<sup>4</sup> syndrome whose parents were abusive, and where the school principal was unsupportive.

Having subsequently discussed the story with some colleagues, I now realise that the above description forms only a part of the reason that I am sharing this story. This is because the story and most stories in this book, seem to be more about me than about my students.

As much as I have tried to rewrite this story to be about Joshua, I always remain the hero who saves the day. It seems that I value this story because it reminds me that I managed a challenging situation and came out feeling proud of myself. One could say from my need for repeated positive reinforcement that I suffer from an inferiority complex and this would not be entirely wrong. I would rather say that it is important to me because I need stories which reinforce my trust in my teacher-intuitions; thus, I can retain my courage to stay open and solution-seeking in situations where I find myself completely out of my depth. I am comforted in the knowledge that this is true for most teachers, and my sharing of this story aligns with one intention of this

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4 Asperger syndrome is a disorder that is characterised by social and communication difficulties as well as exhibiting patterns of repetitive and/or clumsy behaviour.

book, to stimulate my fellow teachers to research the growth of trust in their intuitions with stories of their own.

Almost all teachers know that meeting the needs of all their students is an impossible task. Teachers will often share their stories of challenge and success in the staffroom as part of their informal support sessions. They tend to do this over lunch break [recess], and it often appears as a moaning about their students when the strain becomes too great, however, it is always about sharing the struggles to achieve our common ideals. I share this story because I want to emphasise how important it is for everyone involved in education to prioritise developing and trusting their own intuitions in each and every situation. The alternative is that we rely on previous patterns of response, some of which we will have learned when we were children, many of which we probably hated at the time. The courage to let go of historically learned behaviour is not easy. When we do, we move into uncharted territory and risk not having the support of memories that strengthen our belief in what we are doing. All the more reason why stories such as this one are so important.

In this story I devote my attention to meeting the needs of one student. It turns out that it was the right student at the time. Pure teacher instinct guided me to this.



I used to say to my colleagues, ‘In 100 per cent of cases, if you can’t get the support of the parents, you won’t solve the problem with the student.’ I have now revised that figure to say ‘In 99 per cent of cases...’.

In 2008, I was already an experienced teacher when I took over a Grade 8 [thirteen-year-olds] mathematics class from their beloved teacher, who had left the school after the first term. They took an instant dislike to me. They worked me hard, and I was “fighting fires” for 45 minutes of each 45-minute lesson. Despite trying everything I had learned up to that point, I could not figure out why. In my third week with the class, one particularly bright boy, Joshua, who seemed to play a significant, but understated role in creating the negative attitude of the class, asked me for help while I was busy with others. When I was done helping the others, I went to him. With a warm smile he assured me that his problem had been solved, so I moved on to the next

student in need. The next day, he did the same thing with the same result. On the third day, when he did the same thing, I asked to see his book. He looked me warmly in the eye and convincingly reassured me that he completely understood the work, so I didn't need to worry. That's when I really started to worry.

I had to ask Joshua three times before he reluctantly handed over his book. At this point the class fell into a strange silence and were all watching anxiously. In Joshua's book, the work from our third week had a proper heading with Monday's date, and then, 'Asked Philip for help and he didn't come'. Tuesday said the same, and Wednesday said, 'Asked Philip for help and ...'

I looked at Joshua inquiringly. He tried to put a defiant look on his face, but I could see that he was actually sorry. We both knew what had happened each day, so why was he creating this false record of events? 'Joshua, I think I need to speak with your parents about this', and without another word, I handed his book back and continued helping his classmates. After the lesson I had a conversation with the school principal who agreed to meet the parents with me. A few phone calls later and Joshua's divorced parents had agreed to meet the next afternoon.

Mother, father, the school principal and I were in attendance. I had asked the principal to join as I had a hunch that Joshua's record of events was intended for his parents, and that this could mean trouble. Everyone was more tense than I would have expected, however, I ignored this and began the meeting by expressing confidence in Joshua's mathematics ability. I then told them what I had found in Joshua's book and asked the parents why they thought he was doing this. Was there something that they were aware of that could help me to help Joshua?

Mother started. For fifteen minutes she told me in no uncertain terms that I was the worst teacher her child had ever had. I should have known that her boy has learning problems and is Asperger's, and... and... and...

I hadn't known of Joshua's Asperger's condition and looked to the principal at this point who did not look back at me. He was looking at the mother as though she was telling a most interesting story. She went on attacking every imaginable fault with an ever-increasing volume, proving that I am a seriously incompetent teacher. I kept glancing at the principal, whose expression

remained unchanged. I was puzzled that he did not stop her clearly random tirade, and that he would allow her to abuse one of his teachers in this way. I also realised that there would be no point in addressing what she was saying as she had not mentioned anything specific that had happened.

Taking charge of the meeting and catching her in a moment of pause as she was gathering her breath to continue, despite my inner shakiness, I calmly thanked her for her feedback, and turned to the father, hoping that he would bring some calm and reason into the discussion, and hopefully give me some information that could help me with Joshua.

The father took up where the mother had left off. After a few minutes of a deeper voiced tirade of personal attack that was also not based on anything factual, I tried to understand what was going on. The parents were divorced, Joshua had learning problems, and lacking the knowledge or means to help him, the parents seemed to be trying to prove to each other that they loved and supported their boy the most. Had I just set myself up as a convenient target for them to have a go at each other?

Having given up on the principal to be of any help and still shaking inwardly, I let the father reach a partial pause and then interjected in as calm a voice as I could manage. I apologised for seeing them in such an unhappy state, thanked them for their feedback, reassured them that I would do my best to help Joshua and promptly ended the meeting.

I went home, knowing that I would never get Joshua's parents support, so would need to do something that I had never done before. I would need to somehow earn Joshua's trust despite the support he would receive at both homes for continuing to make him the victim and me the villain. Without knowing what I would do, I trusted my night's sleep to come up with a solution.

I got to school with my mind set on the single goal of gaining Joshua's cooperation, knowing that I had to do whatever it takes to achieve it. The alternative was too impossible to contemplate. At the start of the next class I went straight to Joshua who was sitting at his desk with an excited crowd around him. I knelt down next to his desk so that we would be at the same eye level, looked Joshua in the eye and said, 'Joshua. We are only three days into this new work. I know that you can manage it. I will get the class working and then help the others so that they can get on with the work. I'll then come

to you for the last fifteen minutes of the lesson. I'm confident that you will manage this section if we can work together like this. Would you like my help?' I stopped talking and gave him my full attention. Joshua and his friends were calm and quiet through my whole speech. His friends now also turned their attention to Joshua to see how he would respond. Joshua's response was immediate, 'Yes, I would like that. Thank you, Philip'. The mood in the class immediately changed and his friends moved to their desks.

I went to the front of the class and explained to them what would happen during the lesson. I asked them if they would be happy with this arrangement as I would be unavailable to help anyone except Joshua during the last fifteen minutes. The gentleness of their response was surprising. It was clear that they all already knew that Joshua had agreed to this arrangement, and that they really wanted Joshua to succeed.

The next few lessons proceeded in this way, and each time that I was helping Joshua, over half the class surrounded us and followed our work closely and quietly. To keep the onlookers engaged, I would ask them to answer questions occasionally. This eventually led to a few of his classmates willingly taking up the support for Joshua on a regular basis. With this, I no longer needed to be putting out fires with the class, and we began to have fun together.

So many thoughts went through my mind trying to understand what had actually happened. My final conviction is that Joshua, despite, or perhaps because of his Asperger's, and because of his extreme intelligence, had found highly skilful ways to get his parents, the principal and his classmates curled around his little finger. With everyone trying to support him, I figured that he was loving the attention and kept getting more skilful at keeping their attention by controlling the narrative. I therefore reasoned that my strategy was possibly effective, because even though the rules of the game had changed, he had remained the centre of attention. This was a lucky coincidence as I had not planned this. Whatever the reason for the success, I was deeply grateful that I was no longer under tremendous strain each lesson, and that Joshua and his classmates were now getting their educational needs met.

I had several peaceful encounters with his parents over the rest of the year and neither of them mentioned our first meeting. I was most certainly not going to bring it up.

On the last day of the school year, an awkward and loose-limbed Joshua came running and shouting my name down the corridor towards me. I turned to face his oncoming voice as he gently slapped an unwrapped slab of chocolate onto my chest with a broad smile. He thanked me for teaching him and told me that I was his best teacher. Proof for me yet again, that I do my best teaching when I'm doing my best learning.

## WHIRL WIND: WHAT IS REAL, WHAT IS NEEDED

Marshall Rosenberg devised a strategy for resolving conflict which he called Non-violent communication (Rosenberg and Chopra 2015). The pathway to finding a solution is for the two protagonists to be vulnerable enough to tell the other what their real needs are. Rosenberg says that once the one can reflect the others needs back to them so that they feel heard, a solution will then be quickly found. After using his work for almost twenty years, I realised that there are no rules in life other than those of the title of this piece. I have used and tested it in every way possible and have concluded that it works in every situation. It works in science, and it works in human matters. I refer to this approach as a whirl wind because the words are an acronym for WHat Is ReaL, and What Is NeedeD, and because it involves some real risk of vulnerability in an often-threatening situation, as well as that the solution suddenly appears as though out of nothing. Many of the pieces in this book have resulted from following the whirl wind approach.

Neither finding what is real, nor what is needed, is straight forward. There are so many things that can get in the way.

Possibly the greatest challenge to whirl wind a solution is one's inability to bear discomfort for more than a few seconds. While we still have possible strategies for finding a solution, we can still maintain our self-control, however, once we run out of options we will usually resort to the classic "fight or flight" responses. This is a simple story to illustrate the point.



When I was school principal there was a parent who wanted the school to fire the after-care teacher. She told me that the teacher is always rude, and she did not want her son exposed to this kind of behaviour. I asked the parent, child and teacher to describe any incident that had occurred, and nothing seemed clear enough for me to understand the situation, so I called in the parent to meet with myself and the teacher.

In the meeting, the parent kept accusing the teacher of various things related to her child but could not give anything concrete to back them up.

We sat for over half an hour trying to find out where the problem was and came up with nothing, while the tension and anger in the room grew worse. The only issue seemed to be that the parent was often late in fetching her son, but the teacher could not be blamed for losing her patience with this. Despite all my efforts, the parent kept speaking accusingly and angrily to the teacher, and the teacher was responding in an increasingly unapologetic, direct and confrontational manner. My own temperature was starting to rise at the complete lack of material substance where we could place our focus away from their growing personal conflict. If I could not figure out what was really going on I would not be able to do what is needed.

Not finding any helpful substance in the words of the parent, I did something I had not done before. I took the risk of not listening to her words, but to rather listen to what she was trying to say behind the words. Finding this alternative strategy helped me to calm down and become playful. This playful state quickly gave me a new thought that I now wanted to test. I put up my hands to stop the conversation and asked the parent if I could speak to the teacher on her behalf. I told her that I wanted to act out what I thought she was trying to say, and that she should tell me where I was going wrong. Would it be OK if I pretended to be her and address the teacher directly? She gave me permission, so I turned to the teacher, who I knew to have a strong nerve for receiving criticism, and said the following.

‘I don’t like you. Everything about you I find annoying and irritating.’ Seeing the ease with which the teacher was taking my personal attack, and the affirming body-language of the parent as she leaned in behind my words, I became more adventurous. ‘Your behaviour is so rough and hard that I always feel like you are being rude and uncaring. When I’m late to fetch my son it’s always because of factors out of my control. You don’t have to shout at me. Why can’t you just smile calmly and greet me, otherwise it just makes my own stress and frustration at being late worse. It makes me think that you don’t like me, that you don’t care about me.’

I turned to the parent and asked, ‘How am I doing?’ She beamed back at me and loudly acclaimed, ‘Yes! That’s it!’, as though my words had released her from her own restraint to say these exact words. I asked both if I could carry on and they said yes.

I now spoke softly, making up what I thought may be true. ‘Yet, as much

as I dislike you, I know that you do a great job in looking after my son because he always comes home happy and well fed. I wish I could be on time, but my boss is driving me crazy and if I don't finish what he needs I fear that I may lose my job.' The parent nodded sadly.

Now that we had established what was real, I moved in to say what I thought was needed. Still looking at the teacher, on behalf of the parent I said, 'I hope that you can be more understanding in future', to which the teacher eagerly nodded. And now, to create some balance to the solution I put myself further out on a limb and turned to the parent, still speaking on her behalf, 'And I will bring you something for the extra time that you spend looking after my son.'

The parent nodded warmly and looked entirely relaxed. She had clearly felt seen and heard. I stepped back and watched in amazement as the next five minutes, the last minutes of our meeting, were spent with warmth and laughter between the teacher and the parent. The parent left after giving the teacher a big hug.

Needless to say, I have used this strategy many times since. It's a great test for me to see how well I am listening as well as for getting to the rub of what is really going on.

A little whirl wind is always exciting if you have the nerve for it.





**EVERY GROUP IS UNIQUE**

## GRADE 9C

When I met Grade 9c, I had already been teaching for over twenty years.

This class presented me with several challenges, but particularly the challenge of personal energy. It was after my year with this class that I realised that I am getting too old to do the “heavy lifting” of being in a classroom all day and should move more into upper management.



Everyone in Grade 9c failed last term!

On the second day of the year the students of Grade 9c were already fooling around in class because they were already lost in the work, and we were only doing the naming of the parts of the body. This was enough evidence to know that this group of students had low academic self-confidence and self-esteem.

When you must work hard to get a group of students to learn, you need to draw deeply on your experience and find a way to make a connection with them so they can make a connection with the work. This involves lots of confidence boosting and motivating. Lots of positive feedback and personal conversations. Loads of repetition, repetition, repetition. Lots of focus and determination and being thoroughly prepared; but mostly, lots of hard work and trying to survive the lessons with as much dignity as possible. Sometimes even five minutes of learning in a lesson is a lot.

A glance at the timetable in the morning lets you know when your energies need to peak, so you build towards that lesson. You can't get them started as a class. The start means walking around helping everyone to settle and get ready. About five minutes of this and you may have the class ready if you have something interesting to show them. Otherwise, it helps to have a worksheet for them to work on individually. To actually teach for five minutes in a lesson is a privilege you won't often be granted unless you make an example of one of the students; the one who steps badly out of line first. Then follow these steps. Make a bigger noise than needed until everyone is quiet and listening to you act like a crazy person. This is the part that needs the most energy and if you are getting older you may need a few deep breaths and a short prayer in preparation. Move your attention from the poor target-student to the whole

class, letting them know just what they are doing wrong. Then soften your voice and apologise to the ones who are clearly working, 'I'm sorry that you should have to hear this. You deserve better than to be shouted at.' Carry on in a soft voice, let them know how much you appreciate their self-discipline, love of learning and all the other positive things that they do and that you want the rest of the class to do. Next comes the sad appeal to make their parents happy and proud of them by doing well and lastly, the loud and almost angry taking of the class interest and work ethic back to the work that they need to do, and to help them see that it is interesting and they will manage it well if they give it their proper attention. If you finish with a determined toughness you may get about half a lesson of good work from them. Do this about twice a week for the year, with slight variations, and you will understand the demands of Grade 9c.

I've just finished my last lesson for the year. I know many of them will fail. They took all my skill and experience and asked of me to learn more. I know each of their faces in the full range of human expression including sleep, crying, laughing, concern, anger, hatred, love, deviousness, lying, confessing... and occasionally with focus and thought.

As I shook each one's hand out the door, I felt the warmth and love of the year's efforts had not been in vain. As untrustworthy as they may be to work and pass the exam, I trusted them with my being and was rewarded with it being filled with memories and humanity.

What a shame it won't show on their reports.

## **SURVIVING A SURVIVAL CAMP WITH 'SHOPPING-MALL' STUDENTS**

This piece could alternatively be called, 'Is classroom science real?' or 'What do students believe about science if they don't experience it?'

I have often asked the students who are most engaged in my science class if they grew up close to nature. My informal surveys show that a surprisingly high number of them did. Unfortunately, the opposite also seems to be true. This story looks at one important occasion when urban students got the opportunity to feel an intimacy with nature for possibly the first time. This experience helped me to understand why so many students who have a close relationship to nature, love science.



As school principal, teachers of the Grade 8 class tell me that the students are starting to behave restlessly and carelessly among themselves, and disrespectfully towards them. From their teachers I get a full picture of their state of being and it seems that they are not being sufficiently physically and socially challenged. To remedy the situation, I decide to take them out on a survival camp, where all the comforts and luxuries of life that they take for granted will be removed. On camp they will need to use a wheelbarrow and large water containers to fetch drinking water, as well as to stack straw bales to create private areas to dig their toilets. They will also be sleeping in tents, cooking their own food and washing in a nearby river. In short, they will need to look after all their basic needs. The resistance from most of the class is shown on the day that I introduce them to the idea; I asked them to show with a thumbs up or down if they are keen for the trip. Only the three or four students who have been exposed to the outdoors are keen.

In preparation for the survival camp, we run through all the equipment that they will need as well as the plan for our time together. The most vocal of the class are who I call the "shopping-mall kids", the students who spend most of their socialising time in shopping malls eating ice-creams, playing arcade games and looking through things they like in the shops. The idea of this camp makes this group very grumpy indeed.

One of the key activities for the camp will be a night-walk where we will use the stars to orientate ourselves. For them to know what to look out for, I show them computer-generated visuals of what the night sky will look like when we are on camp. The shopping-mall kids chat away happily while putting dots on their page drawing the constellations of the Southern Cross and Orion's Belt which will be used to find north, south, east and west.

We arrive at our campsite, an open field next to a river, in the afternoon and set up camp. Once all is in place I gather them to remind them of the camp expectations and then release them to make their dinner before dark. By the time darkness has fully set in, most of them have finished washing their dishes and are going in small groups to the toilets and doing their final ablutions before going to bed. At this point I hear a thirteen-year-old girl call out my name excitedly. She and her friend come running up to me shouting, 'It's real! It's real!', while pointing to the constellation of Orion. They are clearly amazed that it actually exists. They then excitedly search for the Southern Cross and hug each other with furious joy when they locate it. They now ask me for instructions on how to use the stars to find north. In the process, I realise that these students had drawn the diagrams in class without the notion that what they were learning was real in any sense. I am shocked to think that these students would possibly have experienced the science content as forever detached from their wreality had we not done this camp.

During the camp, the class enjoy many walks in nature, swimming in muddy dams, doing their business in a self-dug toilet, washing and swimming in a river, negotiating whose turn it is to fetch drinking water and fuel and cooking their meals.

One unexpected additional challenge that we face is a fierce thunderstorm on our last night. It keeps us all busy trying to stop the tents from being blown down, and once it has passed, trying to dry ourselves and our belongings in front of a bonfire.

After breakfast the next morning, we gather around a small fire for our final reflections and goodbyes before the school holidays. During the session one shopping-mall boy emotionally declares,<sup>5</sup> 'I feel like I have been a prisoner in my house my whole life. I thought that everything in nature wanted to attack me, but nature is more of a home than indoors could ever be.' As we say our

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5 This is my recollection of the concepts he said.

goodbyes, it is the shopping-mall kids who can't stop crying and hugging each other.

I realise that they probably don't understand why they are crying. I believe that they are crying because they have never experienced a liberation from the luxuries of life; having never previously felt that they have something of consequence, something important and meaningful to do in their daily life. I also think that they were ready to practice being independent from their parents and other support systems. Mostly, I think that they experienced an intimacy with nature, the home of our true nature, and are scared that they might forget it.

## PACIFIC ISLAND AND MĀORI STUDENTS PLAYING RUGBY

The following story shows the impact of forming a positive relationship with students in my mathematics class.

People are always interested in forming relationships with others. In 2010, I moved to a new school in New Zealand and was given a particularly challenging Year 10 [fifteen- to seventeen-year-old] mathematics class, where almost every student in the class had already developed a negative attitude to the subject. I had worked very hard to get them to be positive in class and it came to my help in an unexpected way in the following story. At this stage I had only been teaching at the school for about two months.



One day, while doing break duty, my attention is drawn to the rugby field because my teacher-instinct recognises a quality that sounds like trouble. I see that the older Māori and Pacific Island boys have decided to play a game of rugby against each other instead of having their usual mixed teams. These young men are huge, much bigger and more powerful than me. I can see how the tackles are becoming more physical and the mood on the field is becoming more personal and serious. I look around for another teacher, preferably one of the physical education teachers who are bigger and who have worked with these young men before. Seeing no one to call, I must decide to either run for help, firmly believing that a fight will have started before I can come back, or risk life and limb to try and stop the game before it gets out of hand.

I decide on the latter and stride onto the field, loudly demanding that they give me the ball. These huge young men at first don't even see me because of their focus on the opposing team. Only when I start physically getting in their way do they even notice my presence. I am so small and insignificant that they initially don't know what to make of me as I have no hope of stopping what they seem to have in mind. Soon, however, they start to laugh as I walk towards each person holding the ball who then passes it to someone else. I realise that I am having success when these young men start passing the ball between Māori and Island players.

A tall, handsome and powerfully built Island boy from my Year 10 mathematics class comes forward. He puts one arm around me and gives me a patronising, but warm rub on the top of my balding head, saying that I should not worry, that nothing is going to happen. This makes everyone laugh and the final tension between the two sides disappears as they step out of their racial warrior-trance. I then get the boys [they no longer seem like big men] to mix up the sides before I allow them to continue playing. The teams mix without any resistance.

I did not intentionally allow myself to be the joke, yet that seemed to become the catalyst that enabled the boys to let go of their hardening racial and warrior identities. I had to let go of my pride and keep focussed on my primary intention to achieve what initially seemed impossible. It also did not escape my notice that both Pacific Island and Māori culture are steeped in indigenous and religious worldviews, and that the human warmth that re-emerged so readily on the field will be at least partly as a result of this.

## TEACHING PRACTICAL: LEARNING FROM TWO SCHOOLS IN WYNBERG, CAPE TOWN

In 1986, when I was studying for my teaching diploma, South Africa was still under the laws of apartheid. I deliberately chose to do my practical training in two schools that were fairly close together, about three and a half kilometres apart, where one was a white school and the other a Coloured [mixed race] school. This story is not intended to be a political comment on the times, but rather to present aspects of the different lives of white and Coloured high school students in the middle of the 1980's as I experienced them.



In 1986 I went on my first teaching practical experience to Wynberg A, which, at the time, was still a school for white boys only. This school is situated in the southern suburbs of Cape Town, similar to the school that I attended, and it still carries a very proud tradition of excellence in sport, academics and raising English gentlemen who will become the leaders of South Africa. Such schools are as important for making friends and knowing how to meaningfully interact within a specific class structure in society as they are for developing academic and other skills.

At Wynberg A, I taught the mathematics section of exponents to Grade 8s. I thought that the section was straightforward, and I taught them the work so quickly that I confused the entire class. I soon realised that teaching mathematics and science would require me to break everything down to its basic and fundamental components and as much as this is hard work, I could see the immense value of it to understanding everything. I slowly developed the patience required to build each topic up from first principles and still feel grateful for this skill in wrestling for my wreality.

I did my second teaching practical at Wynberg B, a Coloured school no more than a few kilometres from my first practical. Apartheid laws divided Wynberg into two, with the Coloured area being close to the relatively wealthy white area. At this school, I met a very different world, one where some teachers were often late for school, the principal seemed to lack authority and where one teacher, an elderly white man, seemed to only come to school

about twice a week and was drunk when he was there. While I was teaching at this school, the students embarked on a school boycott because the education they received was seen as an “inferior form of education” imposed on them by the apartheid government (South African History 2011).<sup>6</sup>

After a day of tension with police due to student boycotts, to settle the terrible restlessness of my students, I got my class to lie down on their backs on the floor and close their eyes. I then took them on an imaginary, peace-making journey up into the air with family, friends and enemies, including the police and protesters. It took a few minutes to settle the class, as the initial restlessness turned into laughter at this ridiculous exercise, before they could settle into experiencing the seriousness of the activity. In the process I could tangibly see how they shed their high levels of anxiety for a more grounded state. Once I had them in the air with Table Mountain to the one side, they could embrace each other and gain some perspective. I had never done anything like that before, but their shift in mood encouraged me to go as deep as I thought was needed. Many of the students who were reluctant to trust in what they were asked to do at the start, were among those who did not want to leave when the lesson was over. Comforted and strengthened by the exercise, many students then shared their real fears about the future. This exercise enabled me to see the potential for using imagination in education as well as in how to create a space to help students process their trauma and develop an integrated wreality.

One day after break [recess], the entire school body was urgently called to the hall. The principal addressed the school, informing the students that they would be asked by the SRC [Student Representative Council] leader to boycott the school in commemoration of the 10-year anniversary of the 1976 Soweto student uprising (South African History 2011). The school principal encouraged the students to stay at school, however, he did not give them any reassurance or support to help their decision-making before walking off the stage. The students were then addressed by the leader of the school’s SRC who, shouting: told the students that they should boycott school. Many students left the hall in a state of bewilderment, looking for some way to make sense of what was going on and what to do. The younger students felt particularly

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6 This piece is not a general comment on the times, but rather a reflection of my personal experience at that time.

insecure. They could not get advice from their principal or teachers as they had effectively gone into hiding in the staff room. I reflected later that this was probably because they had been traumatised by earlier boycotts and violence. I found myself as the sole adult in a sea of uncertain students desperate for some guidance. Some students gathered around me, and I tried to facilitate their needed conversations so that they could decide in freedom what to do as they wrestled with their young wrealities.

Thinking back, now almost 40 years later, I can see how my journey to become a teacher was set within a much bigger context than I was aware of at the time. While at Wynberg A, I did not even think about the management of the school or politics, because these were as I had experienced them in my own schooling career, and I took the discipline and structures needed for unencumbered learning for granted. As a result, my main learning had been about how to improve my academic teaching strategies. At Wynberg B, my main learning was in developing a more personal engagement with student wreality and in helping them manage their anxieties.

I experienced, through the very different challenges faced while teaching in these two schools, how important the context for education is in determining student and teacher wreality.



## **NO. 8 WIRE**

Number 8 wire in New Zealand has the reputation of being able to fix anything in the hands of a no-nonsense, understated practical Kiwi bloke. This can-do kiwi culture came under attack politically during the South African rugby tour of NZ during the anti-apartheid era, because it ignored another deeply rooted Kiwi cultural norm. This was the sense of responsibility to take care of others who are in need.

The moral imperative to show rejection for apartheid came up against the view that sport and politics should not mix. The strength of feelings that this caused tore the fabric of many families apart and set up a culture of political legislation that would limit the creative spirit of being able to fix any problem with creative resolve and the attitude of, “she’ll be alright”.

This poem captures the drama between these two cultural attitudes and was written after living in New Zealand for a few years and after developing a deep love and respect for the “Kiwi bloke”.

### **No. 8 wire**

It was the problem solving, creative plan  
With real needs in a tough world,  
From fence to house, church, gun or plane  
That earned for number eight a name.

Was it that he could not evolve  
From sport and practical resolve,  
The fiery spirit, the warrior creed,  
To meeting of more subtle need?

Or was it fear and apartheid  
That turned the tide ‘gainst number eight?  
But few are now with time to think  
Who don’t feel loss to see him sink.

Queen and country now legislate  
The time and place for number eight.  
His initiative being carefully tied  
To fit in with her party line.

## THE YEAST FOR CULTURAL ENRICHMENT

This piece, like the previous one, is not directly related to science or teaching, but tells of an experience that opened my heart and mind to an aspect of the broader culture in which I lived and taught. At the time of this experience, I was teaching in a multiracial school in a traditionally wealthy white suburb in Cape Town but lived in a middle-class suburb in a traditionally multiracial area.



In 1993, I live in Observatory, Cape Town, and often take a third-class train and minibus taxi to work. Both modes of transport are used mostly by Black workers as they are cheaper. Further, although the laws have changed, under apartheid the first-class carriages were reserved for whites only.

I know that if I take a particular third-class train carriage on my way to work there will be a Christian church service there. This carriage is easy to find because of the singing and rhythmic beating against the side of the carriage. The singing speaks of pain and redemption, of healing and blessedness. One song rolls into the next as the leadership falls on the one who is inspired with the next piece. The congregation and its leadership flows on and off the carriage as we pass station after station. Sometimes a man will break the music with a prayer. If he carries on for too long, one of the women will politely take up a theme of what he is saying in a new song that then starts up mid-sentence. The twenty-minute train ride takes me into a different world. My heart soars with the humble spirit of release into freedom. Even though I am the only *umlungu* [“white person” in isiXhosa] in the train carriage, I never feel conspicuous.

From the train, I accompany some of the women into a mini-bus taxi for the last leg of my journey. The taxi will drop me off opposite my school, but on the way the women disembark to work in white homes in the wealthy suburb. I feel the power of these love-bearers as a healing yeast being folded into my white English culture. I think about the white children who will receive this love, and about the women’s own children who have been left at home, or

who perhaps live with their grandmothers back in the Bantustan of Transkei.<sup>7</sup> Everything about me is changed as I leave the taxi to go and teach. I feel like a bigger person because my wreality has expanded and deepened.

Despite it more than doubling my time to work, it becomes my favourite mode of transport and gives me memories for life.



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7 The Transkei is one of many large areas that the apartheid government had set aside for Black people to give them a rural life away from the city. It was their way of separating whites from Blacks. Transkei, the Bantustan where Nelson Mandela was born and grew up, is over 1 000 kilometres away from Cape Town. It is in the Eastern Cape, from where many of these Xhosa women came. Job opportunities were far and few between in the Eastern Cape, and at the time of writing, is still an impoverished area.

## MENTORING THE NEW XHOSA TEACHER

In 1994, the year of our first truly democratic elections in South Africa where Mandela was elected president, I joined the school management of a Waldorf School in Cape Town. Most Waldorf schools do not have a single person who acts as the head teacher or principal and makes all the important decisions that affect the school. Instead, they have a body of willing senior teachers known as the College of Teachers, who take on this role without any financial incentive. This was the case when I joined the management team. I was highly idealistic and was given a lot of opportunities to develop my leadership and mentoring skills. The following story tells of my very first mentoring of a fellow staff member.



In 1994 I am on the management team of a Waldorf school in Cape Town. This school was always a non-racial school and as a result, suffered financially under the apartheid government. This resulted in the school being too expensive for most Black students, however, many were able to attend through bursaries. Ironically, in post-apartheid South Africa, the school is now regarded as a privileged white school and still suffers from a lack of government funding. Despite this, the school management have worked hard to create opportunities for Black students and staff to join the school. One great effort was to get a Xhosa person to teach the language.

The school now has a new Xhosa-language-class teacher, Sandy. She is the first Black teacher at the school and things have not been going well. Several senior staff have already tried to help her adjust to the school culture and failed. In our management meeting the teachers lament that their years of trying to get a Black Xhosa teacher have failed, and that they may now need to start again from scratch after only months of her teaching. Despite being new to the management team, I volunteer to help.

I arrange with Sandy to visit her while she is teaching and am sitting with the students in their class before the start of the lesson. In this school the students stay in their classroom and the teacher's move around from one lesson to the next.

As Sandy walks into the classroom I immediately notice that she gets shocked into frozen disbelief that the children do not automatically respond respectfully to her presence. They had been moving freely around the room prior to her coming in and simply carry on with this behaviour when Sandy enters. I immediately intervene. I had heard how well her classes sing, so I approach her and advise her to leave the room again, and to sing one of the songs that she has taught them when she returns. She looks at me as though I am crazy; but does as I suggest. As she starts to sing, the class spontaneously sing along so that they are at their desks and ready to learn by the time the song is done.

She now looks at me with great confidence because I have helped her to understand how to structure her lessons so that everyone is happy, and the children are learning well. After working closely together for several months, towards the end of a particularly rich mentoring session she says with great earnestness, 'Philip, God loves you very much.' I know that this is her way of expressing her gratitude for the insights she has gained through our work together, but I also know that she has seen through me and believes that she has found the source of the Presence that helps her in her work. In that moment I look back at her, and seeing her complete confidence, I fully trust and believe her. I have come to trust that this is something that she would know, so I feel truly and completely unconditionally loved for the first time in my life, thanks to her.

Sandy and I work together for a few years, with me gaining much from our time together, and she growing in enjoyment and success as a teacher at our school.



## WHAT HAS TECHNOLOGY EVER DONE FOR US?

We all want to have and use the latest technology. It solves so many problems and makes life easy. It helps us in every conceivable way, and all of humanity benefits despite it transforming every culture and natural environment that it dominates.

Technology has improved our health, quality and length of life and opened doors to so many new opportunities. It has given us the gifts of easy access to quick and affordable transport, long-distance travel, planetary-wide instantaneous information and communication, entertainment from the greatest artists of all time and so much more. We are now able to fly, run and swim faster than any creature that has ever existed. We can go where no creature has ever gone before and live relatively comfortably in hostile environments like Antarctica and outer space.

Machines have changed every aspect of our lives and world. So, what is technology, and how can we understand its true nature? As you read what follows, try to imagine technology as an invisible person who uses us to manifest itself in the world. See if you can picture not just how it works, but also what it would look like if it had a physical body of its own.



It is our use of technology that originally set us apart from the rest of nature. We have never been the strongest creature on earth, but our use of tools made us the most powerful. The group with the best technology has always been able to dominate not just nature, but also other groups. These technologies were then copied and improved upon by others who later took power. Over the millennia we have found ways to use a greater variety of materials to make stronger and better tools to solve our challenges. Soon, our survival challenges were not the main driving force for new technology, but rather our imaginations, wishes and desires to be able to do things that we could not do before.

Many limitations to unfettered technological development were lifted in the 1700's in England. Society there had become structured so that the

rule of law, banking system and level of scientific and business education among the middle classes made it possible for them to use their initiative to start businesses (Harari and Perkins 2014). This gave them access to secure funding and materials to develop machines that would make it possible for ordinary people to have access to the luxuries that were previously only for the nobility. They did this by mass-producing the work of skilled artisans at a fraction of the cost. In so doing, the standard of living of everyone was ultimately uplifted.

In the process it put the artisans and cottage industry, where poor people could have a bit of an income from making and fixing shoes, clothing, baskets and so on, out of business. It gave a new kind of work to those who were now starving from a lack of income. These folk were used in factories and mines and parents were sometimes driven to send their young children into the cities to work. This made British society the first to be completely transformed by the industrial revolution. In response to the social disintegration of rural communities, the educated wealthy in conjunction with the impoverished workers began creating laws to protect the factory workers from total exploitation. In the process, labour laws and eventually human and environmental rights became established. Public education systems also arose so that our technology could have people educated to make it function efficiently and grow. And all the while it was ordinary people who poured their money into the industrialists' pockets because they bought the products.

England was the first country consumed by technology but was quickly followed by the rest of Western Europe and then America. When labour laws in Europe made production too expensive, the powerhouse of the Far East stepped in. First it was "Made in Japan". When their economy had grown sufficiently enough to again make labour too expensive it became "Made in Taiwan". Then "Made in Korea" and now, "Made in China". Already we are seeing the shift to "Made in India". I wonder if we will ever see "Made in Africa"?

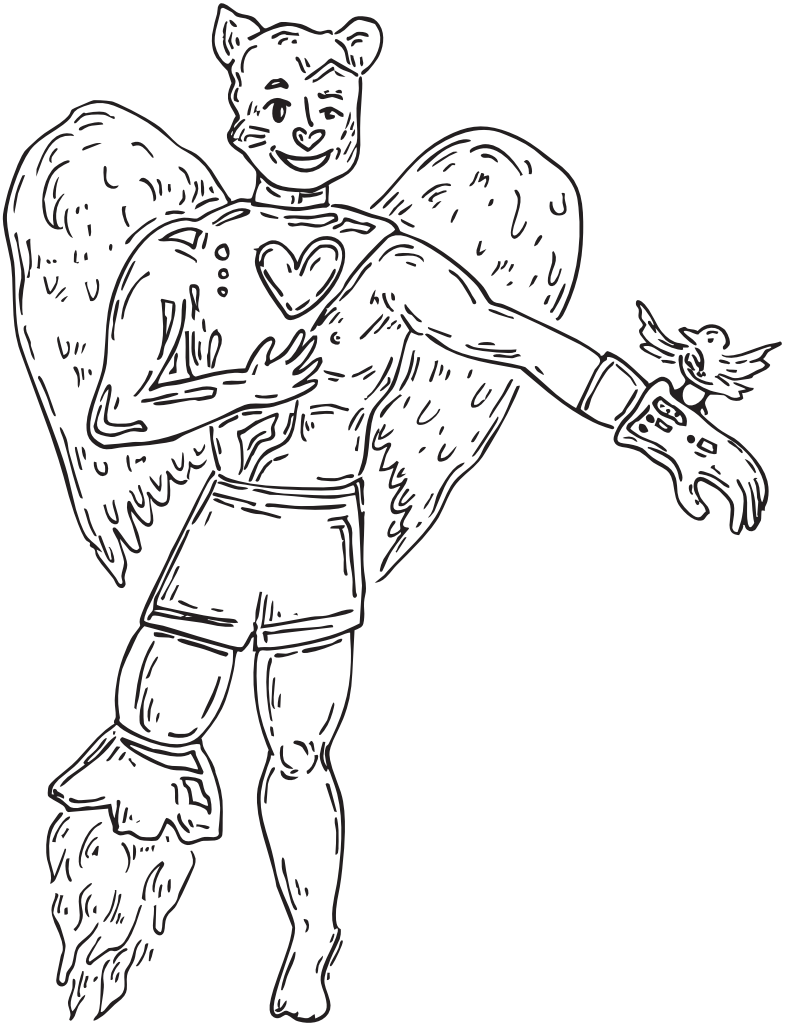
By now we can see how technology moves across the globe shaping societies as they seek the empowerment that it gives. When I was much younger, I can recall adverts saying how the vacuum cleaner and other appliances will do the work for us so we could have more time to do the things that we want.

Instead, what has happened is that the speed of technological development has forced us to work faster to stay competitive. Instead of helping us to slow down and enjoy life more, it has made the pace of life faster to keep up with it. It also meant that we spend more time with technology than with other people or nature. It not only takes our time and makes us work faster, it also demands our attention.

But what is technology's goal? What is it ultimately creating? By imitating and improving all that we can do, is it getting us to create a Superman? Up until recently it has been getting us to create its body; the physical parts that can do all and more than we can. With Artificial Intelligence [AI] we are now able to give these bodies minds. At the time of writing, it is already possible to create an online avatar that looks and talks like you. It will not be long before we can give these avatars physical bodies that even look like you. It is more than likely that the ultra-rich will create several avatars that will not just look and sound like them but even think like them. This is because AI can think better than any of us, and with access to almost all human knowledge, they will become more powerful than us in every imaginable way.

Science fiction has long depicted a scenario where humans become subjected to the domination of our own technology. By following the journey of our reliance on technology, we can see that this idea has possibly been there from the start, and we continue to be willing subjects in its great project.

What if this is true? What then should our attitude be? Technology has been with us from the start and it is here to stay. We owe it a debt of gratitude for its service in making us the most powerful and productive creature on earth. The being of technology may have its own intentions, but we need to keep improving on what began in caves when we developed the tools to ensure our survival and domination of nature. When technology moved into the age of mass production in England, we responded by protecting humanity with labour and environmental laws, human rights and public education. We just need to keep adapting, making sure that our lives do not become completely subservient to technology. And we need to make sure that our relationship to the worlds of nature and the liberated human spirit remain strong and healthy. There has always been a time-lag between the establishment of a technology and our appropriate response to its effects, but we are a pretty smart species and I'm confident that we'll figure it out.



## RUGBY LOYALTY

Developing a sense of loyalty is a very important part of being human. As we grow up, we expand our loyalties from our parents and family to our family friends, school, town and nation. We also develop other loyalties, towards our religious, language or cultural group and so on. When we travel or are exposed to groups other than our own, we begin to open ourselves to the meaningfulness of each group, and our blind loyalty towards that from where we come, can start to loosen its grip on us. At some point, for many of us who expose ourselves to significantly new experiences, we start to transform our idea of loyalty from groups, individuals and inherited beliefs, towards ever greater values and ideals. The study of science has definitely played its role in helping us to mentally break free in this way. It seems to me that this is how culture changes.

Sport is often where our loyalties show themselves in a relatively unfiltered manner. The following two stories about watching rugby, share two very different experiences of loyalty.



When I was about 37, I moved to Wellington, New Zealand, to teach in a Waldorf school, known there as Rudolf Steiner schools. South Africa, New Zealand and Australia, are all strong rugby nations, and so there is much rivalry between them. As the only ‘Saffer’ [the New Zealand/Kiwi and Australian/Aussie term for South Africans] on the staff, I was invited to be the representative voice among my Aussie and Kiwi compatriots.

I thus joined the crowd in a local pub to watch the Rugby World Cup final between England and Australia in support of my Aussie buddies. By this time, I had been living in New Zealand for two years. While talking to a friend, my heart suddenly physically leaped with expectation in my chest, and I could not figure out why. I searched for the source of the stimulus and saw that a television was visible in my peripheral vision up to the right. I looked up at it just in time to see the South African flag passing off screen as the camera panned the flags of all the nations who participated in the cup. I realised that this was the cause of my heart-leap. My subconscious had seen the flag and

jumped with longing at the sight.

I was amazed at three aspects of this experience. The first one was that my body had responded to the stimulus without my conscious mind playing any role. The second aspect was to realise how powerfully my subconscious was attached to my identity as a South African. And the third, and related aspect, was to become aware of how much my subconscious was physically missing the familiar symbols of “home”.

After nine years of living in New Zealand, in 2012 I moved to Pretoria, South Africa, an inland city that I had never lived in before. I had always lived in predominantly English-speaking cities, and this was my first time in a predominantly Afrikaans-speaking one. I was at a social gathering with Afrikaans friends and relatives of my partner. There were approximately ten of us gathered in the lounge watching a rugby match. The women were chatting elsewhere while we watched the Stormers, who come from Cape Town in South Africa, playing against an Australian team. Having lived in Cape Town for most of my life I was naturally supporting the Stormers.

Initially I was shouting for the Stormers, but when the Australian team played some outstanding rugby, I applauded them loudly and appreciatively. After about ten minutes of this change, where my fellow watchers were quiet because the local side was now losing, one upset and angry watcher shouted, ‘Philip! Have you no loyalty man!?’ I looked at him, paused to process the question and the pain with which it was asked, and then quietly replied, ‘Yes, I am loyal to good rugby’. The questioner stared at me in silent disbelief and the matter was left in peace, never to be spoken of again.

I later realised that by living in New Zealand for so many years, and then living in Pretoria, my sense of loyalty had adapted. It seemed to recognise more than just the support for a single team, but also an appreciation for the game that brings teams together. It is, further, more than possible that my work as a science teacher, where I am forever encouraging my students to develop the power of abstract thinking, has played its role in being able to move my loyalty from the particular to the universal. To move my loyalty from my team to the game that brings the teams together.



## **XHOSA COLLEAGUE STRUGGLES TO CONCEIVE**

In 1993, I work in a Black township education centre in Gugulethu, Cape Town, on Saturday mornings. I teach nine- and ten-year-old children reading, writing and mathematics. I work alongside a married Xhosa woman who is struggling to fall pregnant. She invites me to accompany her and her family to a river near their home. Here, many Christian and African traditional prayers are said, and she is submerged into the river to help her conceive.

We all travel back to the house of the couple where she then enters a hut that has been built solely by her husband so that she becomes surrounded by his influence. The intimacy with nature with the relevance of the flowing river as the act to open her womb, and the husband-made hut as the act of her being fully taken up by her husband in these rituals, moves me deeply as I can immediately recognise the logic and power of each. It resonates with my own deep relationship to simplicity and nature. The couple say they are Christian and yet they have chosen this traditional ritual to solve their practical dilemma. Although many around them see the couple's choice as a contradiction, I am impressed to see how they embrace a holistic wreality that includes their indigenous practices and religious beliefs.

This experience makes me realise that I do not have an indigenous knowledge base to draw from as my world was already permeated by rational, objective thinking when I was growing up. On a cultural level, my English-speaking world had already lost its connection to indigeneity.

I recognise the roles that nature and science have played in filling this gap in my life, and can see how thirsty my wreality is for a renewed intimacy with nature and spirit.



## **CAN SOMEONE FAR AWAY SEND LIGHTNING TO STRIKE ME?**

During a second-year university natural science module, a student asked whether someone in Limpopo could send lightning to strike someone in Gauteng, over 100 km away. In the lecture I had been teaching about weather conditions and how they are caused, so the question was not totally out of context. Many students in the class laughed at this, not because they thought it was ridiculous or funny, but because they were familiar with some of the local beliefs about this.

Evholution tries to find the links between different worldviews and belief structures. It uses scientific inductive, enquiry-based, critical thinking strategies to address the non-physical evidence of human experience. This approach makes all kinds of religious and indigenous questions welcome in the class. It encourages students to make broad associations with what we do in class, while also inviting them to think critically about their own beliefs.

Our discussion resulted in about ten students of various religious and indigenous backgrounds staying behind after class to discuss it further. This conversation gave the students an opportunity to share their beliefs, ideas and fears in a spirit of true open-enquiry, hence, the approach that was used met the need of the affected student as well as others.

About one month later, I recalled that the question had previously been raised at a meeting between students and the science faculty at the University of Cape Town during the fees-must-fall drive to decolonise education (Schultz 2016). When I realised this, I began to think that perhaps this question has become a bit of a “litmus test” for students to assess the scientific prejudice of older white lecturers like myself. I then asked the student if this was the case and he said no, that it was sincerely asked as it was of real concern to him.

At the time I was only able to raise a limited response to the opportunity presented and have now included more substance to what was said from further conversations with this student and his friends. The conversation below is an embellished summary of the ideas that have been shared in ensuing discussions. I’ve included stories related to telepathy and prayer as well as researched cases of near-death experiences and reincarnation, so be

prepared for an extensive ride through a range of ideas that may challenge your beliefs or sensitivities.



‘Philip, is it possible for someone in Limpopo to send lightning to strike someone in Gauteng?’

I respond with, ‘Do you mean like Thor, the Norse god of lightning?’ The class laugh, but the student ignores this and answers, ‘Yes.’

‘What an interesting question. What do you all think? Who thinks this is possible?’

About five respond with a ‘yes’. Then I ask how many think that this is impossible, to which about seven respond with a ‘yes’. Most of the roughly 70 students do not put their hands up.

I continue, ‘There are a great many indigenous stories about the beings who are responsible for thunderstorms. These stories come from all over the world. In New Zealand the name for this being is *Tāwhirimātea*, who casts storms on the earth in fury at the separation of his father *Ranginui*, who has been forced into the heavens and his mother *Papatūanuku*, the earth. The belief in nature spirits as beings who stand behind all natural phenomena is truly universal in indigenous cultures, so let’s not think that this is just a local question. Besides, religious texts also describe God making lightning, often to express his anger and judgement, so let’s tread respectfully here.’ [See the piece, *Seeing the music dragon*, that follows.]

‘But this is a science class, so let’s try to ground our discussion with a scientific approach. We will need to look at data that goes beyond the norm in science, but a reasoned approach is needed. OK, let’s first clarify the question. Essentially, I think that you are asking whether someone can decide to make lightning occur at a specific place and time by using their mental powers, yes?’ The student answers with, ‘Yes.’

‘In that case, let’s broadly examine how the mind makes things happen. Firstly, we can take the obvious example of moving our hand, or walking. This is a mental decision and our body moves. Science has studied the working of nerves and muscles, but are you conscious of how we make this happen, of how the mind knows which muscles to move?’ The whole class responds

with, 'No.'

'So that's interesting. We can understand the mechanism of our body, but not the link between our conscious mind and our body. In medicine this has been studied to a degree with the placebo effect, where they found that if a person believes that a medicine will help them, their healing rate is significantly better than if the patient does not believe it (Bausell 2008; Colloca 2018). It is so powerful, that when new medicines are tested, they are regarded as effective if they work better than the placebo effect. So, the mind-body system is real and the mind can make things happen to the body in a way that is different from just moving our hand.

'Many people believe that prayer and positive thinking can be used to help other people to heal faster. These are all non-physical interventions where the mind makes something physical happen, but this time they happen in someone else's body. There are also many people who experience the presence of others who are far away. For example, a colleague of mine who lay close to death from Covid-19 for about a week, told me that while she was unconscious in hospital she could hear the voices of people praying for her. Some of the voices she recognised while others she had not heard before. At that stage nobody was allowed into the hospital to see her, so she must have been mentally in a place where "prayer is heard". It is possible that it was just a delusion. But she was sharing a real experience that she had, and she had no reason to create such a fantasy to share with her loved ones and myself.

'I believed her because I had once had a related experience. As a grown adult, someone did something annoying to which I responded like a childish teenager. I was so bitterly disappointed at my behaviour that I went into a quiet place and inwardly cried out in despair at being so easily reduced to behaving like the frustrated young teenager that I had been 35 odd years earlier. About five minutes later I received a WhatsApp message from my daughter in New Zealand asking if I was alright. She had had a very real dream of me being in severe pain and in need of help. I was in South Africa at the time. This was most unusual for her, so I can only assume that she somehow perceived my distress in that moment. If she did, this would be a form of telepathy.

'And there are people who have studied telepathy scientifically. Very recently, a series of podcasts called the *Telepathy tapes* have been published where researchers Ky Dickens and Dr Diane Powel present their research

into telepathic communication between mostly non-verbal autistic children and their parents as well as with each other (Michels 2025; Powell and Williams 2024). While these researchers are having their work called a pseudoscience by members of the scientific community, if the many cases that they researched are true, then the bridge between minds of living people may be more common than many of us think. And it is not just telepathic communication between humans that has been reported upon. There are also many folk who claim to communicate with different kinds of animals, with many of them reporting tremendous success in their work (Breytenbach 2015; Del Monte 2020; Williams 2005).

‘All the above stories are personal anecdotes, but that is the only way in which to explore human mental experiences. Our materialistic science cannot speak for the experiences of the mind, so we need to rely on people to share their stories. And they help us to see how one mind may be able to communicate with another even over long distances.

‘Some further research that may help us to answer your great question, is on near-death experiences, or NDEs. NDEs are experiences that some people have when they come close to death and experience themselves outside of their bodies, seeing and hearing things while their bodies are lifeless. People who have these experiences mostly report having a feeling of blessedness and love beyond anything from previous experiences. There is usually bright light that somehow does not blind them, and a feeling of love that is often associated with a burning fire that is so extremely pleasant that most folk want to stay there and not return to their body (Gardipee 2014; IANDS 2017; Ritchie and Sherrill 2007). The research into NDEs covers a varied enough set of cultures, beliefs and backgrounds to know that they are not copy-cat reports. The accounts also contain enough variation to again verify that these are not derived from the same sources. What makes NDEs relevant to your question is that they can be thought of as presenting the possibility of our mind existing independently of our body. In none of these cases, however, have I read of someone making something physical happen, so we must look elsewhere for the mind to engage with matter beyond its own body.

‘An idea that may be even more difficult to grasp than sending lightning onto someone’s head, is reincarnation. Well over 100 cases have been studied of children who recall being someone different in a previous life (Irwin 2017;

Kelly and Kelly 2008; Tucker 2008, 2021). This is an interest of mine, and I recently found a case of a Swedish Christian woman claiming to be the reincarnation of Anne Frank, who is famous for the diary that she wrote before being murdered by the Nazis in the Second World War (Kelly and Kelly 2008). In her case as in many in the west where the idea of reincarnation is uncommon, her parents initially thought that she was crazy.

‘This is not unlike people who think that sending lightning is crazy, yes?’

‘Eventually both her parents found enough evidence to believe that their daughter was in fact the reincarnation of Anne, but her father, as a devote Christian, understandably really struggled with this.

‘There are also recorded cases of boys who reincarnate as girls and vice versa, but there are no recorded cases of people having been animals. If reincarnation is true, then not only can the mind move free of the body as in NDEs, but can “bond” with different bodies as different people, like some kind of avatar.

‘But let’s go back to science for a moment to see if there is a way to make things happen at a distance. Most people have cell phones and remote controls for televisions, and each of these can make things happen over a distance. If I phone you, your phone will ring. Science has made this possible because we understand the mechanisms for the action. But there are also ways in which communication happens which science cannot detect. Quantum entanglement is where two particles become entangled, so that a change that happens to the one particle will instantaneously affect its entangled partner. This has even been tested with particles that are over 1 200 km apart (Yin et al. 2017). What strikes us with quantum entanglement is that we have physical objects that become intimately connected and where a physical change in one makes a physical change in another and yet science cannot detect how the communication takes place. Here we see a physical change taking place over a distance.

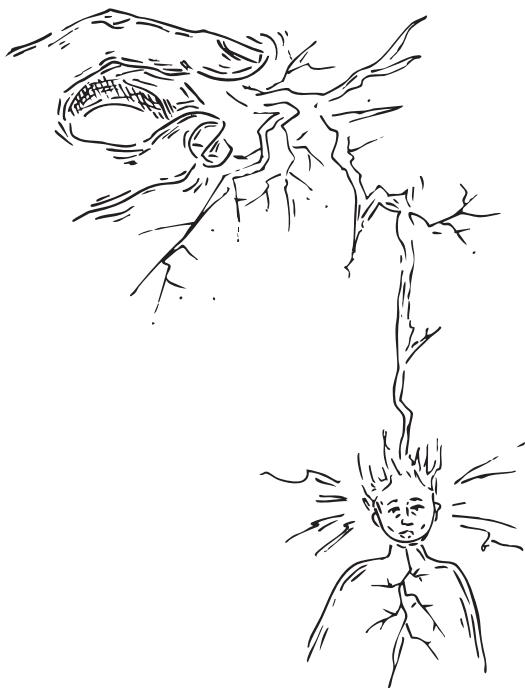
‘And science has another great unknown in how matter can be influenced by substances that cannot be detected. Science is aware that galaxies behave in ways that we cannot yet explain without imagining two substances that we haven’t found; dark matter and dark energy (Perlov and Vilenkin 2017). The effect of these imagined substances is so powerful that scientists believe that they make up over 90 per cent of our universe. This is a case where

something non-physical has a powerful effect on matter in ways that we do not understand.

‘To conclude, there are many things that people are working on that can help us to understand more about the mind-body or mind-matter relationship. So, is it possible that someone can send lightning to strike someone else? You will need to decide for yourself. You must decide if the ideas we have discussed, or if there are other related ideas, that can help you form a plausible link between the mind and lightning to make it happen.’

At the end of our discussions the boy who initially asked the question shared his real motivation for asking. He said, ‘I don’t want to believe it. I don’t want someone else to have that kind of power over me.’

I was pleased that he felt confident to raise his initial question in a science classroom and that he had the humility to share his vulnerability that someone could have this power over him. I was, however, left thinking that, in my scientifically minded quest, I may sometimes miss the point completely.



## SEEING THE MUSIC DRAGON

In some of the stories that have just been told, indigenous, religious and scientific worldviews have been engaging with each other. Here is a story of a personal experience that convinced me that the nature spirits described in indigenous wisdom and fairy tales are non-physical, but real (Grimm and Grimm 2016; Mutwa 1964; Royal 2005). Most cultures have stories of fairies and other non-physical creatures who are mostly our helpers, but who can also be our enemies. There are also modern folk who claim to be able to communicate with the spirits of animals or “fairy-tale” type beings (Breytenbach 2015; Crombie 2018; Dispenza 2019; Erickson 2011; Helliwell 1997; Loy 2016; Weirauch 2004; Williams 2005). The story that follows is the only occasion where I personally experienced a non-physical being of the type mentioned in many indigenous stories.

I am not sharing this story to convince anyone of the existence of nature spirits. I am sharing it because as educator researchers we will work with students who may have had similar such experiences or hold a related indigenous belief, and it is our job to be open and respectful to that. The reflexive process at the end of the story is given as another demonstration of the rational approach that can be brought into a discussion of such experiences. This was already done in the previous piece titled, *Can someone far away send lightning to strike me?* The idea in the current piece that we project our mental images into the space around us will be expressed in a more scientific form in, *A dark and silent world*, later in the book.



Sharon is a dear friend and classical musician who plays the piano and viola with various groups and orchestras. Working with others in the making of music can be very challenging, but sometimes the musicians become so comfortably immersed in making music together that something extraordinary happens.

Sharon was on the piano accompanying a violinist during a concert at a new venue in Wellington, New Zealand. As always, listening to them play

was a liberating experience that took you on a journey through breath-taking vistas, dramatic transformations and deep emotions. In short, there was nothing superficial about their approach or execution even when performing a light-hearted piece. On the day that our story takes place, both musicians were in a highly agitated state while waiting for the concert to begin. I had gone backstage to check if there was anything they needed, then left the room and sat down in the seventh of the ten-row concert venue. There was an audience of about 70, mostly elderly folk in the rather plain, rectangular, low-ceilinged chamber.

The musicians came out, bowed and began the recital. The opening piece was warm and gentle, and set the mood for the sonata that would follow. The audience was accompanying the music attentively and the musicians were listening closely to each other and growing their trust in the sound they were producing. When they had warmed up earlier in the venue the room was empty, so their sound felt slightly too loud. Now, with the audience present, the edge had been absorbed and the music's rounded warmth filled the room like a hot drink on a cold day, comforting the audience inside and out.

At the end of their first piece, Sharon looked at me to check if everything was good and I gave her a double thumbs-up and nodded slowly; our sign that everything, from the balance in volume between the piano and violin, the acoustic dynamics in the room and the audience's responses were perfect. After acknowledging the applause, the musicians changed the music on their stands and paused, looking at each other in preparation for the three-movement sonata.

The first movement was fast and bright, and the pianist's fingers were a blur across the keys as she created and shaped the body of sound within which the violinist could move. With many firm turns of the hips and leanings into her instrument, the violinist poured out the melody with richness and fluidity, enabling the fast-changing music to become one sweeping movement, bringing out the excitement of each turn while the pianist made sure that the audience were secure in their seats. It did not take long for me to lose myself in the music. While so transported, I remembered my task to check on the audience, so I lifted my gaze from the performers to see how they were receiving this masterwork. The intense concentration and skill of the musicians seemed to sweep the audience away. It felt to me that the music

was a single, living entity that flowed through the audience with a life of its own. And then I saw it.

A gigantic serpent-like dragon was moving up and down over the heads of the audience. It was not as clearly visible as it would have been if it were physical, but my imagination made sense of the bits I could see, and the resultant image embossed itself on my mind. The serpent was ferocious looking but remarkably non-threatening or even interested in the people. It didn't pay anyone any attention, least of all the musicians. It just moved sinuously along with its large head and long, thick, scaly body towards the back of the hall.

I looked at the musicians who were so furiously busy with their heads down in their music that they had not seen what they had done. I was so keen for them to see it that I wanted to leap out my seat and shout for them to look up and see the being that they had brought into the room. Being well trained by Sharon to not disturb the musicians no matter what, I contained myself. The rest of the concert was just as magical, but the dragon that I had seen had disappeared, not to return.

The end? Almost.

The facts of the case are that I did see the dragon. I experienced the dragon as an embodiment of the music and I experienced its existence as independent from the musicians. I know that all this happened in my imagination so please don't doubt my sanity. And no, I had not been drinking or using any mind-altering substances. I do have an overactive imagination, however, I had never seen such a thing projected out into my environment like this before.

It is the nature of this intuited revelation that we now need to discuss. I am trained in the sciences, but believe that science is not yet mature enough to bring us the depth of feeling and artistic insights that I imagine it will in the future. I believe this because of my experiences with Sharon's music and because the scientific explanation of the experience takes longer to present than the story itself (Feynman 1955)! The arts are the carriers of the wisdom of being human, and yet it is through science that we can bring a deeper understanding to this experience. It is a match made in heaven, so to speak.

There is no doubt in my mind that the high skill levels, total investment and unusual intimacy of the musicians contributed to the sound they were able to produce. I also do not doubt that the acoustics of the hall must have

served to bring the sound to me in a singularly stimulating way. Either way, the sound that reached me must have stimulated me physically and mentally to such an extent that [and this is the exciting part] what arose up from my imagination became projected into my senses as though it came from the outside! But how could this have happened? And why did the image appear as a dragon?

If I had been sleeping during the concert, I would have known that it was a dream. The unusual power of the music must have had the effect of putting at least some aspect of me into a sleep or dream state and so my dream–fantasy life must have conjured the image that it found most relevant to express my experience. This, however, cannot be the full truth. True, the music had moved me personally in that I could actually feel myself moving. But I was really enjoying the experience and my previous association with dragons was decidedly not positive. I saw them as mindless and violent creatures who, had I imagined them into the room, would have savagely ripped the poor oldies apart, eaten them on the spot and roasted the rest of us into toasty snacks for later. This leads me to conclude that my subconscious, intuitive mind tapped into associations with which I was not familiar and which led to the revelation. A New Zealand friend claims to see these beings on a semi-regular basis. The Māori call them *Taniwha*<sup>8</sup> and it is more than likely that this association crept into my subconscious. But, again, my association with *Taniwha* was decidedly not peaceful or even associated with music. I had only ever heard that they are river or water beings. Then I remembered something significant that could help me work out what was probably going on.

Shortly before I saw the dragon, my attention was focussed on the musicians and how the audience were experiencing the music. It may be that my joy in the perfect immersion of the musicians and my selfless interest in the enjoyment of the audience lifted my consciousness to this new experience. Previous experiences of perceiving the usually hidden spiritual world had all been related in some way to my compassionate interest in others. My compassion for the weed as related in *e and me* and in the girl that I liked in *The cost of my personal Pentecost* [both stories presented later in this book] seemed to follow the same pattern. I therefore imagine that this selfless mental presence may be crucial in enabling this experience. Further, some

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8 Taniwha is pronounced ton-if-a, with the “a” pronounced as the u in “up”.

folk on social media who claim to have enlightened experiences share similar experiences of selflessness (Sadhguru 2009; Adyashanti 2014; Tolle 2022; Freke 2009) as promoted by all religions.

What I find equally exciting is how the resultant image appeared to have come from outside, through my senses rather than seeing it inside my head. To explain this will require understanding how our senses work, and why we see objects out in the world when our nerves only bring the nerve impulses to our brain [See *A dark and silent world* also presented later in this book]. Suffice to say that I believe that when I was carried away by the music and I added to that my interest in the audience, my sympathy-driven intuitions were powerful enough to stimulate my optic nerves into bringing my imagination as an outer vision. Whether I am right in this thinking or not, it is nonetheless extraordinary to think just how magnificent our being is, and what other imaginations await us as we grow ever stronger in balancing our rational and intuitive minds with selfless and sincere interest and compassion for others.

And now for the final and possibly most important question: Is the dragon real? Those inclined to rational materialism may say, 'No, it was obviously a figment of your imagination that happened in the way that you described, or similar'. The indigenous or religiously inclined may say, 'Yes, and you should start a church for the Music Dragon, where believers get swept up into a similar emotional state through music so that they can see the dragon. Oh, and don't forget the shrine and acoustically designed temple'. To which the rational materialist thoughtfully adds, 'True, it could be a great money-spinner'.

What do I think? I know what I saw, and the Māori legends and corroborating experiences of my friend are convincing enough to make me believe that all indigenous cultures must have had members who had seen nature spirits. It cannot be random that every indigenous culture has stories of such beings, and I would regard it as arrogant if we think that we now "know better" than our ancestors. As science-minded education researchers, if we can be as open and objective as science demands of us, I think we should take the time to really listen to our students when they share experiences or beliefs that are beyond our own, and ask probing questions. We may just learn something.

## SECTION 2:

### GIFTS AND CHALLENGES OF SCIENCE

This section looks at some of the many experiences and ideas that have stimulated my relationship to the science content that I teach. They are shared as the kinds of insights that can be gained when we take a committed, creative and meaningful attitude into the science class.

The first two pieces are given as the philosophical background of my approach to science. These are followed by pieces from teaching mathematics, physics and then chemistry. I put them in this order because mathematics is often seen as the invisible structure that stands behind all of science. Galileo Galilei spoke of mathematics as the language of the universe (Galilei 1623). More recently, Mulliken spoke of chemists as folk who love molecules and who get to know them as individuals, while he thought of physicists as folk who ignore molecules and give their attention to ‘fields of force and waves’, the substructure of atoms and molecules (Mulliken 1968: 52-57). In my imagination, this sequence follows the order of Smuts evolutionary levels, where chemistry [the study of matter] emerges from physics [the study of energy] and physics emerges from mathematics, the invisible structure that orders the functioning of both.

Many of the pieces on physics and chemistry are poems that I wrote. These poems have been used in many ways in my classes, but only when it felt like they would add to the ideas that we were already discussing. I have occasionally used some to introduce a topic.

This section ends with pieces intended to encourage us as science education researchers to be as committed and invested in our work as possible. It is only with a high degree of personal engagement in our work that we will get ourselves and our students to grow the fruits of science for our wreality.

## WHY DO I LOVE SCIENCE?

Periodically, I question the value of being a teacher of science. I think about the poor pay, lack of respect and appreciation and the exhausting demands on my time and energy. It usually happens when I am not finding magic in my daily work, and I end in a state of deep distress. Usually, when I become such a mental mess, my strategy is to take a short walk in nature which calms my soul and brings me back to a grounded sense of sanity. The following story, however, does not come from such a walk, but still comes from nature.

When I am blessed with a moment of magic that moves me to a new awareness and appreciation of what I do, I try to strengthen my memory of it by writing it down.



Why do I love science?

What do I love about teaching science? It is not the so-called scientific method. It is certainly not the marking and bureaucracy of the education system. It is the joy and comfort I get from deepening my relationship to the world around me; the worlds of energy, matter, plants, animals, people, my students as well as the human-created worlds of music, art, culture, law, politics, economy, technology, religion and so on, all of which make me feel more connected to myself.

This morning it is the fundamental harmony of the natural world which is warming my awakening to the day. The sunlight pouring in through my window opens my appreciation to how all the layers of reality work seamlessly together to comfort and strengthen us in life. They are so intimately interwoven that we are usually totally unaware of them. And there are many layers.

My gratitude for the warming photons of sunlight makes me grateful for all twelve fundamental particles, of which photons is one. According to science, these are responsible for all phenomena in our universe. Three of these particles make the protons, neutrons<sup>9</sup> and electrons of the atom. These worlds of particles are way below our threshold of awareness, however, they

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9 Protons and neutrons are not fundamental particles themselves, but are made of up and down quarks in different ratios.

work together so that the macro layers that we are aware of can manifest. Different types of atoms make the variety of elements that we find on the periodic table, from hydrogen to iron and gold. Because atoms have electron fields, each element has different chemical properties. These elements then react and combine to form various compounds which then bind to form the rocks, water, air and other parts of the inorganic world. This is layer 5, the first layer that we can perceive with our senses. Some substances that we can see, like diamond, are at level 4, but are special and rare. Once we enter the realm of life we need the further layers of complex organic molecules, cells, tissue, organs, organ systems and the full organism; another six levels! Here we have the infinitely more complex and diverse worlds of plants, animals and humans, which enable life, mind and personality to manifest. [See the piece, *The multilevel universe*, later in the book, where these levels are put into poetry.]

Each layer has its own laws and behaviour, and needs to be a stable support to those above. Try imagining such a fine lattice of worlds built so securely that at the top is a consciousness like our own with the capacity to understand this whole sequence, and to build our own worlds of music, art, science, culture, technology, spiritual knowledge and so much more.

As I lie in bed, I can feel how, in nature, all these worlds work together in a healthy balance. I feel gratitude to this world out of which our modern consciousness was born, and to the world of science that has given me the ideas and mental skills to appreciate it so consciously. It fills me with an awe which makes these words I've written seem empty of the profound world they have tried to express.



## WHAT DO SCIENTISTS BELIEVE?

I love the moments of philosophical debate in my classes, especially when they lead to a real awakening of new perspectives. As with all things, timing is important, and I will often leave a philosophical question unanswered until it has been repeated. If a question has been asked three times, I regard it as an obligation to address it, no matter what I may otherwise feel.

This story comes from my time teaching in Johannesburg, where some of the students came from homes and communities which regarded science as a belief system that conflicts with their religious or indigenous ideas.



The bell went at the end of a Grade 9 science lesson. We had been discussing the primal stars which created the full range of chemical elements in the universe. As it rang, an earnest student asked me, ‘What do scientists believe?’ Even without any context for his question from our class discussion, it was nonetheless clear that he was referring to the creation vs evolution debate. As so many of my students came from religious homes, there was enough interest among them for me to give an answer, however, the timing was wrong, so I sent them off unsatisfied. Midway through our next lesson two students spontaneously asked the question again, this time with a widespread interest from the whole class. It was clear that they had been discussing this among themselves after the previous lesson and it was now time for a proper answer and a class debate.

‘Scientists believe in questioning everything. Most of you believe what your parents believe because that’s how you were brought up and it makes sense to you. If that makes you think you’re right, are others who were brought up differently wrong? But they are only doing what you are, and following how they were brought up. How many people do you know who have changed their beliefs? And why would someone believe things that makes them different from their family and friends who they love and trust? Why would anyone risk the possible rejection?’

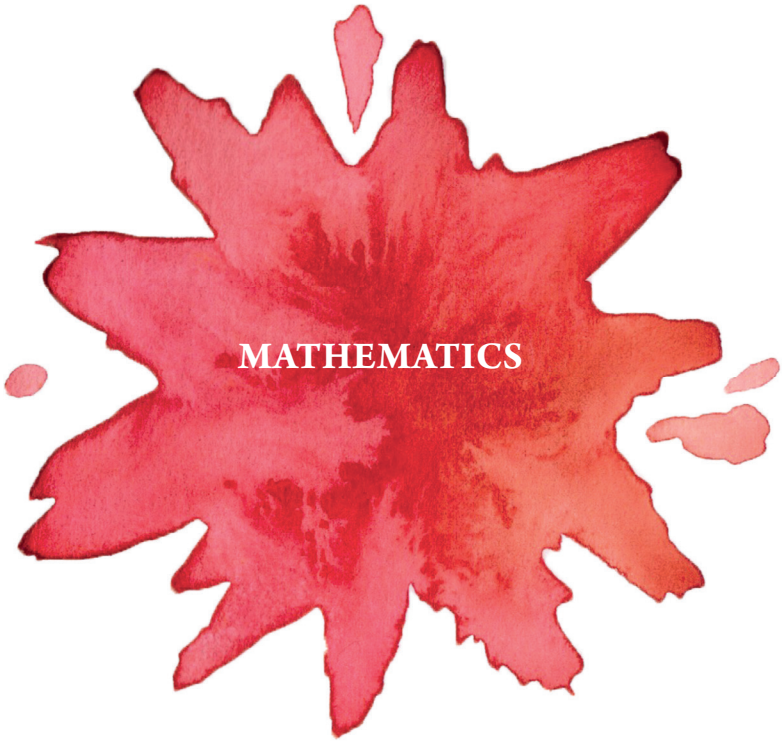
‘Well, science believes in investigating and questioning everything. When we do this, we start to see things from a broader perspective. This can easily

shake our previous ideas about reality and life. And this can be challenging for everyone involved, but would science have made the progress it has if it had not been prepared to risk everything in its pursuit for provable facts? The conclusions of individual scientists may vary, but in science their conclusions become subject to further investigation. If they are not open to change, then they will fall into the original trap of believing they are right and others are wrong. In this way science challenges us to remain open and humble, knowing that our wreality will always be limited, so we should remain open to new information.’

We then spoke about various religious beliefs and how we identify with our own, and do not need to reject it to be scientists. I also mentioned the many science Nobel Laureates who are also religious/spiritual (Dimitrov 2010).

Our focus then moved back to the stars. When I showed them the Hubble deep field photo of the hundreds of distant galaxies, a different learner asked me if I believe in aliens. I looked around the class and realised that most of them were looking with eyes that could be ready for a new perspective, so I asked, ‘We have only just become aware of all these millions of galaxies thanks to the Hubble space telescope. Do you think that God created all these worlds just for us?’ The earnestness of their liberated mental focus from the previous conversation led to a universal and resoundingly unfiltered response of, ‘No’. The sound of it felt so substantial that I now believe we have a few more youngsters with the required openness to new evidence to be called scientists.



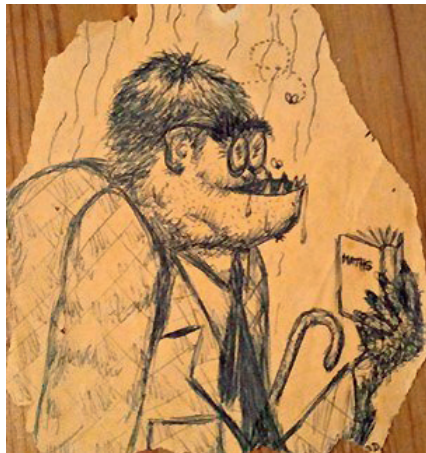


## WHAT SOME STUDENTS THINK OF MATHEMATICS TEACHERS

When I was in Grade 8, thirteen-years-old, a classmate of mine drew this picture during a mathematics lesson. Derek Davey was not a fan of mathematics. I have always loved maths but could empathise with Derek, and loved this picture so much I asked him to sign it and have kept it close ever since. I use it to remind myself that as a maths teacher there will always be some students who see me this way.

The details of Derek's revulsion are perfectly captured in this smelly, functionally blind, hunchback, heavy jaw and dribble-mouth nerd of a gorilla who is attractive only to flies. It is so trapped in its world of maths that it has no idea of how badly adapted it is to worldly norms and standards. It also shows how little value Derek saw in it for his life at the time. He drew this in 1977.

Needless to say, Derek did not go on to study science, he studied language, art and music, has played in several bands and has published a memoir.



## TEACHING CALCULUS TO SIXTEEN-YEAR-OLDS

When teaching science, and the mathematics related to it, there are some lessons where surprising and unexpected magic occurs.

In this lesson, I was teaching a class how to derive the derivative from first principles. This is a common way to introduce students to the mathematics branch of calculus, and I had done it many times before. On this occasion, I was in New Zealand, and I had already taken this class on an outing where I needed to write up a list of all possible risks as well as contingency plans, should something go wrong. This makes good sense, however, having come from South Africa, where recognising and avoiding such risks were regarded as common sense, I found it annoying and time consuming. As a result, during this particular lesson, my imagination relished the idea that in this section of work, I could expose my students to a situation where all safety measures were gradually eliminated, and where their mental powers alone would be responsible for their success or failure.

The result was liberating for me and tangibly empowering for the students.



Calculus is the mathematical theory developed by Sir Isaac Newton for finding derivatives and integrals. The process that Newton followed involved taking specific, real-life scenarios, and systematically replacing actual measurements with abstract symbols like “ $x$ ”, until only symbols remained. The result is the creation of a powerful general formula that has universal application.

While teaching the steps for deriving the derivative with my class, I realised that this is like walking across an imaginary mathematical bridge where initially the values are concrete, so you can “see the bridge, the handrails and the other side”. By the end, all concrete values have been replaced with abstract symbols. Each new step is now created by the student through their understanding and logic alone, one step at a time, until the process is complete and they find themselves safe on the other side. The gradual releasing of all the standard measures of safety and security like eyesight, handrails and bridge are experienced by the students when each concrete value is replaced

by a generalised symbol.

The students kept “falling off the bridge” until they developed confidence and trust in the power of their abstract mathematical thinking to replace the missing “sensory” information. Some students did not manage to “cross the bridge” by the end of our lesson, but they all witnessed the great majority who had, and the enormous sense of achievement they gained from it. They also strengthened their class community as they worked to help each other over the “gap”.

I left the class feeling immensely happy to have found a way to bring an experience of the power of strong, clear thinking to my students in a way that they can be fully conscious of what they are achieving as they do it. I was also happy to have found a demonstration for my long-held conviction that logical, rational thinking is an essential tool for human empowerment and development.

The inner confidence gained when we develop a verifiable trust in our thinking to overcome “dangerous” challenges and make sense of the world is incalculable. It was this that I was seeing in my students, that made me deeply joyful.

## MATHEMATICS ROBBED BY PUBERTY

Here is another mathematics class story. This time I had already been teaching for about twenty years and had long developed the habit of looking for signs of quality mental activity in my students. This story is of the greatest change in mental ability that I have ever encountered beyond the impact of a head injury, major drug usage or an upheaval in personal or family life.

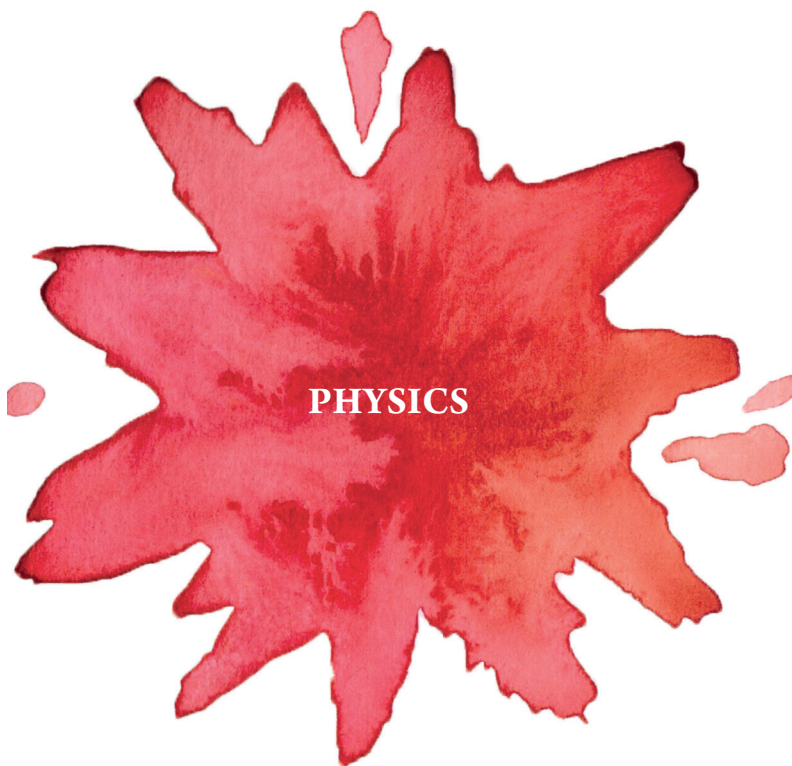


In 2010, I am teaching in New Zealand. In my home class of Year 9s [twelve/thirteen-year-olds], I have some students from Pacific Island background. At the start of the year, one boy who is particularly big and strong even for a Pacific Islander, Paul, is doing well in my mathematics class. After the Easter holiday, the class returns, and Paul can now no longer do mathematics. His body looks like it is growing at double speed and I need to give him forceful individual attention to engage his mental focus.

In consultation with Paul, his friends and his parents, I can find no secondary issues that may have caused this enormous change, and I think that Paul's growth hormones have taken over and his mind seems no longer to have the freedom to engage with academic work. I worry that if this carries on for too long, Paul's confidence in his abilities will collapse. I also teach Year 11 Pacific Island students, some of whom are suffering from a lack of confidence in mathematics, and I believe that I can see something of a tragic developmental pattern emerging.

The only other time in my career when I have seen a similarly enormous change in mental ability during puberty is among some Afrikaner boys in South Africa. I begin to jokingly wonder if it is just a coincidence that these two peoples also appear to me to make the best rugby players.





## WHAT IS ENERGY?

There is surely a deep joy in finding an unanswered scientific question which could lead to world scientific fame. Could this be a way that one of my students will have their name studied in future science classrooms? We study so many names of dead people in science, like Faraday, Pascal, Newton, Heisenberg and so on, it makes science seem so complete that no-one living will ever be added. Its spirit of discovery seems so far away from my students that they often do not see a space for themselves within it. In trying to inspire my students to think big in science, I sometimes say things like, 'Nothing would give me greater joy than to find the Nthabiseng Molefe *Theory of Levity* or Srinivasan Shah's *Nature of Energy*'.

While studying sound this week, we played around with tuning forks. Our first job was to hear what the music note "A" at 429.6 Hertz sounds like. 429.6 Hz is the measure of how many times it vibrates a second, so "A" makes 429.6 waves in the air every second. Our ears can't measure the number of vibrations, however, they have the extraordinary ability to convert the vibrations into nerve impulses which somehow get transformed into the experience of sound. [Here is another unknown in science and source of possible future fame.] 429.6 Hz is a particular tone. We then compared it to "middle C" at 256 Hz. This has a lower tone as it vibrates fewer times per second. Another tuning fork at 512 Hz makes double the waves of "middle C", which we also hear as the tone "C", just one octave higher. And it happens that if you double the number of vibrations in a second of any note, the two notes will sound the same, except that the faster one will always be one octave higher. What is mathematically cool for "C" is that the note will always be a power of two, with  $2^8 = 256$  being what musicians call middle C.

All this maths, movement and music moved our attention to the underlying source of all action; energy. It manifests in so many forms, from heat, light and other electromagnetic waves to movement, electricity and of course, to the making of sound.

Energy uses matter to express itself. The same bit of energy can transform from manifesting as heat in one moment, to creating movement or electricity or... basically anything we use electricity for. Like some kind of magical genie, it uses matter as a porous substance into and out of which it dances. But what

is energy when it is not playing with some physical toy?

What is its nature in its own realm? We have been so mesmerised by what energy can do, and all the different forms she can take, that we have overlooked our basic manners. Energy must think us rude, violent and greedy savages the way we force her to work for us without so much as a thank you. We haven't even bothered to ask her real name?

The lesson ends with me saying to the fresh, bright, Grade 10 future scientists, 'If you want to become the most famous scientist of all time; and I mean "Who's Einstein?" famous. Find out what energy is!'

## INDEPENDENT POWER

Here are two stories of when people have changed their relationship to energy. These are moments of witnessing a significant reality-shift in others.



This story was inspired by my son who was traveling around New Zealand in a campervan with solar panels on the roof.

Robin had finished his studies and worked in a restaurant for a few months to earn enough to buy a small campervan; really just a station wagon with a bed and a simple camping setup in the back. One morning I called him from South Africa to ask where he was now. The reception was poor so we messaged instead, with him sending me photos of the snow-capped peaks that surrounded him as the reason for the poor reception. He said that he had recently bought some new batteries for his solar panel, and that he was feeling good about having so much “free” electricity that even with the cloudy conditions, he had more than he needed. He was encouraging me to get solar power at home so that I would feel this same independence and abundance of sun-gift electricity.

In South Africa, at that time and when writing this piece, electricity was almost exclusively produced by coal-fired power stations. These were fairly bad polluters beyond even the CO<sub>2</sub> that they emit, because some of the health and safety measures required by such power stations had not been installed. Electricity was, thus, costly to both the environment and my pocket. And there was also the question of corruption at ESKOM, where billions of rands were being siphoned off by criminal groups through crooked tenders being awarded with kickbacks for insiders. The country was still in the process of incorporating independent power producers into the national grid, but still held an almost total monopoly, meaning that using ESKOM electricity was almost akin to funding criminal syndicates and environmental harm.

As Robin was enthusiastically sharing his joy, I could imagine his liberation from needing to rely on an external source of electricity and realised that in my nearly 60 years of life, it was an experience that I had never known.

These thoughts also reminded me of the story that follows, of when I witnessed someone using electricity for the first time.

This story is about Lizzie, a young Xhosa woman, who moved from rural Ciskei to the city of East London, in the Eastern Cape of South Africa.

For my first year of teaching in 1989, I moved to East London. My housemate, John, was also a young man starting his teaching career, and we did not have two cents to rub together. John was English speaking, but could also speak Xhosa, and John's mother told us that her domestic worker had a sister Lizzie, who could not speak English, but who was desperate for work. Could we employ her to keep our house clean and to cook for us? We said no, as we could not afford it, but after much pleading and negotiating we all agreed on an embarrassingly small salary with free board and lodging.

When Lizzie joined us, John's mother trained her on the daily and weekly tasks. I tagged along, watching the training without understanding much of the language, but understanding what was being learned. Lizzie was clearly very bright and keen, and followed each instruction with a nod or brief question for clarity. When they got to the kitchen, John's mother indicated the individual knobs on the stove that controlled each hot-plate and the oven, with Lizzie happily nodding each time. At the end of the stove demonstration, Lizzie asked a question. John's mother responded with reassuring gestures and mentioned "electricity". Lizzie nodded and then asked something about the electricity while pointing to the back of the stove. John's mother again reassured Lizzie, this time by opening the kitchen door and pointing to the electricity wires going from the kitchen to the garage. Lizzie nodded, and said something about electricity while pointing to the garage. John's mother then shook her head and said something about Egoli, the city of Johannesburg, about 1 000 km away.

At this point, Lizzie put her hands on her head and turned on the spot in desperation, all the while exclaiming 'Tshini. Tshiniwam.' This would be the English equivalent of saying, 'Oh dear God'. John's mother became a little bemused and reassured Lizzie that she would not need to go to Egoli to keep making electricity for us so we could cook. It took a while to convince Lizzie that other people would make the electricity for us, that we would pay them for this, and that she did not need to worry about it.

She was greatly amazed and relieved, and quickly got her head around the fact that this magical electricity meant that somebody else in Egoli would need to fetch the “wood”, make the fire and send the “heat” to us through the wires so that she could do the cooking in East London.

### 3 – DIMENSIONS OF LIGHT

Light is one of those substances that eludes any single definition. This is because, like the electron and other fundamental particles, it can manifest as a particle or as a wave. The magical aspect of this is that it will behave in the way that our experiments demand. [See the piece, *Electromagnetic radiation*, for a poem that expresses this, as well as the piece titled, *The electron*.]

Modern science generally thinks of light as an electro-magnetic [EM] wave. The electric wave works in tandem with the magnetic wave as they move, carrying the energy package, the photon, through space. In this way, we can imagine the EM wave as the energy form of light, and the photon as its physical body.

We can think of this photon-physical-body carrying the experienced light in the same way as our physical bodies carry our mind. Light is thus, housed in the EM wave or photon as we are housed in our bodies.

This poem is a play on the energy or EM wave nature of light as understood by science. The relationship between how electricity and magnetism stimulate each other is known as electromagnetic induction and was discovered by Michael Faraday around 1831 (Faraday 1832). This discovery eventually led to the understanding of light as electric and magnetic waves that work together as they move through space at the speed of light. These waves need to be 90 degrees to each other for this mutual stimulation to occur, and they then move in a direction 90 degrees to the movement of either wave. This led my thinking to wonder about the three dimensions of light and how this would mean that they could never meet in the same plane. It made me think that all three, the electric wave, magnetic wave and the movement of the light, must be very different things, things that do not belong together, but which work together to manifest light in the world.

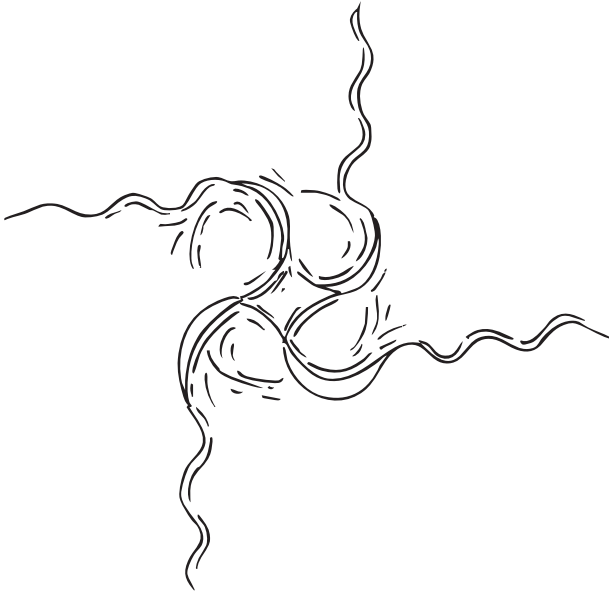
### 3 – Dimensions of light

It is now to us well known,  
That light is made of two waves sown  
Intimately tight together  
In separate dimensions forever.

If left and right the one does sway,  
Then up and down will the other play.  
Always 90 degrees apart,  
Like fighting boys with hardened heart.

Magnetic and electric wave  
Weave so one the other does save  
From breaking time or losing way,  
Bearing light-energy's piercing ray.

Through space and time the couple move,  
Our life on Earth with warmth to soothe,  
And empty space with light to fill,  
Bringing day into our world.



## ELECTROMAGNETIC RADIATION

Together with *A dark and silent world* and *3-dimensions of light*, this poem also gives us something to contemplate of light's extraordinary nature. In this case it is Einstein's idea from relativity that light can manifest particle and wave behaviour, but only shows the behaviour of one at any moment in time.

Perhaps most surprising is that it always shows the behaviour that our experiment is designed to test!

### Electro-Magnetic radiation

Albert it was who started to play  
With the space, time and light array, [array should be in one line, so each  
verse has only three lines]  
In search of our home when we pass away.

Newton's model, as though made of sticks, [must also be at the end of the  
previous line so only 3 lines per verse]  
Was blown away by Al's mathematics.  
Bending space and stretching time. No tricks!

Light is now the solid ground,  
On which our universe is found.  
To which everything we know is bound.

Yet light itself will itself shape,  
To the demands our experiments make, [three lines per verse]  
And a particle or wave form take!

## A DARK AND SILENT WORLD

Conventionally, we tend to think of our senses operating in a one-way direction, of waves of stimuli coming towards us with nothing going out in return. When I became aware that some people with autism can easily become overwhelmed by sensory overstimulation, it occurred to me that this is possibly because the sights and sounds that enter their mind may be experienced as though they are happening as a jumble inside their head instead of from outside in the world.

The fact that we don't experience all our sensations in our head must mean that we are inwardly active in some way when experiencing sound and light from external stimuli. If this is true, then we must subconsciously drive our sense of experience outwards to imagine that we are experiencing it outside of ourselves. It is this powerful thought that is expressed in this poem. [Also see the piece, *Seeing the music dragon.*]

What this poem also expresses is how the experience of sound and light are not studied in science. Science studies the waves and vibrations and only calls them sound and light because of our associated sensations. It is only the waves and vibrations that objective science can detect. It requires a living being to experience sound and light. Science is therefore tempted to imagine that our outer world is dark and silent, and that we hallucinate the sensations. Humans and animals whose sense organs allow for the transformation of these stimuli into sensations, experience the world as full of light and sound.

### A Dark and Silent World

Do our senses lie  
When they fill space  
With sound and light?

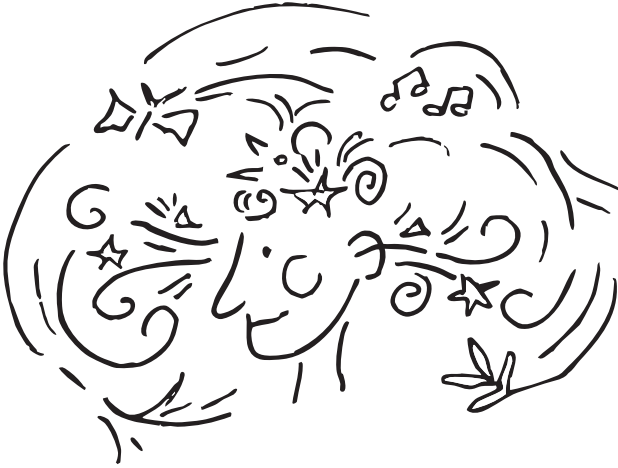
waves and vibrations  
reach ear and eye  
from air and sky.

chemical change and sparking paths

lead the signals to our centre  
where we perceive and are moved in measure.

then out, we chase the signs  
to place them back where they began  
and touch the stimulating world around.

What kind of being are we  
Who experience a rich, full life  
In Science's silent, mechanical night?



## TIMING MATTERS WHEN TEACHING SCIENCE

What we call science today, developed slowly over many centuries. Its name, prior to being called science, was natural philosophy, and was less experimental and more focussed on natural phenomena (Schaffer 1986). Every culture has had its own approach to science. Indigenous science tended to be practical and mythological (Kolopenuk 2020), the Ancient Greeks were philosophical (Aristotle 350 BC), the early Arabic scholars were religious and practical (Eberly 2004), and the Christian scholars who birthed modern science were religious, practical, philosophical, theoretical, abstract and mathematical (Coudert 2011). These various approaches to science reflect the needs of people in different contexts and at different times. They are manifestations of the gradual awakening of our objective, rational mind giving its attention to the outer world of matter.

To illustrate this point, here are three different expressions of photosynthesis from three different points in time.



Photosynthesis is the process that plants use to make high energy compounds using sunlight, carbon dioxide and water. The first is a piece of the poem, *The Botanic Garden*, by Dr Erasmus Darwin (1798), the grandfather of Charles Darwin. He used mythological pictures and romantic language that are unusual today, however, if you know what to look for, you will recognise how photosynthesis is depicted as a wedding between matter [oxygen] and energy [light].

Erasmus Darwin was an upper-class Englishman raised on a classical education. He uses “beings” like Sylphs, Eve and *You* [probably meaning God] to inspire our imagination to pictures of action and co-ordinated will. His description of the dawn, light and leaf are multi-layered and textured. It is a living work of art more than a work of science. In other words, it is a work of feeling, inspiration and imagination more than a work of information and reason. In his time, this was acceptable.

## The Botanic Garden

By Erasmus Darwin

When Morn, escorted by dancing Hours, 25  
O'er the bright plains her dewy lustre showers;  
Till from her fable chariot Eve serene  
Drops the dark curtain o'er the brilliant scene;  
You form with chemic hands the airy surge,  
Mix with broad vans, with shadowy tridents urge. 30  
Sylphs! from each sun-bright leaf, that twinkling shakes  
O'er Earth's green lap, or shoots amid her lakes, Your playful bands with  
simpering lips invite,  
And wed the enamour'd OXYGENE TO LIGHT.---

Erasmus Darwin also wrote more purely scientific works. His study on the effects of light on the human eye describes how our retina and cornea respond to changing light and colour conditions (Darwin and Darwin 1786). At a slightly later time the German poet, philosopher and scientist, Johannes Wolfgang von Goethe, wrote a scientific work on the half-spectra of light that you see when you look at the boundaries of light and dark through a prism, describing these as the “deeds” and “sufferings” of light (Von Goethe 1840), an idea used in the piece that follows. Both these extraordinary men included human elements in their scientific work because they experienced the intimacy with science in their own lives. They did not separate their humanity and feeling for life from their science. Their personal engagement with life and the world was what enriched their scientific understanding. To use Feynman's definition, this must have been part of a true scientific age where the scientist, artist and poet were one (Feynman 1955). The scientific work of both Darwin and Goethe is mostly ignored in the modern day because scientific reductionist materialism, sometimes called positivism, which dominates modern science, rejects all elements of subjective experience.

Our second is from the McGraw-Hill encyclopaedia of Science and Technology (Parker 1984). In book 13 on page 455, photosynthesis is presented in a manner that is common to most modern textbooks. The

complete absence of any and all imaginative, religious or metaphorical content is deliberate. It contains the most distilled essence of the universal mechanics of photosynthesis as, ‘the manufacture in light of organic compounds [primarily certain carbohydrates].’

‘ $\text{H}_2\text{O} + \text{CO}_2 + \text{light energy} \rightarrow [\text{CH}_2\text{O}]_n + \text{O}_2$  Where  $[\text{CH}_2\text{O}]_n$  stands for a carbohydrate [sugar]’

The encyclopaedia description is an expression of objective fact, similar in manner and identical in information to what can be found in any current textbook on the topic. The facts are put into a logical sequence that needs only the scientific paradigm to be understood. The symbolic reduction into an equation is the briefest and most abstract way we have of expressing photosynthesis. With this equation, it does not matter who expresses the work. The facts remain devoid of human interference to avoid bias and other human sources of subjectivity. The influence of “beings” of any sort is consciously avoided; actively rejected. The practical fruits of this purely objective and rational approach are exactly what led to the extraordinary achievements of our ever-developing technological age.

The third is from a poem I wrote in 2015 on the periodic table [the poem is presented later in this book in an edited form]. In this poem, I remained faithful to the modern scientific wish to not include mythological beings but have tried to infuse the objective scientific facts with human qualities to which we can all relate. Carbon is portrayed as a character with wish and behaviour driven by her own nature. For many modern scientists, this would be a potential problem as it assigns “will” to inanimate nature. They might argue that this is a fallacy and risks confusing fact with fantasy.

## Carbon

This powerful ground of the compounds organic  
Weaves into one the Heavens and Earth as it  
Secures in its bonds the summer day sunlight  
That soothes our ache on a cold winter’s night.



There are many reasons to believe that science education and communication

need to include experiences that human beings can relate to. In this poem, the science content has been presented in a story-form. I have seen first-hand how students often lose interest in purely abstract content, however, when they immerse themselves in imagination-rich stories, even the bell for the end of the lesson that is often seen as a symbol of freedom, becomes a disruption. After all, who does not love a good story (Mirkin 2017)?

How we educate determines how children experience their world. It determines where they put their attention and what they believe is valid knowledge, therefore, we should take it seriously when teaching science.

# STUDYING COLOUR TO BROADEN OUR PERSPECTIVE

## *Part 1*

Many Waldorf schools do not have a principal, a single person who leads and runs the school, but some do. In 2016 I was the principal at a Waldorf School, where I was responsible for dealing with all the problems that disrupt the smooth running of the school. This included finding ways of addressing developmental, cultural, personal and racial challenges among the student body. In this work I often took a hands-on and creative approach.

This story uses the idea from Goethe about the deeds and sufferings of light mentioned in the previous piece, to see how the light spectrum of the rainbow is actually two half spectra that overlap (Von Goethe 1840).



One day, the teachers reported that there was rising tension between the white and Black students in the Grade 7 class, and that some students were accusing a white teacher of being racist. Although apartheid had been gone for over 20 years and these students had never experienced what it was like to live under apartheid, racial tensions were still a part of South African life, mostly due to the enormous economic and cultural differences between many white and Black families. In my private school, economic differences were not visible along racial lines, but because racial tensions still existed in South African society and politics, the students were still sensitive to them. I asked the most senior Black staff member to meet the class with me, where we discussed what racism actually is, and how serious it is to make such accusations. This made the students realise that they need to be more careful in their accusations, and they immediately stopped. Not content to leave it at this, I also decided to teach the class for a week of science lessons on colour.

I taught them light and colour using experiments and poetry. The students did many experiments, including an experiment where they saw how colour emerges at the boundary between black and white when looked at through a triangular prism. The following diagram was shown to the students so that

they could see the



I discussed with the class how the beautiful colours only emerge where there is a boundary between black and white. Further, they noticed that it is only when the two boundaries are close together that the colours of both boundaries overlap and the green in the middle of the rainbow stark contrast between black and white.

Each member of the class was then instructed to look at this diagram through the prism. The resultant colour images that they saw looked something like this.<sup>10</sup>



green in the middle of the rainbow arises. I got them to look out the window with the prisms to find the half-spectra as well as where they overlap. Most were able to find not only the normal rainbow where green is in the middle, but also the inverse rainbow. This they saw when looking through a tree where a dark branch was set in front of the bright sky. In this case the violet and red overlap and they saw a bright magenta in the middle.

While teaching the students, I observed their behaviour with each other and noticed that they were dealing with a lot of stress, internal mistrust and fear. Some new children had recently joined this class and seemed like they had not yet found a way to be comfortable together. So, after doing our many

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10 See the middle section connecting the squares in second figure.

experiments I wrote a poem for the students to learn and perform as a group to build their class spirit. The students copied it down and learnt the poem while at their desks until they could all recite it by heart.

## **More than Black and White**

Between light and dark, so some say,  
Lie stark boundaries or shades of grey.  
But those with science as their friend  
Will show the truth when light we bend.  
A triangular prism made of glass  
Will show the grey scale as a farce.

Dark into light is our first test.  
Red to yellow burst forth at rest.  
Then turn around for light to dark  
And turquoise to violet now leave their mark.  
In nature together these two are placed  
When the rainbow full does radiate.

Yes, my friends do not despair  
What monochromatic minds declare.  
They only see polar extreme,  
And overlook that in-between  
Light and dark the world is full  
Of feeling-rich colour ... Beauty-full!

After a few days, the class stood as a group in given positions to dramatically present the poem. As the class got into the dynamics and mood of the poem, they became more courageous and adventurous, working together as a team. I then invited volunteers to do solo performances of some parts of the poem. Unsurprisingly, it was those who were most disruptive and needy of attention that chose to do this, and who did it superbly. The class presented the poem to the whole school during an assembly and received very positive

feedback from fellow students and teachers. The objective facts of their science observations coupled with the personal attention from the principal linked together with the warm acknowledgement from the rest of the school, empowered the students to unite as a class, and for the next few months, the racial and social tensions in the class disappeared.

## ***Part 2***

In the above experiment we used glass to bend or refract the light. In nature the rainbow forms when sunlight interacts with millions of tiny water droplets of rain. The droplets not only bend the light, they also reflect it so that we need to turn our back to the sun to see the rainbow.

To the evolutionist, what we see here in the explosion of colour as the light passes through the water droplets, reflects what happens in the explosion of colour elsewhere in nature. We see it in the beautiful flowers that emerge from the green plant when it is transformed in the droplet-shaped bud. We also see it in the bright butterfly that emerges when the caterpillar passes through the cocoon. Could it be that what the rainbow is for matter, the flower is for plants, and the butterfly is for animals?

This emergence of dynamic colours in each of these instances is a picture of transformation. In each case something entirely different and beautiful emerges. Is this because it has passed through a trial of compression or condensation of some kind? And then what would be the equivalent for humans? What kind of suffering, sacrifice or trial can bring about such a transformation in us? Is Nelson Mandela an example of this when he emerged from his many years in prison? Can we find examples of this in our own lives. Is the Christian story of the death and resurrection of Christ a spiritual expression of this?

When we look at the world through the eyes of evolution, all these transformations can be imaginatively and logically seen as a continuation of what we know from the rainbow.

If this is true, then suffering can take on a rich meaning. And if we use the flower and butterfly as a picture of our own possible transformation, then we can trust and respect the need for withdrawal into the bud or cocoon, and to

not interfere with the process. We need to trust it to take its own good time so that our fully formed beauty will emerge with its own magnificence.

Could this be why we constrict learners into classrooms and give them high stakes tests?

## MAGNETIC GAZE OF ATTRACTION

A topic that is taught in Grade 9 [fourteen- and fifteen-year-old] physics is magnetism. As with all science topics, it is useful to let the students' physical senses do the teaching where possible. Magnetism lends itself to a great variety of practical work, and this story is about teaching magnetic fields and how they change under the influence of attraction and repulsion. The experiment that we were doing looked at the effects of two magnets on lots of little compasses, because a compass needle will always align itself along the magnetic field.

I wrote this story after a particularly beautiful moment where the class and I both left our objective minds behind and had drifted into the romance of attraction and repulsion.



The magnetic field raying out from any one pole is not in straight lines; they curve outwards like a fountain, pouring their influence into the space around them like the spreading of a tree upwards and outwards towards the sun; a radiant basking in total openness.

As we bring an opposite pole closer, the field lines closest to the approaching pole turn their attention inwards towards this new influence. Instead of a dreamy outpouring, their interest is captured. They can't take their eyes off it. Pure blind attraction, drawing the poles together. While still a distance apart they just gaze fixedly at each other. However, at a certain distance they can no longer resist, and they collapse into each other's arms as the magnets collide.

When a "like" or same pole approaches, the field lines seem to avoid each other as they ray out in search of their opposite. If forced closer, the lines are squashed outwards more strongly as they try to avoid looking at each other, and eventually the magnets push each other away, repulsed by the closeness of one doing the same as themselves.

Does the objective world of magnetism feel bound as it is to behave so predictably, mechanically and faithfully? And how do you get the "formal, academic learning" back on track after the whole group has felt themselves as

a part of this passion interplay?

‘OK, guys, go back to your seats and draw what you have seen.’



## ELECTROCHEMICAL DRIVE

At a conference, after I had presented my *Periodic table* poem [given at the start of the chemistry section of this book], a fellow participant asked me if I had a poem on electrochemistry for a student of hers. I replied that I did not, but that we could write one if she liked.

We started by trying to identify the key aspects of electrochemistry, one of which is its application in batteries. We recognised that it is the chemical tension between two substances that causes electricity to flow when we create the right cell structure. We also decided to base the poem on the reaction between copper and zinc, as this is the most common cell used when studying electrochemistry. By the time we needed to go in for the next conference presentations, we had written two verses of the poem. It took another day to create the rest of the poem, however, it was still in a rough form, and smoothing this out took a few weeks.

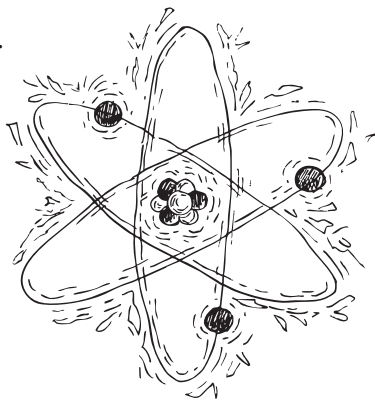
Here is the final product.

### Electrochemical drive

Containe copper and Zain zinc exist  
Like many of their friends, in two separate states.  
In one they are single, solid, alone,  
In the other they swim in solution as ion.

Their preferred state depends on their friend,  
On what each prefers determines their end.  
When Containe and Zain together play  
Containe becomes solid and Zain swims away.

Containe and Zain together would be  
In peace and chemical harmony,  
When Containe solid on her own does stand  
As a Zain-solution surrounded island.



This ideal dream serves us well  
In our electrochemical Galvanic cell.

We take them in their condition of longing  
And hold them apart to serve our bidding,  
Their electrical and chemical needs  
Will drive the power in our batteries.

Scientist's results all give the nod  
For Containe in solution and Zain-solid rod.  
Quite apart they must be placed  
When, with their awakened drive we are faced.

Cleverly placed between the two  
Are the links that make them do work for you.  
A chemical bridge lets the ion-blood flow  
So the wires above, nerve-sparks can show.

This voltage-making nerve-spark behaviour  
Is what our ultimate efforts are after.  
We use this power to drive our cell phones,  
And film remotely with high-flying drones.

So pause a moment in quiet contemplation  
Of the help we receive from chemical motivation.  
Where gratitude replaces our self-serving greed  
By remembering the gift of their intimate need.

## THE BIRTH OF THE UNIVERSE

The birth of our universe is usually referred to as the Big Bang. It is a most unscientific term, and for me, captures nothing of the depth of significance or creative transformation of the moment. The following poem is a response to my need to give this great moment something of its evolutionary magnificence.

This poem describes the first steps of evolution, up to the manifesting of the chemical elements of matter. The 'child that grows and multiplies' is atoms of the different chemical elements that are arranged on the periodic table.

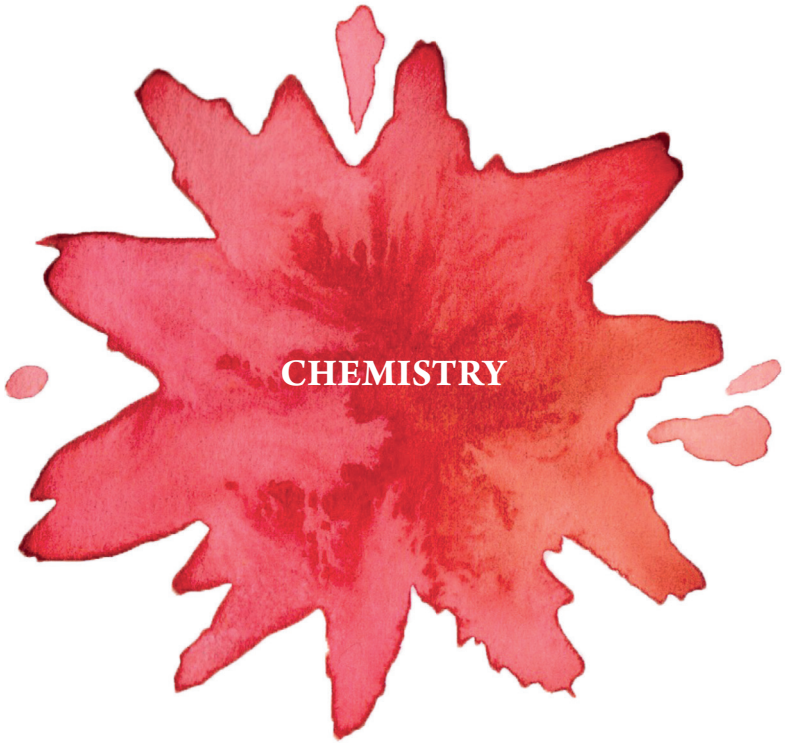
### **The Birth of Matter: [Precursor to the periodic table]**

Our Mother's cry was never heard  
As the birth of our universe unfurled.  
Sweet agony in making way  
The Material world with which to play.

Passing through the birth canal,  
The pressure-bear made Energy change.  
New substance and new world formed,  
An Internal to External life exchange.

The child did grow, transform and multiply  
Till elements varied in nature did vie  
For their part in material identity  
Now arranged in place for all to see.  
The Periodic Table tells the story  
Of the life of matter in all its glory.





# PERIODIC TABLE

The idea of matter having a birth, maturation and death was introduced to me for the first time during my Waldorf teacher training. This poem was written many years after this training, and only after I had taught the periodic table many times using this idea.

The periodic table is for chemistry what religious texts are for religion. It is the place where so much information is stored, and where this information is in such a perfectly ordered form that it enables many insights and understandings to occur. When school science students learn about the periodic table, they are taught to identify specific elemental properties using patterns that can be found on the table. This poem does not identify or reveal many of the common patterns but uses some of them to bring out the threads of a specific story, the story of the birth, development, maturation and death of matter.

1	← PERIOD 1 →																2	
3	Li	Be											B	C	N	O	F	Ne
11	Na	Mg											Al	Si	P	S	Cl	Ar
19	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
37	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
55	Cs	Ba	*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn

## Period 1:

I'm on top of the table and what do I see?  
 The expanses of space, the primary polarity.  
 Hydrogen and Helium, being born at the start,  
 Are both light and tiny but with natures apart.

Great suns and stars are the mighty engine  
 Driven by the smallest element Hydrogen.  
 This first born is a tireless campaigner,  
 Even giving his body to form the remainder.

Helium the perfect would do no work at all

Were Hydrogen not driving the great fiery ball.  
 Sh-He<sup>11</sup> takes no companion, not on Earth or at home,  
 Yet the elements see her up high on her throne.

‘Oh, to be like a noble gas’ is the call,  
 And the elements hear it one and all!

1	METALS										NON-METALS						2	
3	H																	He
4	Li	Be	← PERIOD 2 →										B	C	N	O	F	Ne
5	Na	Mg	← PERIOD 3 →										Al	Si	P	S	Cl	Ar
6	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
7	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
8	Cs	Ba	*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn

## Periods 2 and 3: [the first 20 elements]

These children of Hydrogen, most varied in type,  
 Line up in 7's; Helium's children apart.  
 Continuing their ancestors opposite statement  
 Of action and drive Vs. perfect containment.

To the left, the metals numbering 7 in all,  
 Were hidden till electricity's power them stole  
 From their lover's side, show their introvert face;  
 Alkali, base's slow binding embrace.

7 Non-metals all different and bright,  
 Quick acting and ready, stand on the right.  
 Their sharp acid-making attracts metal mate  
 To a balancing marriage, a salt crystalline state.

This taking and giving, the blind meeting of needs,  
 Makes the rocks of our Earth, the soils for our seeds.

11 The symbol for helium is He, but I wanted to depict it as feminine, so added the Sh in front of the He to make it sh-he, pronounced she. The combination of male and female in the name gave it a perfect balance between the sexes, something that suits the perfection of the noble gasses of which helium is the first. [This should be a footnote, thanks]



## The transition elements:

Now life slows down as the elements mature,  
And the passion of youth not as marked as before.  
For these heavy metals, subtlety counts,  
As they're mostly found in trace amounts.

Like adults there's less flash in their drive,  
But add qualities needed for life to thrive.  
From structure to colour to unusual trait,  
We may take for granted so don't underrate!

At the top is iron and all of his mates,  
Making tools for our industry and machines for the mine,  
At the bottom is gold in her fine royal state;  
Making jewellery for our love that won't lose its shine.

Middle aged life, so dull to the young,  
Is enduring and useful with a more inward fun.

1	H	2	He																																
3	Li	4	Be	5	B	6	C	7	N	8	O	9	F	10	Ne																				
11	Na	12	Mg	13	Al	14	Si	15	P	16	S	17	Cl	18	Ar																				
19	K	20	Ca	21	Sc	22	Ti	23	V	24	Cr	25	Mn	26	Fe	27	Co	28	Ni	29	Cu	30	Zn	31	Ga	32	Ge	33	As	34	Se	35	Br	36	Kr
37	Rb	38	Sr	39	Y	40	Zr	41	Nb	42	Mo	43	Tc	44	Ru	45	Rh	46	Pd	47	Ag	48	Cd	49	In	50	Sn	51	Sb	52	Te	53	I	54	Xe
55	Cs	56	Ba	57	La	58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho	68	Er	69	Tm	70	Yb	71	Lu		
87	Fr	88	Ra	89	Ac	90	Th	91	Pa	92	U	93	Np	94	Pu	95	Am	96	Cm	97	Bk	98	Cf	99	Es	100	Fm	101	Md	102	No	103	Lr		

## The radioactive elements:

Just beyond Lead, himself almost dead,  
Lie the elements too heavy to hold their own thread  
Of life together and just fall apart,  
Releasing an energy to stop your heart.

Their radiant glow as they start to decay

Was a startling find that made great minds play  
That matter and energy clearly were paired,  
In the famous  $E$  equals  $m$  times  $c$  squared.

What was seen at the birth like the sun shining bright,  
Giving life to the plants and Earth chemistry,  
Now changes to death in the dim glowing light,  
Or explosion of accelerated radioactivity.

Ashes to ashes, dust to dust, right?  
No! Energy to Matter, Matter to Life!

## STUDENT FEEDBACK FROM TEACHING THE PERIODIC TABLE

Please forgive what may seem like an attempt to advertise this imagination-rich evolutionary approach to teaching chemistry. I have put these comments here to give you the opportunity to imagine the thoughts of some students when taught in this way.

In these lessons we spoke of the chemical elements as characters with different personalities and properties. This is because they are the material ground upon which life, mind and personality is built, and the elements seem to already contain the potential to manifest them all.

The 'black and white boxes' that one student refers to are the elements on the periodic table. The 'main lesson' was a 3-week block of studying chemistry for roughly 1 hour each morning to sixteen-year-olds. This block was for both science and non-science students.

The first chemistry was a separate world for me, but now I can relate to it in all different ways. I can see the elements as different types of people and the different deeds they do.

You helped me to turn boring, blurry black & white boxes into vivid living, breathing beings. I especially enjoyed this part of the main lesson. It appealed to my imagination. In another way the table is a simple reflection of the twisted path of our lives.

The metaphor which we created during our main lesson where ~~you~~ we compared the human being to one single atom. I found a really interesting concept to think about. This metaphor entered into every aspect that we covered in the main lesson.

I found this main lesson absolutely brilliant, I couldn't believe how interesting it was. In the past I found chemistry dull, hard to understand and hard to get into. But this wow! It had meaning for me it wasn't dull facts, I enjoyed it thoroughly. Thank you for bringing chemistry to life for me.

## THE ELECTRON

The electron is what is called a fundamental particle, one of about twelve such particles that make up all of matter [and anti-matter] and its behaviour. These are called particles, however, this term is only used to try and concretise their distinct energy “signatures” and behaviours. As a result, even electrons are sometimes considered to occupy a field as opposed to a particular space. In other words, it is thought that the electron does not always exist as a particle, but is sometimes a wave.

This is a playful poem written shortly after learning that the electron is sometimes regarded as a particle with a ‘tendency to exist’.

### The electron

*[Spoken in an Irish accent please]*

This wee tiny fella Can't fully be known  
(Weighing one thousandth Of his big brother Proton).  
For example, you might find him  
Sitting somewhere at home.

You won't know what he's doing  
Or where he'll be next,  
Or even if he's ever  
Fully at rest!

And the more we find out  
The stranger he'll be  
As, at the right time  
He'll become energy!

This seemingly magical  
Habit of his  
Gives him now  
A ‘tendency to exist’.



## THE GENIUS OF ORBITALS

There are many surprising aspects to the atom. Perhaps the most surprising is that all the chemical elements are made of atoms, and all atoms are made of only three kinds of particles, namely protons, neutrons and electrons. So, how is it that three kinds of particle can make elements with such different chemical properties? It is because the electrons which encircle the heavy nucleus of protons and neutrons, are highly organised.

There are no obvious reasons why the electrons should always be organised into pairs around the nucleus. And yet they always settle into specific spaces around the nucleus in pairs, and these spaces have a certain amount of energy. These spaces are called orbitals, and any electron that joins an atom will always fall into the lowest energy orbital, where the lowest energy orbital is always the one that is closest to the nucleus. Understanding the energy requirements of different orbitals around the nucleus is what made Neils Bohr famous, and what helped in the development of quantum mechanics.

Our knowledge of orbitals also helped us to understand why each element has the type of chemical reactivity that it has. This is because chemical reactions are all based on the electron configuration within the orbital structures. Elements whose electrons have filled a perfect number of orbitals have no wish to react. Elements with one more electron than these will do everything in their power to get another element to take it away from them so that they can also have a perfect electron state. They find a suitable partner in the elements that have one electron less than the perfect number.

The most surprising aspect of atoms may not be that they are only made of three kinds of particles, but that they have magical spaces around the nuclei called orbitals. Without orbitals our material world would not have had chemistry, so life in its current form would be impossible.

### The genius of orbitals

When particle types three the atom did form  
It wasn't just a new entity born.  
The integral structure it would take  
Would give rise to variety, a new world to make.

If you or I were to guess what would be  
From plus, minus and neutral particle's three,  
We might think plus and minus in a married embrace  
With their neutral children in encircling space.

But no...

Down at this level the forces that act  
Give us results more surprising than that.  
The positive protons and neutral neutrons  
Are the heavy centre, the nucleus' sons'.

Strong nuclear forces (thought of in hindsight)  
Are what prevent them from moving apart.  
But what stops electrons, minus and small  
From collapsing into this positive ball?

Pockets of spaces surrounding this weight  
Are homes for electrons in a surprising state.  
We usually think of these fellows in movement  
Going round the nucleus with quite some excitement.

Yet they live in sister-partnership pairs  
As close to the nucleus as possible, where  
The energy needed for life is the least  
For containment and balanced-being at peace.

When you arrive to visit their home  
By their address your reception is known.

Some electrons elope at the drop of a hat  
While others might leave you outside on the mat!  
(or, be invited inside for a permanent chat!).

So, because of these orbital spaces (by name)  
Their chemical natures just can't be the same.  
Which is why each element with structure unique  
Is different from its neighbour in more ways than physique.

## LIVING WATER

In chemistry, water is thought of as  $H_2O$ . We study its chemical reactivity as well as how it moves through the phases of solid, liquid and gas. The energy involved in each of these changes is an important aspect of chemistry. This poem shows how some of these changes occur in nature.

This piece is about the water cycle and hints at the energy changes with mood and movement. The sun's energy frees the water from the liquid state, and when it cools down at the top of the mountain it turns back into water. This water is now high above sea level, thus, has an enormous amount of gravitational potential energy which powers it back to the ocean or lake. This poem tells us more about the dynamism of energised water than about chemistry, but gives students the opportunity to live into the qualities of water in its liquid and gaseous phase.

### Living water

Sun lifts the water from the sea,  
Lighter than feather rising free.  
Drifting towards the warmth of land,  
Over beaches soft with sand.

She sees the river of her future  
And dreams of dancing-splash with her.  
Through trees she hears wind's whistling thread  
When pushed up lands lifted head.

Surrounded now in cool-mist hush,  
Joining her neighbours comforting touch,  
She relives the feel of combined weight  
And falls to earth with growing haste.

Hitting earth she writhes and turns,  
To join the movement now she yearns.  
In growing numbers they toss and flow,

Cascading, smashing, letting go.

And when their numbers steadily grow  
They settle down to laminar flow,  
Smoothing down the flattened earth,  
They move back to their place of birth.

Back with their blessed mother,  
They tell their stories to the other,  
Of joyous flight and powered might,  
Moving in ocean currents light.

## ELEMENTAL BONDING

In South Africa, chemical bonding is taught to all school students in Grades 8 and 9 [thirteen- and fourteen-year-olds]. As a result, I often introduce this topic to the students in a broad, artistic or philosophical way to get them thinking about it prior to learning the details. Montessori called this approach “cosmic education”, because you begin with the whole cosmos and then place the content details in a particular context. Steiner, the founder of Waldorf/Steiner education, called it teaching ‘from the whole to the parts’.

This poem aims to get students thinking about chemical bonding in relation to their own experience in life. It also tries to give some dignity and honour to bonding by showing its role in the life of matter, plants, animals and humans, thus creating a feeling for the “cosmic” “whole” within which our work will fall.

### Elemental bonding

Can it be love if there is no freedom,  
Bound as they are to act out their nature?  
Can it be passion as they may have no feeling?  
And what about will-power, motive or reason?  
What name should we give to the deeds of the elements  
Whose power to act is so fixed in their bones?

Its fruit is the hardness of steel and of stone,  
The free air we breathe and the place we call home;  
The Earth with its various habitats and formations  
Are all held in place by the elements relations.

And what shall we say of the elements of life  
Who hold in their bonds both warmth and light?  
Enabling embodiment of plant, beast and human;  
A perfect body for each kind to live in.

We humans have reason, wishes and meaning.  
The beasts, awake senses, instinct and feeling.  
The quiet plant with its external organs  
Reaches up to the sun and breathes with the seasons.  
All formed on the body of elemental service,  
The unnamed work of the ground of existence.

## ACID MAN AND LADY BASE

This next poem is a poetic description of some acid-based chemical reactions. When studying acids and bases, the ideas of strong and weak, concentrated and dilute, as well as pH calculations take centre stage, and this happens sometimes before students have really formed a clear impression of the nature of these substances.

The experiments described in the poem below reveal the behavioural properties of each, despite the existence of exceptions to the rule. After the poem I have included a glossary should any researcher decide to use the poem and experiments with a class. A video of me performing the poem and experiments can be found at: <https://www.facebook.com/100069084456951/videos/335065760214656>

This poem describes two experiments using acids and bases. The first experiment involves ten reactions. Hydrochloric acid is placed into five test tubes which contain the five different substances mentioned in the poem, and sodium hydroxide base is then put into five different test tubes with the same five substances to observe how they each react in order to see their different chemical nature. The second experiment involves reacting acid with base directly as indicated in verse 5. Using fairly concentrated nitric acid and potassium hydroxide together, shows the vigorousness of the reaction. It also gives rise to the formation of a salt which may crystallise within an hour. This shows the learners the nature of acid-base reactions and how salts are formed.

### Acid Man and Lady Base

Of these the ancient Alchemists spoke  
Who knew them both as active folk.  
Base, born of metal and acid her mate  
Have needs that only the other can sate.

To find their nature, for what they strive,  
We place in sets of test-tubes five  
Magnesium, milk and copper sulphate,  
Crushed chalk and oil; our sacrifice, our bait.

Acid brighten, dissolve and boil  
To lift from solid its heavy toil  
In one swift act his halide sword  
Or brimstone fire has form destroyed.

Slower working, to hold and bind,  
Our Lady's fruits though soft in kind,  
Take what is loose, unbound and free  
And ground it, give it presence to be.

When together these two we place  
The drive, the need, the hot embrace  
Seems like a fight to dominate the lover.  
Inanimate opposites attracting each other.

Then, left to cool and crystallise,  
As children born of their parents' demise,  
Small shining seeds; salt crystals delight,  
To fructify the Earth as solidified light.

### **Glossary of terms used in the poem**

Alchemists	Early experimental scientists who looked for the qualities and properties of materials which related to human nature
Folk	People
State	Satisfy
Toil	Burden or to work hard
Halide	A reacted halogen, for example: Flouride, Choride, Bromide or Iodide
Brimstone	An old name for Sulphur
Ground it	To make it solid and to take a form of its own
Inanimate	Not able to move of their own accord
Demise	Death
Fructify	To bring new life or ideas

Facilitation tip if the topic of sexuality arises during discussions following the use of this poem

When using this poem, it is important to discuss the alchemist association of masculinity with acid and femininity with base. In discussion with students, I will often ask them who in their family demonstrates acid or base behaviour, their mother or father? It is often a reverse of what is presented here, and this helps students to not develop an unthinking approach to the topic. Further, the topics of homosexuality or hermaphrodites [folk who are neither male nor female] may be asked about by students. I will then add the idea of alloys of metals and compounds where non-metals react together, like in the formation of water, to add chemical examples to our thinking. In the case of those who are either hermaphrodites or who feel themselves as neither male nor female, I mention the metalloids, elements which demonstrate both metal and non-metal properties, but which are not included in the poem. The inclusion of such ideas will add a scientific dynamic to the debate, allowing the students to take this information into their own deliberations.

## PLANETS, METALS AND TIME

This poem is my attempt to honour the ancients who created our seven-day week. They took a month of 28 days and divided it into quarters. They then named the days after the planets that were then known, where they also thought of the moon and the sun as “planets”. The qualities of each planet were associated with a different metal, and my inner science-teacher was thus tempted to create a poem that wove the nature of the metal into the nature of the planet as I believe would have been part of ancient lore. It is also interesting that the ancients had no problem holistically connecting the qualities of planets, metals and time.

If we follow the ancients in having seven days from seven planets, and use the celestial bodies that we know are actual planets, we would still have seven if we excluded the Earth and Pluto.

In English we have lost some of the easy associations of the name of the week to what the ancients thought of as planets, however, the Latin languages still have them clearly, with Monday—Lundi [Lunar], Tuesday—Mardi [Mars], Wednesday—Mercredi [Mercury], Thursday—Jeudi [Jupiter] and Friday—Vendredi [Venus] being the names in French.

Thursday is associated with tin, but we don't have a common association with tin, therefore I left it out here. In the previous verse, mercury is the name for both the planet and the metal.

### Ancient weekly wisdom

The Metals and planets have long been connected  
With imaginary threads and mythical devices.  
Yet more interesting still is the naming to time,  
In our seven-day week with ancient paradigm.

**Sunday**, bright shining, a **golden** beginning,  
The central pivot of glory and righteousness winning.

Monday, **Moon**-day, **silver**-spoon start-of-work day,  
Reflecting the light of yesterday's Sun- day.

Tuesday, **Mars** day, rich-rust-**iron**-red-clay,  
The ground forging strength for individual life-path-way.

Wednesday, **Mercury**, quick flowing, hard-to-see, Shining paradox of a heavy  
weight moving free.

Thursday, **Jupiter**, visible moons and great size, Bright-slow-moving-night-  
light so distant, so wise.

Friday, **Venus**, soft-**copper** warm-containment,  
Bright-chasing the sun as enfolding love raiment.

Saturday, **Saturn's**-way, great week-end perspective  
**Leads** deep-true impression; inwardly reflective.

The later found planets and their radioactive metals,  
Uranium, Neptunium and Plutonium made nine,  
(Now eight with Pluto's odd and skew orbit).  
Have not changed the week from a Moon-cycle-quartered.



## LET'S TRY AGAIN

Teaching brings its own challenges of trying to encourage students to develop a committed attitude to their science studies. This story relates just one of many times when I've reached the edge of my abilities and patience. In this case, there was fortunately a "drop of light" at the end of the tunnel.



I'm frustrated, concerned but quietly hopeful; ultimately, I'm grateful.

It's 5 am Saturday morning and I've been woken up by the morning call of birds and my Grade 12 science experience of the week. The schoolyear began on Wednesday and I have seen the class each day. I've not taught any of them previously. We came to an agreement on our first day; a commitment to understand everything every minute of every lesson.

On Friday this commitment met its first real test. While studying "frames of reference" they were asked to work out how fast an aeroplane is moving relative to a girl walking on a moving train, where the girl and the plane are moving in the same direction and the train in the opposite direction. The challenge here is to see what everything looks like from the girl's perspective. This involves imagining that the girl is standing still and everything else, including the ground, is moving. It's a bit like walking east and imagining that you are stationary and the ground is moving west underneath you, only more complex.

At the end of the lesson I could see that several learners were finding this very challenging and giving up. At that point something inside me snapped. 'You've chosen to do science! Science is hard!! Some of you are finding this hard and are turning away. Where would you be if your parents turned away when life got hard? You've chosen to understand everything in every lesson. This is your first real test and you are turning away. This work is hard. Now do the work to make your commitment real!' As I spoke, I saw a slight attitude shift in several learners who had been giving up. It looked like a softening of attitude and a reopening that quietly says, 'let me try again.'

## FRIDAY AFTERNOON LESSON

Government controlled education is often accused of putting assessment before education. This is because there are high-stakes assessments that will be gatekeepers to higher education opportunities, so everyone wants good results. Education, therefore, gets focussed on learning the culture and expectations of those assessments, and students get trained to master what is expected in these and learn little else. It also places an enormous stress on the students, as they know that this is an unforgiving initiation into an uncertain adulthood.

This story is from my time teaching in Johannesburg.



It is getting close to exam time again, so the rush to finish the syllabus is on. My matrices came for an hour and a half after school on Friday. They were tired and not all of them were there. The work being covered, Chemical Equilibria, requires interpretation of graphs and mathematical calculations.

At one stage I shifted from looking at Concentration – Time graphs to working with Reaction Rate – Time graphs. By this stage we had good momentum on the Concentration – Time graphs and the sudden change in direction had left me pretty much having turned the corner onto Reaction Rate road on my own! After some backtracking and subtle navigation, we got back together, but as you can imagine, the progress of our afternoon trip from here was slow.

Despite the tiredness, stress and pressure, we still had a few laughs and ended up fresher than we began. By the time we finished, my love and respect for these dedicated, beautiful students had taken another mysterious step towards my centre. Now, at 05:08 am on Saturday morning writing this note, I feel like I've been injected with a warming draught. As it flows my eyes droop, and my weekend rest can begin in earnest.

## THE COMMITTED TEACHER

Science education usually focusses on the development of our mental faculties, however, we need to encourage our students to develop other faculties if they are to be successful in science. In 1835, the Irish poet John Anster translated Part One of Johann Wolfgang von Goethe's masterwork *Faust*. The passage below, which gives us a clear picture of one such needed faculty, is from a section titled *Prelude at the Theatre* [*Vorspiel auf dem Theater*] and was spoken by a character called "Manager" [Direktor]. It elucidates the profound truth that stands behind Nike's advertising slogan of 'Just do it.'

Are you in earnest? Seize this very minute—What you can do, or dream you can, begin it, Boldness has genius, power, and magic in it, Only engage, and then the mind grows heated—Begin it, and the work will be completed!

This quote speaks to the quality of immersion of the teacher in the classroom, and how it really matters. Does the teacher carry a total belief in their work and in the potential of the children in their care? Many young people in South Africa have a lack of meaning and self-belief. I believe that the remedy for this is for them to see adults working with love, investment and belief. How differently would we educate if we recognised that every thought, every feeling, every action has consequences for our students? I hold that everything is meaningful and shapes the students in ways that are impossible to tell, because what we do gets buried deeply into their psyche and only re-emerges many years after they have left our care.

Kahlil Gibran in his book *The Prophet*, lays clear for us the need for this quality or faculty to build a personal intimacy and sense of responsibility in education.

'And if you cannot work with love but only with distaste, it is better that you should leave your work and sit at the gate of the temple and take alms of those who work with joy.' (Gibran 2015: verse 33)

Gibran goes on to discuss the relationship between passion and reason to manifest and maintain this kind of love-filled work.

'For reason, ruling alone, is a force confining; and passion, unattended, is a flame that burns to its own destruction.

'Therefore, let your soul exalt your reason to the height of passion, that it may sing; 'And let it direct your passion with reason, that your passion may

live through its own daily resurrection, and like the phoenix rise above its own ashes.' Gibran 2015: verse 58)

Einstein is said to have expressed Gibran's idea something as follows, that the intuitive mind is a sacred gift and the rational mind is a faithful servant. And that we have created a society that honours the servant and has forgotten the gift.. (Samples 1976).

May we education researchers and practitioners of science always remember this.

## JUST ANOTHER BAD DAY

As a teacher, you just cannot avoid them. So much about your life as a teacher is out of your control. I will never forget the story of a young teacher walking into the staffroom at break saying something like, ‘I was so well prepared! And it was going to be such a fun lesson! Teaching would be such a great job if it wasn’t for the xxx students!’

But it is not just the students who may have a different idea of what is needed. The perpetual pressure on teachers also takes its toll, and we get worn down to the point where making even the smallest extra effort can feel like it will break us. Sometimes we become so exhausted from too many of these experiences that we need to dig deep to find the strength to carry on. Then it comes down to an inner negotiation to make the effort. It is not always the case, but this story records an occasion when the adult in me won.



Another bad day

This morning I’m a broken man. My self-confidence is close to zero and I don’t know if I believe in what I do anymore. The work seems irrelevant to my students’ and to me. All I see is bits of paper with meaningless notes and numbers. My mature learners are not taking the work seriously and ploughing through mud must be more rewarding than this. I’m not enjoying teaching them and am not motivated to prepare fun activities either. A vicious spiral to destruction. Someone must do something. I’m the adult so it’ll have to be me. Bugger! It’ll keep bothering me until I act, so rather now than later.

‘They don’t deserve it! Ungrateful, lazy xxxers!’ is my angry inner response, resisting the impulse to be a responsible adult.

I try to fight back with, ‘Yes they do, they’re just kids!’. Then the winning argument, ‘They don’t know what they don’t know,’ I say lovingly to myself.

A fresh set of notes on the new topic with a decent worksheet will get them working and build their confidence.

Two days of comfort were gained. We saw each-other in a better light and we lived into the work. It came to life around us and we could lightly feel its reality and learn from it. Then gone, and for most, all they could see was an irritating and demanding teacher. But some remember, and that may make all the difference.



## **SLOW BUILD, CLEAN BREAK, TO GAIN PERSPECTIVE FOR A NEW TAKE**

This piece is a depiction of the evolutionary process of development. In the science classroom it does not take such a dramatic form, but it nonetheless follows the same pattern when ignorance is transformed through pain and effort into knowledge and understanding. This poem has only one line at the very end that reflects the new state of mind where the balance is restored. This process explains why pessimists know that life is mostly pain and suffering, and why optimists trust that everything will be OK in the end.

### **Slow build, clean break.**

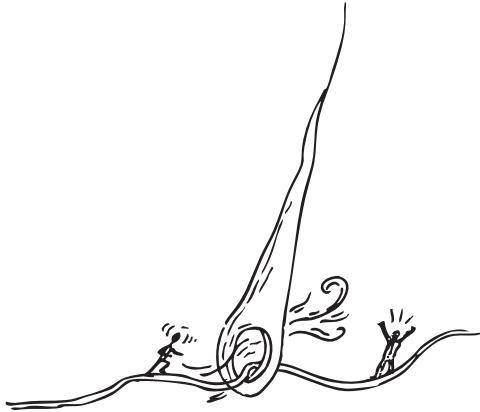
Breathe easy, they mean no harm.  
The world is good and we are fine.  
These little things that come and go  
Test us for our strength of mind.

The build is there but I can cope.  
I have the time to take a breath,  
To keep compassion and openness,  
To maintain my sense of health.

But now the source of my balance  
Can no longer bear the strain,  
And turns now to meet my needs  
Instead of giving what feels in vain.

The first break, gentle and small  
Comes as a plain request.  
The second as a storm of pain  
Loosed from my exploding chest.

Salt-tears and thunder, the rent of mind  
As inner-discord tension is drained.  
Broken, broken, fallen, fall.  
Non-essence gone and cleansing gained.



## GETTING INSIGHT THROUGH PERSEVERANCE

In the teaching of science, students often struggle to gain a clear understanding of the work. It is the teacher's blessed task to guide them through a series of manageable steps until the integrated whole can be grasped. The following story is an enhanced version of that "aha" moment, when we eventually "see" all aspects of a problem after wrestling strenuously with it for an extended period of time. When we engage all our faculties to our full capacity to solve a problem, we are always gifted with some insights if we persevere. I have seen this with my students and in my own life.

The following story describes this process when starting my PhD. For roughly nine months I wrestled to get a clear insight on how to conceptualise my study. I was trying to find an academic framework to justify studying my relationship between science and religion in the formation of my wreality as a science teacher. I wanted the spiritual, indigenous, religious and scientific aspects of my work to be seamlessly woven together to make a coherent study. Prior to the dream that led to the insight presented in this story, I had no idea on which philosophical or theoretical ground to place it.

Knowing how to structure my PhD involved doing lots of reading on what others have done in potentially related fields. On several occasions when reading on a specific topic, I became convinced that "this was it", only to later realise that certain important aspects were missing.

The metaphor of a journey to find "my land" used in the story below is from the dream I had on the morning when the miraculous power of my subconscious mind eventually formulated a meaningful way to position my work. The original dream was reworked the very next morning to give the bones of this story and the ground on which my study was built.



Two-hundred days ago, I set out in search of new land; the homeland of my wreality.

After wrestling for 200 days, almost a full gestation period, I am writing.

My single commitment for the day has been cancelled. Even my lectures have finished for the semester, however, none of this is why I am writing.

I have been at sea. A sea of readings and conversations and experiences. I set out in search of a new land, one that would form the ideal setting from which to present my study. I needed it before I could start writing, and from the start I trusted that I would recognise it when I found it.

For 200 days, it was mostly just ocean; a never-ending meeting of shapes that kept changing, of movement, a perpetual rise and fall, of storm and wind and rain, of calm and sky. Each weather as powerful and beautiful and blessed and scary and overwhelming as the next. On the ocean the weather shook us right through, cleansing our gut, fighting against our survival. A reminder to hold onto our resolve that ‘the Son of man’, the human who wishes to journey as an independent being born out of our inherited humanity, ‘hath not where to lay his head’ (Matthew 8:20).

Each sighting of land lifted my heart with hope. Landing on its shores, I would leap and run with the mind of a child—the Bible tells us this is the way to do it—tasting and smelling and looking and loving and lost in small words captured in mountain-range sentences. And I wrestled with the landscape to see if it represented all the elements that my land needed. From the peaks, I experienced the land’s magic vistas and limitations, each being beautiful and rich was yet but an island and not yet my land. So back on the ocean of new readings, new names, new whole oceans of thought and experience; new hope, new trust, new faith; renewed resolve to become a Son of man.

The signs were there before the landing, before even the sighting of the land. Things began to feel familiar; the weather, the warmth ... The smell was faint, but already the outer-new on the wind was met with an inner echo of recognition, of knowing where this belongs, of home. The indescribable comfort of yourself coming to meet you in a new world, like the upwelling of bliss from a song that floods you with dance in fullness of heart and mind.

This is a reference to the readings that I was doing to conceptualise my study.

I am writing because I’m back on land—a good land to be sure. My new land seems mostly unpopulated and unshaped—I have yet to explore it—but its solid steadiness underfoot and that smell of rightness gives me confidence

that now is the time to start writing. I can still feel the motion of months on the water and I know that I must write now while the two worlds are alive in me; the journey and the arrival, the sea and the land, the familiar and the unknown, the inner and the outer; while I am both moved and grounded.



## HEISENBERG DRINKS FROM THE CUP

Werner Heisenberg [1901–1976] is regarded as one of the founding fathers of quantum mechanics. He is sometimes regarded as a Nazi collaborator because he worked as a scientist in Hitler’s regime. One of the reasons why the atom bomb was so furiously pursued in the USA during the second world war was because they knew that Heisenberg would possibly be helping the Nazi’s to develop one. To the best of historical research, it is established that he was responsible for discouraging the German effort from developing an atomic bomb, it is, however, unclear whether he did this deliberately or by mistake (Rose 1998; Walker 2013). Heisenberg’s pre and post Second World War behaviour was always to support the Jewish scientists with whom he worked, and his deeply spiritual and philosophical nature (Heisenberg 1958), although dismissed as a cover by some, has been deeply appreciated by others.

Prejudice is when one looks at reality and only sees what you already believe. It is then surely a mind free of such prejudice that became the first to recognise that the universe reveals limited information in any moment, so that the more we know of one aspect, the less we can know of others. This is known as Heisenberg’s uncertainty principle in its application to knowing the position and momentum of subatomic particles (Busch et al. 2007). It is not just this profound insight that convinced me that Heisenberg should be taken seriously.

Here, I present two simple, yet profound insights that Heisenberg shared about his relationship to science, nature and God.

‘Natural science, does not simply describe and explain nature; it is part of the interplay between nature and ourselves.’ (Cavallo 1982)

This second quote is given as Heisenberg’s understanding of an evolution of consciousness that a true scientist will experience if they pursue their science to its depths. His trust in the deeply personal enrichment when we commit ourselves in the service of science is what I find so inspiring. This quote is also given to the reader as a prelude to the piece, *e and me* that will follow shortly.

‘The first gulp from the glass of natural sciences will turn you into an atheist, but at the bottom of the glass, God is waiting’ (Dimitrov 2010: 151)

## FEYNMAN: THIS IS NOT YET A SCIENTIFIC AGE

Richard Feynman is often regarded as the top scientist of the twentieth century after Einstein, for his work on quantum electrodynamics. In his work, Feynman found a way to combine the two greatest theories of the twentieth century, Einstein's theory of relativity and quantum theory. He achieved this with the use of artistic diagrams that helped in the formulation of workable calculations. These are called Feynman diagrams.

The ideas from the various religions have served as a great stimulation for artist's imagination over the ages. The architecture of religious temples, synagogues, mosques and churches, as well as stain-glass windows of great cathedrals and mosaics of mosques are just a few examples of this. The great painters, Raphael, Michelangelo and De Vinci were inspired by religious ideas in their works, as were various classical musicians like Bach and Mozart.

Feynman challenges science by asking, where is the stimulation that science is giving to our artists? It would be unfair to imagine that science has not stimulated the arts in any manner. The artistic use of technology in music and film are the most popular forms of art in the 2020s. However, this is not Feynman's question. Feynman is asking about artistic stimulation from the ideas of science, and in this I believe he is still mostly correct.

The quote that follows has served me well in supporting the idea that science will only reach its maturity when it can inspire our artistic imagination in ways that religion does.

'Is nobody inspired by our present picture of the universe? The value of science remains still unsung by singers, so you are reduced to hearing – not a song or poem, but an evening lecture about it.

This is not yet a scientific age.'

Richard Feynman (1955: ) Nobel Laureate Physics 1965

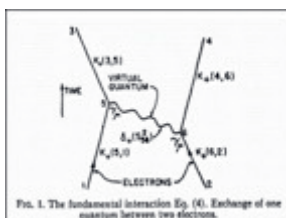


FIG. 1. The fundamental interaction  $E_0(k)$ . Exchange of one quantum between two electrons.

## E AND ME

I wrote the following story many years after the experience that it describes, hence the inclusion of some reflections. This is one of several life-changing experiences that I have had, that confirm for me the Heisenberg quote of finding God (Bell 2019) after a deeply committed investment into finding the truth. This story stands as my personal confirmation of the deep relationship between scientific and religious experiences when we pursue our efforts with full personal commitment.



At the age of nineteen, in my second year of engineering, I encountered the number  $e$  for the first time.  $e$  is not the same as  $E$ , which stands for energy. Before meeting  $e$ , for as long as I can remember, I was an atheist.

In roughly the fourth month of my second year, I was using the number  $e$  to simultaneously solve problems in mathematics, physics and chemistry. Initially I was just irritated by having to use a symbol that I did not understand. Then I became annoyed when I realised that my rational subjects were being taken over by an irrational number.  $e$ , which is equal to 2.7182..., has non-recurring decimal places that carry on forever, which is why it is called an irrational number.

My irritation did not last long.

What was so important about this number that it got its own letter? Upon a little investigation, I uncovered three things that turned my head and made me start to think differently about everything.

The first thing I discovered was that  $e$  represents 100 per cent efficiency 100 per cent of the time. A simple way to think about this is to think about earning interest in a bank. If you invest money at 100 per cent interest per annum, you will double your money at the end of the year, however, banks do not work like this. They add the interest to your account regularly throughout the year and so you end up with more than double your money because you have gained interest on the interest that they add to your account.

Assuming you invest R1 and the bank gives you 100 per cent interest per annum, the most money you could end up with at the end of the year would be if they add interest into your account every second or even every split-second. It turns out that the maximum amount that you can earn by the end of the year is R2.718... which equals e.

This got me thinking, and it brought me to the second thing that I discovered. If e is being used to calculate the behaviour of matter and energy in physics and chemistry, that must mean that aspects of nature operate at 100 per cent efficiency 100 per cent of the time. How can this be? If the universe had randomly evolved as I then believed, how did a perfection principle get woven into it?

The third thing I discovered about e was its multidimensionality, that is, it gives an identical answer in every dimension. Explaining this will take some doing, so take a deep breath if you are not already familiar with the mathematics of calculus.

Distance, speed and acceleration are all different aspects or dimensions of motion relative to time. Distance is how far you travel. Speed is how far you travel divided by the time taken. Acceleration is how fast your speed changes, or speed divided by time.

$$\text{Speed} = \text{Distance} / \text{time} \qquad \text{Acceleration} = \text{Speed} / \text{time}$$

Each change from distance to speed and then to acceleration requires dividing by time. These changes have to do with a branch of mathematics called calculus which involves two opposite processes, integration [finding the integral] and differentiation [finding the derivative]. Simply put, the derivative of speed will give you acceleration, and so the reverse, the integral of acceleration, is speed.<sup>12</sup>

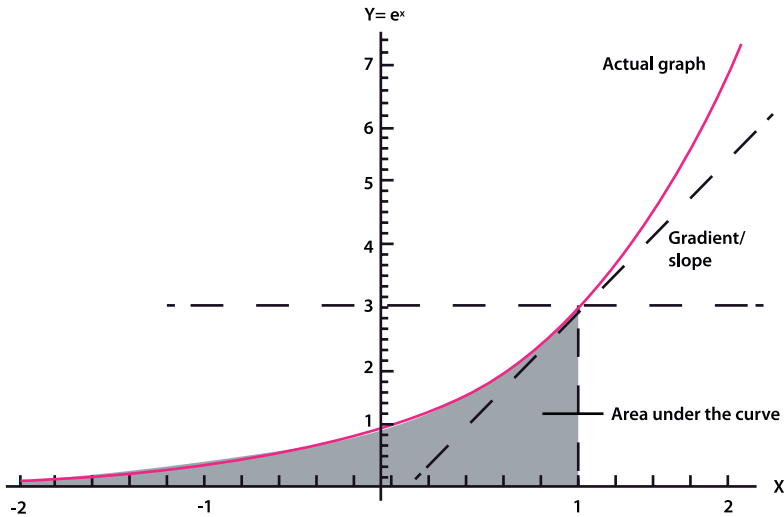
Now, I'm sure that you would find it most unusual if the value of your speed, distance and acceleration were the same all the time, but this is exactly what happens with e. In fact, the only number where the derivative and

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12 There is a gaining or losing of a constant along the way, but we do not need to concern ourselves about this for our current considerations. This change is very interesting for thinking about what information is lost or unknown as we move from one dimension to the next, but this goes beyond the scope of this story.

integral will be identical is if you begin with  $e$  to any power. The mathematical equation for this is  $Y = e^x$  as shown in the graph that follows.

Graph of  $Y = e^x$  where the  $Y$  value of 3, on the vertical line, was chosen for our example



On the graph above, the  $Y$  value of three was chosen as our example [see the horizontal, flat dashed line]. Here, at the point on the graph where the flat dashed line cuts the red curve,  $Y$  has a value of three, but it will also have a gradient of three and the area under the curve up until that point will also be three. This would equate to you travelling at three meters per second with an acceleration of three meters per second squared after having travelled three meters. If we had chosen a  $Y$  value of four, each of the other values would also be four, and so on.

Mathematics is so cool that we could now make separate graphs for distance, speed or acceleration and they would look identical! And each new graph's derivative and integral would also generate identical graphs! This means that we could keep generating graphs of higher degree derivatives or of successive integrals and continue to get identical graphs forever.

If all this mathematics makes your head hurt, then think of it like this. Imagine looking at yourself in two mirrors, one in front and one behind you, where your image keeps repeating itself forever. The only difference is that you see this repetition on both sides of you, so you realise that you are not the

“whole” of you. The “you” that you currently are is simply a point somewhere between an original you on the one side and a you that is yet to come on the other. I must stress that this only works for the quirky little number  $e$ . Any other number would give you different graphs on both sides. I took this anomaly as an image of mathematics and nature’s way of saying that only complete perfection is allowed to replicate itself through all the layers and dimensions of reality.

The upshot of these three findings on my poor soul was devastating. It set off an existential crisis of monstrous proportions resulting in a situation that was as deeply embarrassing as it was illuminating. Dear friends, I would love you to imagine that what I am about to describe is written about someone that none of us know; something that perhaps did not even happen but is given as a story to illustrate a point. Alas, this is not the case, and to bring this story to its proper end, I am required to be as truthful about my reality as I am about the extraordinary world of  $e$ . Unfortunately, to honestly represent my developing understanding, the sublime perfection of  $e$  is about to be besmirched by a marijuana-fuelled urinating experience at full moon.

I was not exaggerating when I said that these findings set off an existential crisis of massive proportions. I became an anxious wreck who was realising that my wreality, the only thing that I felt I could rely on in life, could not be the truth. Having now lost my life-bearings, I was self-medicating with marijuana, otherwise known as weed. Weed led me to the company of others in a similar mental state. The effects of our self-medication made us see things differently, but the relief was only short-term except for this once.

An old, dyslexic school friend, Dick, arrived at my house one night with some Durban Poison, a particularly strong brand of weed at the time. He was a reborn Christian and we were talking about God and related stuff. He was not one of those preachy types and we stayed chatting in his car and drinking water for hours after smoking a little weed. My dilemma surrounded the question of how we could know that God is real when there seemed to be so little evidence of love. And what kind of love is it if it is conditional on first needing to believe in Him in order to receive His benefits. Further, this idea contradicted the supposed freedom that we are supposed to have if we believe in God.

e (the number  $e$ <sup>13</sup>) had already convinced me that there was some extraordinary order that underpinned the natural universe, but I could not think that this order came from the biblical God. After about three hours of talking, I needed to urinate so I stepped out the car and headed for the grassy verge. There was a thin weed standing about twenty centimetres higher than the rest of the lawn and I aimed at it. It immediately bent back horizontally from my impressive force, but, when I swayed a little, it sprang upright. Getting back on target, I was certain that the stem would break and remain flat against the ground once I was done. As nature had it, I ran out of stream and the weed came upright again. It shone up at me in the bright moonlight.

In my elevated mental state, I smiled as I imagined the weed shaking its angry fist at me for having just tried to kill it. Sobriety returned as I realised that it was not berating me—that nature never berates us. Nature just faithfully continues following all her natural laws leaving us free to do with her what we want by giving us the materials and forces to express our free will. Whether we build or destroy, she carries on. Even when we make life hard for her, she simply continues as best she can, aching and struggling along, but never turning accusingly to wake us from our stupidity and cruelty.<sup>14</sup> Matter and life create the possibility for us to do as we please. We can use all its materials and forces to serve our own purposes and express our freewill, unjudged by nature no matter the cost.

This was the final piece of the puzzle. My heart swelled full at the realisation that I could not imagine a greater expression of love and respect for our freedom than this. As I lifted my gaze from the weed, I felt and saw a golden glowing wave of presence and acceptance spread out from the weed over the whole Earth. My lifelong, deep love of nature was now enriched by seeing the radiant loving presence of God. This presence, which was normally hidden within matter, stepped out before my now-opened eyes. I now knew that my beloved nature was filled with a perfection and love that surpassed anything I had previously imagined. Even human freedom took on a new perspective. The process that started with  $e$  and the perfection principle that was a part of

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13  $e$  is also the name of a 'happy drug' called ecstasy that luckily for me only came out once I no longer required self-medication.

14 Even with nature's current struggle to cope with global pollution and destruction, I believe that this thought is still valid.

nature, ended in a transformed relationship between myself and the world. My realisation that the God of Love from the Bible was real and present in matter itself, moved and comforted me as deeply then as it does today.

My journey as a recovering atheist was not easy. No religion or religious practice suited my need to rebuild my relationship with such a Presence as this, and so I remained adrift in a world between science and religion like a worn-clothes beggar.

e,  
A humble number are thee,  
A divine Presence to see, So much bigger than me,  
Being freedom-loving efficiency.



Dear friends, please note that I have not called this story ‘weed and me’, even though this would not be wrong and it would be cute with its double meaning. Nor did I call it ‘God’s call to me’, which sounds as preachy as it is misleading in that the experience felt more like God and I as partners in the process. Credit for the massive healing that has happened slowly over time since this experience must go to e. This unassuming little number stands as a representative for the Presence in nature that opened me to worlds of perfection, love, freedom and religion. So please forgive the use—or is that misuse—of both weeds and my lack of toilet etiquette. I suppose an important aspect of growing up means having the humility to acknowledge our imperfect nature and the indiscretions made on our journey.

$e = 2.718\ 281\ 828\ 459\ 045\ 235\ 36\dots$

This experience led to me changing my study course from mechanical engineering to education. My interest in human beings overtook my interest in working with machines. My burning question was to know what human beings are, what is our true nature. I figured that if anyone can teach me about being human it will be children, as they bear more of the purity and innocence that would teach me what I wanted to know.

This book is a testament to the fruitfulness of that insight.

## SECTION 3:

### TEACHING SCIENCE

This section initially presents several pieces with writings and stories derived directly from teaching science. Many have been written out of frustration at the challenges of the task, while some are expressions of joy and awe at what we science teachers do for a living. They are presented here to give a taste of the struggles and joys of teaching science.

For the most part the stories in *Even opposites find their place* are the result of insights gained by connecting opposing ideas. Such insights often occur from something a student asks, a colleague says, or something that I read. It then stirs and stews in my mind for some time until I feel that I have a relatively distilled way to express it. This reflective and cross-referencing process can take years, but is always tremendously strengthening and inspiring when it resolves into clarity.

*Let's play* is the final part of this section, intended to show how creatively we can exercise our scientifically trained mental faculties and imagination when we don't dismiss unusual ideas out of hand. These pieces are also given to encourage the kind of thinking-outside-the-box that can lead to Nobel prize winning scientific insights.





## DAD, HOW DOES THE SUN WORK?

Children go through significant changes in their relationship to the world as they develop. The change of teeth that happens around the time when children start going to school, and puberty that happens around the time they transition from primary to high school are the most obvious, and like with these, the age that each child will experience the change differs slightly. As a teacher of subjects that require specific mental faculties, I have become aware of two distinct shifts in mental approach to the world that don't seem to be accompanied by big physical changes.

Students at around the age of fifteen or sixteen seem to settle down from the outwardly challenging of adults displayed by the twelve- to fourteen-year-olds. In its place they experience what I call the “gestation of the adult self“. By this I mean that they are now less outwardly focussed and are more quietly working inwardly on becoming stronger and more independent as they develop their adult identity. This can be a very tender time, and they need a lot of encouragement to make difficult choices, like letting go of the friendships that are no longer working for them. It is a time when they are also sharpening their analytical minds to form their independent idea of reality, their wreality. The earlier piece titled, *Teaching Calculus to sixteen-year-olds* looked at an aspect of this. This story is not about the sixteen-year-old change, it is about a no less significant shift that seems to happen between the age of eight and ten.

I have never been a primary school teacher, so have limited experience with this age group. The story you are about to read is about me observing my son, and subsequently reading up on the topic. It seems that a very significant shift happens to children about midway through their primary school years.



Driving home after a glorious day at the beach, we watched the sun as it was moving behind some light clouds, framing them with a golden radiance. Happy, relaxed and filled with childlike reverence, my ten-year-old son, gazing up at the clouds, gently asked, ‘Dad, how does the sun work?’

As a scientist, my initial temptation was to launch into the commonly accepted thermo-nuclear explanation, but caught myself just in time. We had just spent the day experiencing the happiness-generating comfort from the warmth and light of the sun. Our veggie garden at home was one of my son's great sources of delight, and he was fully aware of the fact that the growth of plants is fuelled by the life-giving forces of the sun. Who was I to replace these very real experiences he has of the sun with an abstract, theoretical explanation which is devoid of anything he can connect to.

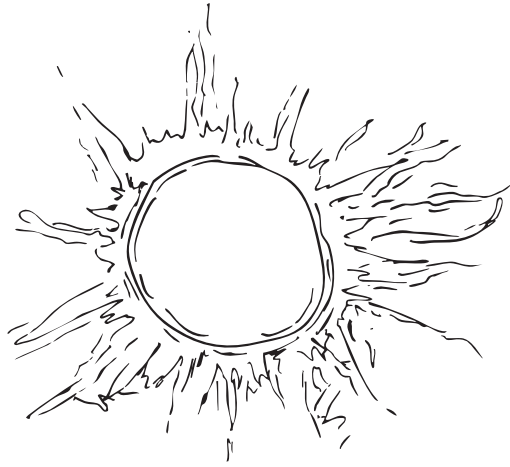
I answered with something like this, 'Every morning, the sun rises and calls on all of life to do the same. The animals awaken and go about their business. The plants open their leaves and flowers and turn their loving gaze towards its life-giving radiance. And we awaken to find the world is still in place and ready for us to start our work for the day. And the sun knows exactly how easily we can become tired, so it leaves us at the end of the day, and as it withdraws its loving light, it allows the quiet lights of the stars to shine through and give us the gentle inwardness of night.' And then trying to connect with what he was possibly feeling and hence the reason for him asking his question, I asked, 'How do you think the sun works so that we could have as much comfort and joy as we had today on the beach? And makes that cloud look so utterly mesmerising?'

He pondered these questions for about five seconds and then asked, 'Dad, how does the sun really work?'

I then gave him the accepted scientific explanation which we discussed until he was satisfied.

The shift in the type of answer that my son was willing to accept from even just the day before, was stark. I spent a lot of time pondering this change. As a high school teacher, I knew that the power of depersonalised and abstract thought increases over time. I was, however, startled by how rapidly its initial onset could be. I concluded that he must have been slowly gestating this shift from a personalised and experiential relationship to his world towards an objective and rational one, and that this shift happened to emerge after a day of wonderful comfort and joy on the beach. I began to think that my son's feelings of inner happiness and peace may well have played a role in him being able to voice the change so confidently; not unlike how the sun awakens the flower from its bud.

To keep all aspects of reality alive in my son, I wanted to ensure that he first recognised his immediate and intimate experiences of the sun's influence before introducing a new layer of understanding. My greatest concern about his question was in making sure that I did not damage the feelings of awe and appreciation that made him ask his question. To see his growing levels of interest in the world through his natural curiosity is a great joy. This was the first time that he had clearly expressed a wish for the abstract ideas of theoretical science and I was delighted to share them with him.



## WALDORF TEACHER TRAINING

All of my undergraduate university education was in the sciences. Even my teaching qualification had a distinct science focus and did not expose me to the arts in any significant way. A key feature of Waldorf education is, however, to use the arts to keep the curriculum fresh and allow for learning in a way that requires the students and teachers to remain in touch with their creative sides.

To be creative in a subject, you must find a way to connect the course material with your inner response and to find a way to express the result. If you have only been educated scientifically, you will most probably not have worked on your intuitive relationship to much of what you studied. This was certainly true for me, and the impact of needing to engage artistically in my Waldorf training was initially quite alarming, but the overall effect was most unexpected, and is a big part of the reason why I do this research. This story is written in the present tense.



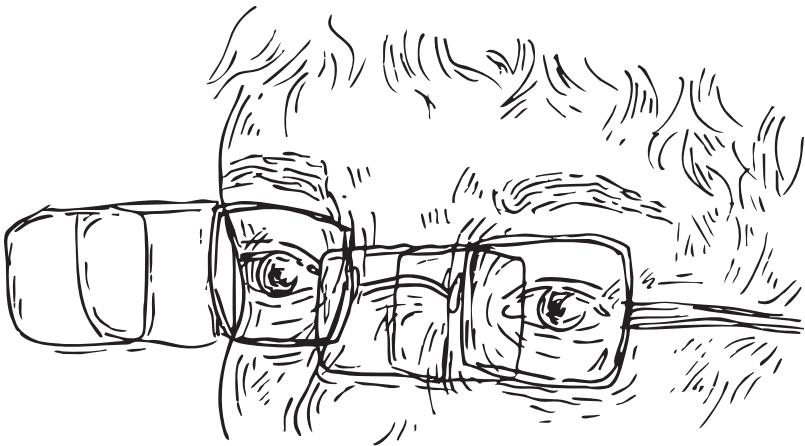
In 1990, I am beginning my Waldorf teacher training. I am already a qualified science teacher with four years of teaching experience in government schools in South Africa. In my training, my 27-year-old self needs to do clay sculpture, drama, painting, drawing, woodwork and metalwork. At the start of my first lesson, our art teacher gives each of us a large piece of good quality paper and only one red block crayon. He tells us to ‘Feel the red. Move the crayon on the paper in a red way’. I have no idea what to do, since I, with my science and education degrees, do not know how to begin understanding what red should feel like. I panic; and then cheat by copying what others are doing. I assume that redness is something universal and specific that I should somehow know. Here, I learn that I need to develop my subjective intuitions and to trust them more.

This same teacher, Benni Kleinhans, when doing wood carving, tells us that wood is “fossilised sunlight”, and we should work it with this understanding. This makes a deep impression on me as this is indeed scientifically true and yet is framed in a way that powerfully stimulates my imagination. This notion

really excites me and I immediately start using this kind of evocative thinking when teaching science.

My Waldorf science teacher, Peter King, describes the periodic table as a picture of the evolution of matter from the big bang. I am already familiar with this from my scientific background, but he then goes on to show how the evolution of matter resembles the growing up of a child, with the earliest-formed elements of hydrogen and helium displaying the qualities of infants and, as you move down the table, the elements show qualities of aging until the radioactive elements at the bottom “die” as they release dangerous radiation and fall apart to form smaller or “younger” elements. I later realise that this type of thinking is where the seeds for my science poetry and prose can be found. At the Waldorf/Steiner school and in my Waldorf training, I experience for the first time a culture where science, personal experience and religion/ spirituality are bridged using the arts. I am, thus, able to engage in my wrestle for a holistic wreality openly and comfortably.

I now have a community of like-minded people who share their own wrestles. In this community, we usually say a verse before each meeting and at the start of the school day, and this stimulates me to write verses of poetry to inspire and create the appropriate focus for some of my classes. Some of these poems are in this book.



## NO CHILD LEFT BEHIND

This poem was originally written in response to then president of the United States, Barack Obama's 'No child left behind' education policy. My total lack of faith in any top-down policy can be seen in the poem. I would, however, love to see a policy where government and its administrative powers are made to provide schools with the funding and facilities to help teachers provide what they believe that their students need.

### No child left behind

There sits a child upon the shelf forgotten, left behind.  
What should we do to get the child to come and join the crowd?  
Loud noises, sad songs and fancy cars; 2 seconds every scene,  
Social pressure, tests, exams, the challenge to succeed.

12 Years of this grand plan has made the child a man  
Who's been so sucked out himself there's nothing left behind.  
To fill the void where once there was a quiet shelf to find,  
Is sex and drugs and rock n roll; panacea for the mind.

So what real substance do we have to do a proper job?  
So that the child, full in itself, extends it all around.  
It happens that the child itself has just the thing we need,  
With wish to play and learn; a seeking-mind to feed.

Each child needs an honest place where interest can be born,  
To test and grow their inner strength 'gainst challenges and scorn.  
Trusting the natural bud formation spent musing on a shelf,  
And when the process is complete, to reveal their blessed, blossom-self.



## ORGANIC, FREE-RANGE EDUCATION

This piece is a critique of much of international governmental approach to education. Their bureaucratic need to be able to measure and ensure improving outcomes gives education a particular culture and climate. As you will already be aware and as will be expressed in this poem, I think there are better approaches.

### **Organic, free-range education**

The fertiliser of our time  
Driving progress and efficiency  
Appeals to our small and self-centred mind  
To compete and to win and be better than the rest.

In schools we've devised ways to make this quite fair.  
With moderated test and exam results we compare  
One child to another and sort them with care  
So that...Umm? We can sell the best fruit at the fair?

Despite the rhyme I don't feel it this time.  
Are we really so small that it's the best we can do?  
Is this the highest our humanity can stretch?  
And does this really bring out our best?

Did Mohammed, Srivastava, Jesus or Buddha  
Einstein, Faraday, Pascal or Newton  
Educationists Hahn, Montessori or Steiner  
Advocate this way to make all life finer?

Was it then Moses, Pythagoras, Confucius or Plato  
Mandela, King, Lincoln or Gandhi?  
All these leaders saw something higher and deeper  
For up-skilling humanity and working together.

Life is long and our roots must grow deep  
In soil with good nutrients and water that's sweet,  
Breathing air that is fresh with bird-song and more  
And in light, warm and clear, from just beyond our reach.

Then the being that we are is the being we shall be  
Growing in harmony with all human diversity  
[Not a mass-produced, monoculture uniformity.]  
And the fruit we will bear when our season is right  
Will be given in freedom, owned by all with delight.

## WHAT IS WORTH LEARNING

One of the more persistent ideas of education is that the teacher is the expert and should dictate what happens in the class. Einstein, among many others, believed that, 'It is nothing short of a miracle that modern methods of instruction have not yet entirely strangled the holy curiosity of inquiry' (Einstein 1949: 34).

Our current idea of education is becoming totally transformed thanks to AI. With new technology we can structure individualised learning programmes for all our students while in the same classroom or online, where the teacher becomes a helper, facilitator and councillor, rather than spending all their time teaching and assessing. But already, over 50 years ago some leading thinkers were proposing that we allow our students to not just learn the content at their own speed and in their own way, but to decide on what they want to learn. Perhaps we can take some value from re-reading the wisdom of Carl Rogers.

'I am reluctant to decide by myself what is important for you to learn because I believe that the most important aspect in learning is to choose what is worth learning. If I alone make this choice, every day I would be reserving the most important part of learning for myself.' (Rogers 1972)

The job of the educator, who is called to be a facilitator, is:

To illicit the real questions that the person has. That's a skill in itself. And it isn't the first and obvious question that is what the person wants to know. Then it is the responsibility of the facilitator to provide rich enough resources ... to not only answer that question but also to show that there are many other related questions which might conceivably be of interest to the learner.

- Carl Rogers (1972, 75: 10 min 30 sec)

## THREAT OF THE ADVENTUROUS SPIRIT OF SCIENCE

Over the ages and in all cultures, many people have believed that the spirit of scientific adventure stands as a force that opposes the indigenous and religious ideas that sustain their communities (Dyson 2007). This spirit of unstructured play, exploration and adventure is seen as threatening to those who imagine that new ideas will destabilise society. They are not wrong in this, but the consequences of preventing it are not good. The oppression of our most powerful tool for personal growth and maturation leads to people allowing themselves to be guided by an external authority and ultimately leads society to cultural stagnation.

This spirit of adventure is usually tolerated in young children until they start attending school. Here, children must then practice what adults regard as serious learning.

In most schools it is not suitable for children to use blankets to create homes, or for a piece of wood to become a truck one minute and an elephant in the next. Yet, during breaktime the only limit to play is the imagination for exploring ever-more stories. The science classroom can imitate this. We can use our playful imagination to apply fundamental knowledge to understand wide ranging phenomena. Student questions and world events then become new frameworks into which to apply the content, giving new contexts for testing our understanding, our world and ourselves. As in unstructured child-play, all ideas can be taken seriously and explored to see how they relate to our current scientific knowledge. In the science classroom, this can mean retaining the spirit of an explorer who investigates everything as it arises. In this mode there are no experts, and everyone can contribute value and meaning to the investigation. In science education circles, this is one version of what is called inquiry-based learning, and it is strongly encouraged in science education (Harlen 2013).<sup>15</sup>

When this adventurous spirit lives in the classroom, the range of questions expand to include all manner of personally held experiences and beliefs such as those from our childhood play as well as from our religious and indigenous

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15 This approach is valued for the development of the science skills already mentioned in this book, but also because of the drop in student numbers who study science-related subjects.

backgrounds. In this way our efforts go towards building bridges between all worldviews in a prejudice-free manner. Knowledge is allowed to breathe between the personal and the universal, the subjective and the objective. In this way the student is invited to fully participate in their learning of science and maths, and to use their insights from the work to grow their personalised understanding of life; their wreality.

This has been my classroom approach for most of my almost four decades of teaching. I have taken it upon myself to make the healthy growth of my students wreality my primary task. The development of our wreality is an obvious consequence of how children play, it therefore makes sense to recognise its central importance in education.

Science education is the perfect tool for the job, because it always presents us with problems that need the application of complex ideas to solve. It is also a solidly tested and proven ground upon which to build a defensible wreality. Is evholutionary science not perhaps the adult way of continuing with unstructured child-play?

## PAPERWORK!

In 2010, about five months after returning to South Africa from New Zealand, I was working in a government school in Johannesburg as the head of physical and natural science. Getting used to the bureaucracy proved to be a real challenge, not because schools in New Zealand don't have paperwork, but because in South Africa each document needed to get printed, shared, signed by all parties involved, and filed. The amount of time involved in getting all of this done was a big frustration for myself and my colleagues, but just getting used to the many systems involved also resulted in a lot of stress.

This story is also an indication of how my energy, that could have been going into planning lessons and enriching activities, was being drained by bureaucracy.



I woke up at 02:45 this morning in a sweat, with “paperwork” on my mind. Minutes of meetings, tests, memo's and circulars from the department, work schedules, documents for GET, FET and CAPS.<sup>16</sup> Lists of responsibilities to perform for each area. Forms for pre- and post-moderation of tests and exams and to ensure that teachers are marking correctly. Forms to check that teachers are checking student's books, giving proper work, teaching properly and keeping up with the work schedules, plus other forms to assess these teacher activities. Additionally, papers for each teacher, each age group and each assessment task.

If filing the forms were a game of Tetris, I lost about three months ago. Why do we have so much paper? Who looks at it and what function does it perform? Does it help our students' future prospects? Is it supposed to protect our students from mavericks' and slobs and to ensure a uniform, national standard for all?

Odd, I reflect, that most of my students' grandparents lived without the written word and now we are choked in it.

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<sup>16</sup> GET is General Education and Training for middle-school students, FET is Further Education and Training for upper-school students, and CAPS is Curriculum, Assessment and Policy Statements which give the guidelines for all upper-school education.

Reluctantly, I allow the bureaucrat in me to answer: Each piece of paper serves a function, to record a part of the whole, to form a link between other bits of paper so that all layers of the world of education, from student to teacher to Head of Department [HOD] to Deputy to Principal to subject advisor all the way up to the Minister of Education can be mapped and recorded. An archive that will show good education is happening.

But why? I retort. It's simple. We don't trust each other! Therefore, we need a trail to prove that we did the right thing. An army of paper to support our actions accompanied by a police force of silent confirmation documents showing that others have checked us every step of the way. Everyone behind everyone else's back.

Does this help my early morning sweats? My filling in of forms or my filing of them? No, it just gets me concerned as to how we got here so fast and whether the net is so tight that any of us will taste freedom from bureaucracy again. Could this be a spark for the next revolution?

Perhaps my wife's advice is best; 'Philip, please turn off the light, go back to sleep and tomorrow, just do your paperwork!'

## ONLY THE FITTEST SURVIVE

“Survival of the fittest” is a common way that Darwin’s evolution is conceptualised. This idea looks at how organisms that are best suited to an environment will survive and thrive until the conditions change. The organisms that are best adapted for the new conditions will then thrive, while some of those who thrived earlier may now become extinct if they are not able to adapt to the changes.

This poem presents aspects of Darwin’s evolution, while critiquing some disturbing consequences of believing that this is the sole driver of reality.

### Only the fittest survive

In this day there is no doubt  
That human-kind is the fittest of all.  
I’m not as sure that we’ll survive  
The smallness that this creed has inspired.

Charles’s gift, his new idea,  
Was formed through detailed observation,  
Disciplined hand and strength of mind;  
‘All things evolve to fit, or die.’

A world not fixed but self-transformed  
Through a right response in every breed,  
Matching need to environmental force;  
Intimate relations with life-forms diverse.

Great working eco-systems have grown  
From micro-impulse in plant, beast and man,  
Each being held dynamically in place  
By the presence of others; an artwork in progress.

Now we, who’re free from this great work,  
Run riot with power to dominate unmatched

Yet still competing as though to survive,  
In the name of Charles, claim 'We're justified!'

Encouraged by sport and business code  
We play the game within the rules  
Thinking mostly of me and mine,  
Imagining, behind the scene, all things are fine.

But ...  
We are the scene, there's no 'behind'.  
Each boom and bust shows all our measures  
To regulate, needs a different basis  
On which to build a lattice contained.

We may want to win but we care for the weak.  
We cheer on the best, and give support to the least.  
By nurturing the soil and the plant who are mute  
We'll awaken to our true, human pursuit.

## TIME TAKEN, TIME GIVEN

In my early years of teaching there were often times when the holiday break at the end of term felt like an interruption. It always took a while at the start of term to get the students fully engaged with what we do in class. After a few weeks the learning dynamics would be fully set up and then we would do great learning while having lots of fun in class. The holiday recess would break this momentum and it would take another few weeks of enormous effort to get things back up and running in the new term. In these times I was so focussed on my teaching that it felt like a flow of vitality through my life. These times gave me so much. The following poem, however, is not about this.

Once I had children of my own, and later, when I got older and my natural flow of energy became less, I found it harder to maintain this momentum. There were also times when my motivation and belief in what I was doing would fade.

This poem speaks of my experience of time when I felt like I was forever running forward without the drive of meaningful motivation behind me.

### Time taken

Tired!

So damn tired!

Nothing is ever good enough and no problem is ever solved.

I know that I am not good enough, but I'm enough for me.

And so are you.

And you.

And all of you.

Why is it so damn tiring?

I'm feeling pushed, but you're not pushing.

I need a break, yet no one is holding me back ...

Time!

Damn time! [Damn time should be in one line]

Me!

Damned me!

I don't know how to take my time.  
How to make my own damn time!

I wish I knew how to shift so that time invigorates.  
Refreshes.  
So that time gives... and not takes.

## ACCELERATING LIFE

The following two poems are a comment on the ever-increasing speed of life. The rush of life always brings to mind the lie that we were told about how technology would make our lives easier because it will do the jobs that take up so much of our time. Instead, as I have already said, what it has done is to take away all the activities that connect us to our world and make us spend more time with technology. And because technology operates at a much faster speed than humans can naturally do, it makes us move faster to keep up with it.

### Accelerating life

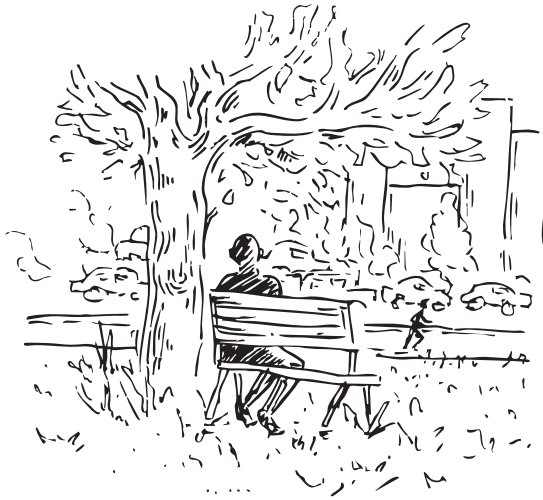
It dawned on me the other day;  
It happened in the usual way  
When I spend the time to look and think,  
Then allow the space to drift and link  
The thoughts in the mind's own fashion.

In every field you care to look,  
From growing plants to reading a book,  
We force acceleration.

Fertilise plants,  
Drive economic growth,  
Standardise learning,  
Mechanise time,  
Impossible deadline.

Rush, stress, competition and worry,  
All human endeavour in such a hurry.

How can we know what we know  
If we spend our time running on the go?



## Please Stop

STOP!!!!!!!

Great God! Stop us in our crazy rush  
Through worldly fuss and mind- distractions  
We've wasted 98 per cent,  
Being spared the rest by Nature.

The young.

The aged.

Those, that on the Edge Of Life  
Bear the Sane Order of the World within.

In moments brief we live That Life  
But fear ourselves to pour all out  
To every soul we truly touch;  
But nothing else matters much.

Let the world's bells blast their tune,  
They have no lasting peel.  
The gentle chime,  
Your soul,  
Mine,  
Is the only sound to calm me down.



EVEN OPPOSITES FIND  
THEIR PLACE

## MEASURE OF SMALL TRUST

The following piece plays on two key perspectives of security, protection and trust. It plays on the modern idea of protection as it is pressed upon us by the insurance companies and how it contrasts with a religious relationship to it. It also shows how a religious life challenges our ideas of security.

The following poem is a mock-up of how an insurance agent might critique the life of Jesus.

### **A measure of small trust**

High walls, electric fence,  
Be sure and use your common sense.  
The criminal mind is one step ahead,  
Create a space to rest your head.

At least insure the things you own  
And some alarm to guard your home.  
You must replace your things if lost,  
And grow your assets at any cost.

*You gave your Son to this?  
No gated place to keep Him safe?  
No Uni degree to ensure He'll be  
With some small measure of guarantee?*

*He chose to leave your home you say,  
No job, no money, no place to stay.  
And you did not provide this Man With health care or investment plan.*

*Thirty three's too young to die.  
I feel sorry for you and your loss.*

*Life insurance can't bring Him back,  
But new car and home will soothe the shock.*

*And some small comfort can be gained  
To see His murderers caught and shamed.  
Our legal system and global media Will bring you justice and popular fame.*

High walls, electric fence  
Be sure and use your common sense.  
The criminal mind's one step ahead.  
Is this the place to rest your head?

## GOETHE AND NEWTON

When teaching at a Waldorf/Steiner school in Cape Town in the 1990s, I was exposed to the phenomenological approach to science of Goethe, the German writer, artist and cultural icon. I was impressed with how he resisted the temptation to find some abstraction or theory to “explain” what he was seeing, but remained connected to the observed phenomena to bring about a personally meaningful and intimate experience. Von Goethe’s approach seems to overcome the intellectual distancing from our world which the scientific theory of our purely rational and objective faculties create. Feeling the passionate intensity of Goethean engagement, and using some of his observational approaches in my own science class, led me to see how our usual approach to science feels like we are leaving part of our humanity behind. In conversation with colleagues, I slowly built up a picture of what Goethe may have wanted to say to Newton and other scientists who pushed for the purely objective science that still dominates today.

This piece is my image of what Goethe’s response to Newton may have been, had he been free to express his deep pain.<sup>17</sup> I have used the Christian idea of communion where the bread is a manifestation of the qualities of love that filled Christ’s flesh. Christ offered his disciples the bread to eat, telling them that it was his flesh. I have used this image because it is so visceral, and because Newton and Goethe were both Christian.



One hundred years apart does not begin to show the distance between us.

You, cold, hard, analytical, fought your way through obstacle after obstacle to achieve your aim, your fame. The most famous book of any scientist of any time belongs to you (Newton and Chittenden 1850).

Yet, I pity your loveless world, your analytical cleverness. Your presence may have been strong, however it was not for life but for death, even your own death.

Oh, loveless Isaac Newton, you cheated me by being before my time.

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<sup>17</sup> There were many like-minded people in Newton’s time. I am just personifying this impulse in Newton as he was the most successful in promoting this approach.

You avoided the greatest battle you could have faced, that of passion, of a soul who believes that poetry and science are one. And you, the killer of their union have desiccated the thoughts of mankind as they try to grasp the physical world only through mathematics and theoretical constraints. Isaac, the world is real. But then how could you know, having never known the love of a woman or man, not even as a friend. Your need for love must have been great, so gaunt and thin you were, so needy for the recognition of your peers; you poor, lonely man.

Now you may rest. Rest by seeing the flesh put back into human thoughts about the world. I have loved many, and I have loved much, and for that have been scorned by society; and by the scientific world because of you. But I know I'm right and will not restrict my living thoughts to the rigid forms you gave. I know I'm right because my senses tell me so, because my being rings loudly and in tune with the music of the spheres. I am a man of flesh and know that flesh is soft because it is filled with love. And therefore, I love even you, not in spite of your hardness, but also because of it. Come, Isaac. Eat my flesh. Eat the flesh of my living thinking for it is filled with love. Eat my flesh because I give it to you that you may be filled, and that you may rest at last out of your head and in my lap.

I hoped to be remembered as a scientist, but as such I am forgotten. People think of me as a poet, a writer or a philosopher, and I weep loudly and with pain because of their blindness. The day is still yours in the field of science, but it will be mine when once again our human hearts and minds seek reunion and demand to be recognised with equality. I never gave myself up as the centre of what is real. Unlike you, I never called for the sacrifice of the human soul for the sake of knowledge. We are both dead, but I still live and with life to give, whereas you give only more death.

See once and for all the deadly fruits of your labour and come to me, and eat, and rest.

## A RELIGIOUS TESTIMONY TO SCIENCE

I love science. I love its relentless, disciplined challenging of reality to reveal itself. Our understanding of ourselves and our world have been immeasurably enriched through the findings of our well-trained rational and objective mind. But this is only a part of our mind. Our search for meaning and our need to feel connected to ourselves and our world requires a different part of our mind. If we only recognise one way of gaining knowledge as valid, we split ourselves (Snow 1959). All forms of error then open up.

Richard Dawkins (2008) is an example of a tireless campaigner for the rational mind. He is well known for his distaste of those who do not base their relationship to life on science. I think he is right that science is and should remain primarily in the domain of the rational mind. It is this reasoning mind that can moderate our thinking and actions and bring objectivity to life. That Dawkins is not always reasonable in his fight against religion should not dissuade us of this.

Religion has served humanity in building social structures, values and knowledge that created stability and enrichment in communities. Its intuited knowledge, often called revelation, has been tested, and has proved itself over a far longer time than has science. In its short lifespan, science has caused more of an upheaval to our social life and natural world than religion ever did, despite religions intuited origins.<sup>18</sup>

Science and religion are not mutually exclusive. Many of our greatest scientists have been men and women of deep spirituality (Dimitrov 2010). What is needed is to recognise that our rational and intuitive minds must balance each other; to create an equilibrium between our objectivity and subjectivity. After all, we do have two sides to our brain and we need to use both if we are not to be one-sided (Peterson 2024). There are many scientists who have given credit for their findings to their intuitions, and many others who have tried to analyse how this intuitive process has helped in scientific discoveries (Strunz 1993; Rothenberg 1995). The most famous example of a scientist giving credit to his intuitive faculties is the German scientist August

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18 Science, through industrialisation, changed society by making many jobs redundant, forcing people from rural communities into the cities to look for work. Our industries have also required raw materials and energy sources that have often led to a polluting and neglect of nature.

Kekule, who credits a dream of a snake curled in a circle eating its own tail that gave him the insight that the shape of benzene, which he had been wrestling with, was ring shaped. It was the first time that a non-linear molecule had ever been identified.

What is clear from these intuitive discoveries is the process of how the intuitive and rational minds cooperate to make these discoveries valid.

## **A GIFT FROM GOETHE: BREATHING BETWEEN THE PARTICULAR AND THE UNIVERSAL**

Science is focussed on determining the universal laws and principles that stand behind natural phenomena. There are specific phenomena that demonstrate the universal principles the best, and these are usually turned into experiments for the classroom. The focus is then so strongly on the teaching and learning of these universal elements, that the context within which these elements express themselves is often ignored.

Many teachers would say this is a good thing, because other aspects of the phenomena may distract the students, and they will miss the key concepts to be learned. An example of this is learning about the Doppler Effect. The most striking experience of a car rushing past is not the change in pitch of the sound that is the key to the Doppler Effect, but rather the change in volume as the car passes. As a result, the change in volume is almost never discussed so that the attention remains solely on the change in pitch.

Children naturally learn by intuiting the universal elements from multiple phenomena. For example, the concept of a “chair” is learned by seeing many different chairs and recognising the key or universal aspects of what makes a chair. Over time this concept becomes linked to the related concepts of a stool, or couch, or a sofa. In the same way, scientists examine many phenomena to distil out of them the universal principles, laws and nature. After identifying universalities, these are again tested through investigating new and different manifestations and phenomena. Hence, a continuous breathing between particular events and universal principal elements is used to keep testing our grasp of reality.

Goethe seems to be the first to use this scientific principle to not just find objective universal knowledge, but to also connect personally to the universal creative presence, what he calls the archetype, that stands behind the multitude of phenomena. All the below are quotes from von Goethe’s writings that show his approach.

In examining every appearance of nature, but especially in examining an important and striking one, we should not remain in one spot, we should

not confine ourselves to the isolated fact, nor dwell on it exclusively, but look around through all nature to see where something similar, something that has an affinity to it, appears: for it is only by combining analogies that we gradually arrive at a whole which speaks for itself, and requires no further explanation. Goethe's theory of colour, paragraph 228 (Von Goethe 1840).

An example of this principle is the human being. Our bodies are made of matter, as are the bodies of plants and animals. This leads us to the idea that matter must have the capacity to bear all of life and consciousness in it. Goethe would encourage us to search all of nature to look for something akin to life and consciousness in matter outside of plants, animals and humans. The *Periodic Table* poem, where matter is seen following a path from birth to death, and *Acid Man and Lady Base* poems in this work are built upon such a phenomenological and intuitive premise. It is our senses and intuition that bring us reality in a form that "speaks for itself". That is not to say that we do not use our rational faculties to explore our sensory and intuited experiences further.

In the following seemingly contradictory pieces, Goethe is saying that universal principles can be imagined as a particular presence, what he calls an archetype, and that it expresses itself within all phenomena. The way he words it stretches our thinking in a deliberate way.

What is the universal?

The single case.

What is the particular?

Millions of cases. (Hennigfeld 2015)

The human being knows himself only insofar as he knows the world; he perceives the world only in himself, and himself only in the world. Every new object, well contemplated and clearly seen, opens up a new organ within us (Simms 2005).

From this point everything gradually falls into place under higher principles and laws revealed not to our reason through words and hypotheses, but to our intuitive perception through phenomena. We call these phenomena archetypal phenomena, because nothing higher manifests itself in the world;

such phenomena, on the other hand, make it possible for us to descend, just as we ascended, by going step-by-step from the archetypal phenomena to the most mundane occurrence and manifestation in our daily experience (Hennigfeld 2015).

## **WHAT A FUTURE!**

The “law of the land” is a great incentive to not commit crime. The potential consequences should we be caught, flash through our mind and we then hopefully choose a more legal option. However, the law is, therefore, always only drawing a line between normal and unacceptable behaviour. It does not stimulate us towards idealistic, enlivening and invigorating behaviour, actions that will make the world a fabulous place to live in. For this upliftment, we need human ideals, strivings and beliefs.

The media often focus on the negative actions of those who play below the line of the law. If we emphasise this too much, we will be creating a future where our attention is continually focussed on the negative. The question is then, how should we position our attention so that our future becomes inspirational instead.

### **What a future!**

You must,  
You must!  
Lists and laws  
To be obeyed.

The shrinking legal ring ensures that we  
Stop.  
Are forced.  
Blocked.  
Insisting that  
We obey, in fear.  
Like criminals or naughty children.  
For acceptance.

No more!  
No more  
Anxious decree  
To drive us all!

Uplifting stories to inspire.  
Artistic deeds, investigative fire,  
Awakening forces in each soul  
To serve a richer life for all.

You could.  
We should.  
Great dreams, ideals  
To be fulfilled.



## THE GREATEST MAGIC IS EXISTENCE

Magic is a word that can refer to many different things. J. K. Rowling, in her *Harry Potter* books, used magic in a way that mirrors how it is often understood. Her idea of magic refers to knowing certain techniques and practices which will make seemingly unrelated actions happen, such as casting a spell to turn someone into a ferret. We may also refer to something as magical when we do not understand how it came about.

In this piece, magic refers to the scientific journey of discovery and the unravelling of the universe's mysteries. It is the magic of creating understanding and wisdom.

### **It's Magic!**

The flash, the bang, the puff of smoke,  
The unexplained sight, the invisible force,  
The sleight of hand, the bewitching mind,  
The skilled science to cast doubt and to blind.

The sensation of magic is found in this,  
But the real thing brings a deeper bliss.

The stable world in which we live,  
With forces balanced like on a tight rope,  
Built on substances thinner than air,  
Of which science knows much, to be fair.

To play with energy, matter or time  
Is a wondrous achievement to be sure.  
To find what they are or why they exist  
Is a magic that needs hard work to secure.

## **FREEDOM?**

We really don't understand freedom at all.

When we do whatever we feel like doing, following our every whim, we may feel free in the moment, however, our destination then becomes meaningless and empty. We become self-centred, truly "spoiled", undisciplined and useless to ourselves and society. As a slave to the random impulses that arise, we become every advertiser's dream consumer. Is this freedom?

When we make considered choices and commit ourselves to them, we limit our scope, closing some possible paths, but paradoxically freeing ourselves from a whole range of random whims and distraction. Perhaps this is why those who do not set goals for themselves end up as addicts of some kind, or as employees who help others to manifest their goals.

Because we don't understand that we are multidimensional beings, it is hard to grasp that what brings freedom to one part of us, often binds another. Surely freedom must incorporate finding our "true" or most essential self and giving that our full support. I wonder if that includes us feeling trapped or free? It probably depends on our self-discipline to keep refining our understanding, choices and commitments as well as our humility to accept our imperfect and multidimensional lives. Here would be a good place to turn to the great examples of humanity, Moses, Socrates, Plato, Buddha, Jesus, Mohamed, Gandhi, Einstein, Mandela, You?

## **MIND POWER**

At the start of this book, I mentioned that our focus will be inward looking, and there have already been many pieces critiquing our often external looking modern scientific consciousness. This piece tries to capture its most essential gifts that can lead to outer scientific achievements. It shows the clarity of mind, inner strength and empowerment that it gives to those who master it.

### **Mind power**

We pride ourselves on our clear, modern thinking.  
Rationally with logic we solve the world's problems  
Even when these solutions leave us with the inkling  
That somewhere in the world it will lead to rebellion.

Fool that I am there's a few things I know,  
Like the power of mind to make heart questions grow  
Into life changing forces that open the way  
To new understandings and courage to stay.

It has many names and multiple motives,  
This power of mind for world and life-shaping.  
Goal-setting, visualising, prayer and meditation,  
The deliberate force of will, a picture-form taking.

Filled with personal wish in full freedom,  
Born from child-like belief more real than sensation  
To bring into life the dreams that we hold,  
Achievable by any so clear and so bold.

So choose your goal well and be not afraid.  
If heart and mind agree then begin.  
Invest your full substance and live the plan laid  
For the oneness of life without and within.

## **BLOOD AND BRAIN**

When Dr Rudolf Steiner, the founder of the Waldorf schools, gave his initial training to the first teachers, he gave them a picture of the human being from his perspective (Peterson 2024). Steiner emphasised the influence of our vascular and nervous systems on how we experience reality. In the modern day we tend to think of these two systems in terms of left-brain rational objectivity and right-brain creative subjectivity (Steiner 1966), but I really liked the image of blood and nerve as different substances that carry these ideas. The following poem was written after many years of contemplating what Steiner had written.

### **Blood and brain**

We need two kinds of network to make it function best.  
Neatly laid, from thick to thin; not tangled in a nest.  
Wiring and piping with centres of control,  
Brain and Heart, placed quite apart yet managing the whole.

Electricity and chemistry seem sensible to me  
So a way to balance reason and passion can be.  
But cold and hot can lose the plot and both get quite extreme  
Should they forget they're just the parts of a functional human being.

Life ruled by passion craves its own fashion of violent abuse.  
Cold-hearted reason plans its own season of cruelty and misuse.  
So, take charge now of your know-how and steer to find your way  
To use the balance, an inner-dance; a holistic interplay.

Trust that both have gifts to give when given half a chance  
And love the world and life we live with noble upright stance.

## DO ANIMALS HAVE A SOUL

Science is a difficult subject for many students and this can put them off from studying it. Beyond the students who are simply not interested in forcing their thinking into the way that science demands, and those who lose their confidence in grasping the subject, I have had students not wanting to learn science for other more deeply seated reasons. Political, religious and cultural ideas can play a role in whether students are open to learning science. Some believe that science contradicts their religious beliefs. [See the piece, *What do scientists believe?*] They understandably do not want to be exposed to ideas that will make them feel alienated from their familial religious or indigenous connections and roots.

I have also had a few students not wanting to study science because they believe it is “white-washed”; that it has been washed clean of all indigenous truth about reality, and that white, European ideas have taken their place. Studying science can unwittingly disturb students’ worlds (Strunz 1993), and our lack of awareness for their concerns can reinforce their resistance.

As a committed science teacher, I trust that the benefits of knowing how to think scientifically far outweigh the challenges that it brings. I feel this particularly strongly when I encounter poorly reasoned opinions that stand to blind or manipulate people to support their position. This is because the damage of emotively driven and poorly formed ideas on those who have not learned to question and think rationally, is where I believe the most disempowering damage is done.



On my way home from work one day, I was listening to the radio and heard how an unclear definition from a religious source was causing confusion and distaste among listeners. Because I was driving, I could not contribute to the programme, however, I could see how scientific objectivity could easily have made this topic more intelligible and “soul-warming”.

In 2013, some priest declared on radio that animals do not have a soul. Some listeners were incensed, but I’m thinking it may be a compliment.

One of the great differences between us and animals is that we are capable

of evil or bad intentions, malicious motives, reasons for doing things which we know we should not. We are vulnerable to lies and guilt. As far as I can make out, animals are innocent of these crimes of corruption. Their being is open and they act true to their instinctual nature; a bird flies, a cat sleeps and hunts. Domesticated animals do act more as humans do, however, they still seem mostly free of malintent.

We take humans to court when they do something criminal. We would not take a lion to court for killing a person. It may get put down because if it has done it once it will probably do it again, showing our lack of trust that it can be reformed, unlike our view of most human murderers. Humans are expected to act out of their higher nature and to stop themselves from simply following their base instincts and psychopaths aside, we trust that we all have this ability.

If having a soul means being vulnerable to a split personality and evil motives, I'd say the priest is correct and I'd see it as a compliment to the purity of animal nature. The priest, however, is overlooking a basic linguistic fact. The word for soul in Latin is anima. If something is animated it gives physical and emotive expression to its inner nature. Don't animals do this, and don't we name them animals after all? Perhaps the priest should first find out what it is in us that makes us be able to act against our better judgement or conscience, and declare animals free of that.

## THE MULTILEVEL UNIVERSE

This poem shows the holistic layering of evolution, from the most foundational to its most complex fruits.

### The multilayer universe

Layer upon layer the universe is built  
With each a world unto itself.  
Forces and laws too strong to wilt  
When used as a supporting shelf.

Science has striven to find the ground  
Of existence and thought the atom was it,  
Yet the deeper we went our experiments found  
Every particle solid could also be split.

To read modern physics is like fairy tales  
'Cept the maths makes the story obscure  
For most modern minds; thus, tragically fails  
Our imagination-rich fascination to lure.

This second poem is double layered, where the left-hand-side [LHS] is one poem that can be read independently from the right-hand-side [RHS]. The RHS is a short expression of the nature or qualities of the layer that is expressed in the LHS line. The numbers on the LHS represent the layers of manifest evolution from energy upwards.

### The levels upon which our human world is built

1. In complete empty space,

Picture a door, imagine a light, Blindingly bright  
and yet you can see, Incinerating heat yet healing  
to thee;  
Pure essence, pure love, pure being, delight.

2. Creating the Atom-Bits that use Particle types three, placed in home spaces,  
Now balanced and centred and still with a need.  
Power of attraction plus-minus in places,  
Stably exist till too big to succeed.

3. Energy-Space-Shaping that hold and fill  
To make the Elements numerous that in the world  
spill.  
Iron strong-shining, Oxygen free, Hydrogen light,  
Lead heavy-dull, Helium independent, Gold stays  
shiny, Carbon black-diamond, Calcium skull.

4. These in turn join through give, take and share  
Leaving compounds to combine in ways of their  
own,  
Form the world we see when lifeless and bare Water,  
wave, ocean; rock, sand and stone,  
Planet, sun, motion; galactic dust-cloud,  
Meteor, comet, night-light at pole, Lightning-  
rolling-thunder;  
Great rivers erode.

5. Now life is a thing in itself unknown,  
Which, using the odds, ought to be rare, But is more  
diverse than water, stone, air.  
Great energy-filled Molecules that rot when not part  
Of full-functioning Units that each play a role  
In life's building block, the cell, as the start, Like the  
atom for matter, is a unit quite whole.  
Tissue, organs and systems under one control.

6. A living being stands on top of this tower  
Holding consciousness, presence and drive in its  
hand. This magical union of all levels and worlds  
is within our grasp to at last understand.

## PIECES OF THE PUZZLE

Smuts (1926) wrote a book on Holism which helped me to make sense of how all aspects of our world have evolved in relation to each other. Somehow, Smuts argues, an active way in which new wholes emerge in the world is through it being made from parts that work seamlessly together, controlled by the greater whole into which they are bound, as expressed in the previous poem. He got the seeds for this idea from Aristotle (350 BC), who noticed that the whole is always more than the sum of the parts. Smuts was also a great fan of Walt Whitman, who wrote passionately about how each part of the human body is an expression of the human soul, and this must have played a significant role in his thinking about holism (Whitman 1855). As a result, Smut's holism sees the intimacy between the functioning and substances of energy, matter, life, mind/soul and personality/spirit in every human being, where every part works fairly seamlessly to serve the wishes of the highest principle, our personality. We can think of Smuts's personality as our conscious mind and the activities that we choose to do.

This is a playful poem on Smuts's idea of holism that draws on the theme of body parts. The ending of the poem is a play on the new whole that is formed, also being something miraculous and worthy of reverence.

### **The pieces of the puzzle**

Eyes only

Nose only

Mouth only, Toes only

Fingers, elbows, shoulders, palms, arms only

Chest only

Breast only

Belly button test only

Eyes only

Sky's only

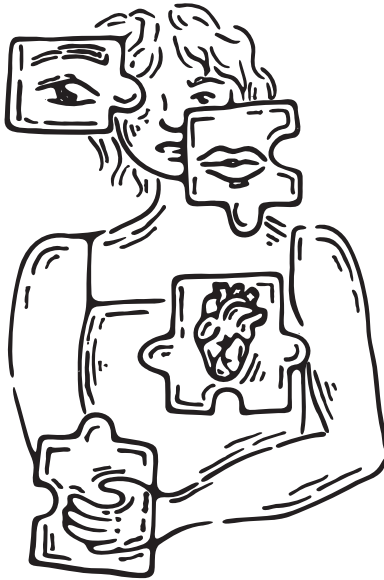
Summer warming braai's only

[Braai = barbeque]

You only

Me only

Joining pieces becoming wholly



## **LET'S PLAY**

The inclusion of the arts in STEAM [science, technology, engineering, arts and mathematics] education is being encouraged to make science more accessible to students (Hennigfeld 2015).

The following stories are not intended to make science more appealing. Science is magical on its own. These stories are given as examples of the magic that we can experience when we are artistic in our perceptions, when we don't just look for the objective and rational materialistic facts of phenomena, but when we look through these facts to experience the qualitative presences that enrich our scientific understanding.

## SCIENCE NOBEL LAUREATES

When researching the use of the arts in science education for my Master's degree, I came across the following reference. I had already been writing science poetry for a few years and using it in my classroom. My experience was that poetry often led to great student engagement, but was aware that for some, it seemed like a distraction. It made a significant impact on me when I then found out that almost all top achievers in science prior to 2010, had an active artistic life.

Nobel laureates in the sciences are 25 times as likely as the average scientist to sing, dance or act, seventeen times as likely to be an artist, twelve times more likely to write poetry and literature, eight times more likely to do woodworking or some other craft, four times as likely to be a musician, and twice as likely to be a photographer. Many connect their art with their scientific creativity (Root-Bernstein 2011 as quoted by Daugherty 2013).

The significance of this finding should not be underestimated. It shows how new scientific insights are achieved. All countries promote the study of STEM<sup>19</sup> subjects to keep their economy strong. However, if we want our students to be creators of science as opposed to mechanics of it, we should find ways to attract the interest of the creative and artistic students into the subject. STEAM<sup>20</sup> education is fortunately a growing impulse in science education.

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19 STEM is an acronym for Science, Technology, Engineering and Mathematics.

20 STEAM is the same as STEM but with the addition of the Arts.

## WHAT DO WE KNOW BECAUSE OF SCIENCE?

The more you think about it, the more you realise how little science actually knows. We know how to manipulate matter, but we don't actually know what matter is. We can manipulate energy, but don't have a clue what it is. And we are in the same boat for time and life and consciousness. Any primary substance that you can think of is beyond our knowledge and understanding. It is not that science doesn't know anything; we know a lot about how to work and play with all of them. What this does make clear though, is that the kind of thinking that we use in science is ill adapted to make any inroads into understanding our worlds fundamentals.

We have learnt how to do a lot with matter and energy, and our rational, evidence-based scientific approach has achieved a lot in a relatively short time. Materialistic science will, however, never bring us closer to actually knowing the fundamental nature of anything, because it disregards the knowledge won through our faculties of personal intimacy, those which bring us an experiential relationship with ourselves, others and the world.

Ironically, our objective and rational, scientific consciousness has only taken centre stage in cultural life in the last few hundred years, yet it often seems to try negate the validity of all other levels of awareness (Comte 1976). It turns music into vibrations, light into waves, colour into frequency ranges. It also "explains" our personal inner life as a set of chemical and electrical stimuli in a human machine. All faculties which must have enabled the modern mind to mature, the very foundation of our developing awareness is often rejected as unreliable and worthless.

Is this like an adult who ignores the child because they have forgotten what it was like to be young?

## ON THE HEARTSHIP

Qualities are related to physical objects, but are not physical. Hot and cold are the qualities that we experience when science detects vibrating molecules. The same is true for all experiential phenomena. Where we experience qualities, science detects the physical aspect that carries them. This idea led me to believe that the qualities are of a like nature to our humanity, since both are only ever subjectively experienced. Hence, in the same way as our bodies carry us, so are all the qualities that we perceive carried by bodies in some form or another. When we immerse ourselves in these qualities we can gain a sense for their kindred nature.

The following poem is a play on shifting our attention from looking at our world rationally and materialistically, to looking at it by feeling into its qualities. The surprising difference in experience led to me playing with the words hardship and heartship, where heartship is the kind of ship on which I like to travel.

### On the heartship

I soften my gaze and touch the world.  
I move beyond the hardened form  
To explore the movement of my soul,  
Being opened by the qualities that warm.

Blues and greens gently surround  
My world of plant, sea and sky.  
They hold me in expansive arms,  
That recognised, my spirit can fly.

In spring more colours, bright and clear  
Bloom from the edges of the green.  
All are sunrise-flowerings morn,  
My heart beholds the world-born queen.

Now music plays upon my soul.

On bird-breath I now uplifted sail.  
Intimacy with my sister nature,  
I'm now beyond cold-reasons veil.

The heartship goes where headship can't,  
To live as one among my kin.  
Behind the sights and sounds we go,  
To dance and play with friends therein.

## THE CONCERT

Is it possible that without the arts we would all be drug addicts? I ask this because for most of us, music, drama, movies, dance and art lift us out of our mundane and pragmatic relationship to life and make us feel refreshed and happy. But they do much more for us than just relieve us of a dry existence. They give us an experience of a state of consciousness that enriches our lives and makes it feel worth living, without which many of us would possibly choose the numbed life of an addict.

Often, when we have an uplifting experience through the arts, we passively allow ourselves to flow into it and almost lose our self-awareness. This poem demonstrates a level of awareness that moves consciously into the pure enjoyment of the moment, and takes it a step further by using it to explore the impact on the physical body and the world while in this changed state. From an evolutionary perspective, although this consciousness is not that of the next holistic substance that will manifest, it seems to have hints of moving towards it. Read the poem and see what you think.

This poem relates a personal experience during a particularly eventful classical music concert.

### Behind the mind

The music builds a mighty world.  
The melody, a surging scene.  
Great vistas filled with hope and life,  
Moving my soul, my very being.

Can the force I feel be simply made  
By a single moving thread of sound?  
Are not the other notes heard played  
What move my all to the great profound?

I listen now to the sounds below.  
The bass, the treble and the quiet brook,

That gently flow through anxiety's web  
And pull out its ever-present hook.

I scan my liver, heart and spleen,  
Each is cleansed by a different stream,  
As around the melody's rousing theme  
I'm danced and moved by love supreme.

The music ends. I walk outside.  
Between each form of sound and sight,  
Around each scene and face I find  
A sacred glory, a flame-filled light.



## THE LIBERATION OF BEING IN NATURE

Whenever I need to unwind and switch off, I turn to nature. In this story, I had spent the morning indoors away from the cold outdoors. In Pretoria, the winter sun shines almost every single day, so by midday the temperature is mostly pleasant. And going out for some sunshine does wonders for the spirit. This poem is about one such special day when nature liberated me from more than just the cold of winter.

The title of the poem is the reverse of the title of this piece to emphasise the intimacy between nature and liberation.

### Nature of liberation

I see a lizard in the garden  
Basking in the sun.  
Now two, now three.  
And hummingbirds nectaring in the crab-apple tree.

They come and stay and fly away,  
Doing as they please.  
On this first lazy, warm and calm  
Bird-song filled winters day.

Insects, bees, even the grass  
Are out and up today.  
My small garden alive and dying,  
In my heart and eye they play.

Comfort and joy they speak to me,  
Drawing me out to see.  
The butterflies through air and sun  
Fly bouncingly and free.



How generous is my dear town.  
Grateful for where I stay  
That mid-July Pretoria weather  
Can lift me up this way.



## SCENT PAINTING

In 2023 I visited Torsten Arncken in Switzerland, a researcher who among other things, develops fertilisers to make plants create scents for cosmetic use. To test the scents, he gets people to paint an abstract image of what they smell, and then describe the qualities of the smells depicted in their picture. Although it is the practical application of his work that funds his research, it is a stimulating thing to do and a highly creative way to challenge one's imagination. When I returned from Switzerland, I spent the next six months finding random foods and spices in the kitchen and painting them. I have used it as a "party trick" with friends, where each person paints a different scent, and then we go around looking at what each one painted while smelling the related scent, seeing if we can find any connections between the smell and the painting.

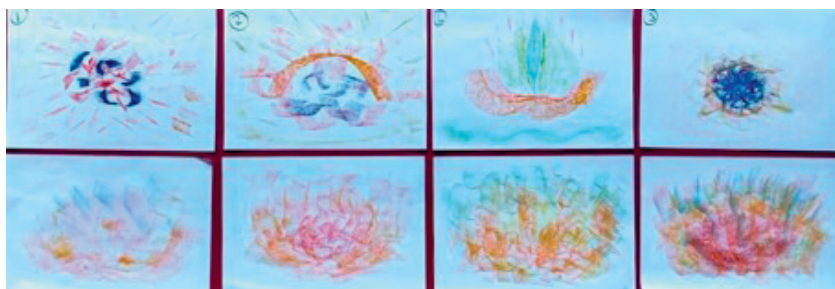
What I love most about Torsten's work is that it forces one to distil the qualities experienced from one's sense of smell, and depict them using colour and form. This is related to what film music composers do when they express the emotions that the film is trying to evoke. If you have ever watched a particularly emotional scene with the sound off, you will realise how much is lost. The qualities that enrich our lives from the outside world come to us through all our senses, and Torsten has found a way to help individuals lift these into their rational awareness through his scientific work.

Torsten had developed fertilisers of gold, copper and iron, and was testing the qualities of each using lavender. He used four separate pots with the same base-soil, lavender source plant and growing conditions, and put a separate metal fertiliser in each pot, leaving one pot unfertilised. These are the four pots in the greenhouse where they grew.



The fourth pot was unfertilised so that it could act as the experimental control. He picked a baby plant from each pot. Putting the unfertilised lavender plant to one side, he labelled the other three in separate paper folders. Not knowing which was which, I then mixed them around so that he would also not know. We painted the original lavender first and then painted the others. We couldn't see what the other was painting and compared our pictures once we were done.

The pictures below are what we painted. If you are familiar with lavender as well as the metals of gold, iron and copper, please challenge your imagination to see if you can identify the number that represents each metal before reading on. The top row of paintings are mine and the bottom ones are Torsten's. The LHS paintings marked 1, are of the unfertilised lavender.



During our smelling and painting, I was amazed at how differently each of them smelled, despite them all being the same kind of lavender. Each time we smelled a new plant, it took me a while to figure out what qualities I could smell. What made it more challenging is that the initial smell is very strong, however, the longer you smell it, the less distinct it becomes (Steiner 1966; Binder et al. 2009),<sup>21</sup> consequently, I had to give it a quick smell, then take it away and try to identify at least some of the qualities and how I wanted to depict them. I would then paint those qualities before having another sniff to find more subtle qualities. When we had finished, we put the pictures together as you can see above, and tried to identify which metal fertiliser was used in each of 2, 3 and 4. I straight away believed that the end one, number 3, was iron as it actually had a harsh and cold metallic impact on the nose,

<sup>21</sup> This is called olfactory fatigue. I have found that as I get older it seems to be more pronounced.

and was totally different from the others. The second on the right, number 4, I thought was copper as it smelled almost the opposite of iron, being warm and soft on the nose, with a very subtle and fine lightness which revealed itself to me on my third smell. The remaining one was similar to the copper, but seemed like a heavier or more dense smell, and as gold is a heavier element, I figured that this must be gold.

It turns out that I was correct about the iron, but had switched the copper and gold. Looking at the paintings as depictions of qualities, this process led me, after over 35 years of being a chemistry teacher, to deepen my understanding of these metals. This experience made me feel like I had had a personal meeting with them. What I appreciate is that I gained a new respect for gold beyond its obvious material value. Now, when I talk about these metals in class I have a different feeling. It is a little bit like talking about someone who you have spent some time getting to know as opposed to someone you've encountered superficially.

Here are some pictures of household smells. See if you can relate to any of the qualities that you experience from the smells in these depictions. It could be useful for you to smell the substances while looking at the pictures. Top left is ground cumin, top right is carraway, bottom left is cloves and bottom right is star anise.



## NAMING SUCCULENTS

I am no good at remembering scientific plant-names. My scientific, analytical interest in the pure sciences of physics and chemistry does not stretch to living things. My approach to naming succulents is, therefore, not scientific, but is my preferred way of relating to all living beings, with affection and playfulness. Naming my plants was the first thing that I did when I started becoming more interested and connected to them. If you Google, ‘Give your plant a name’, you will see that this is a fairly widespread act that people do, and this includes teachers encouraging their students to name plants that they take care of.

I spontaneously named my succulents after the association that I made with their qualities. The first succulent that I named was Dragon tongue on the top left of the pictures on the next page. It initially caught my prolonged attention because it is so unusual, and its shape made me think of many flaming tongues sticking out. It gave me a lot of joy to refer to Dragon tongue by name, so I gradually named others. Naming plants is similar to scent painting, in that we wrestle with a sensory stimulation to identify its inherent qualities and then express these qualities in a different form. In this case, the qualities are expressed as a name.

A botanist may argue that this is fine as an introduction to caring for plants, but it is not scientific, because nobody knows your naming system, thus, will not know what you are talking about. Common or indigenous names for plants are better as they at least fit into a cultural or regional context. Science has worked very hard to create a naming system that is universal so the name itself will position it in relation to plants from all over the world (Whitman 1855). In the context of this book, the usefulness and power of such a system should be obvious. What is perhaps not so obvious is that we are back to the debate between the different value of the particular from the universal. For me and many others, with plants it is the particular that may eventually draw us into the universal.

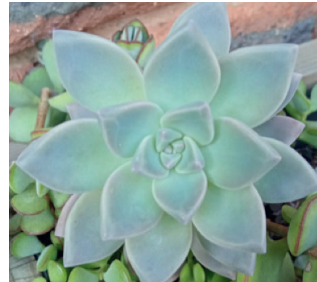
Getting students to look after plants from the seed has been used to overcome what is called plant blindness, to help people to notice plants (Perales and Aróstegui 2021). This referenced research did not report on any student having given their plant a name, which I found unexpected, as

it would be something that many of them would surely have done, however, they did report that by making plants personal, student interest in the universal scientific aspects of plants dramatically increased.

I gave the name to a particular plant, but science gives the name for the kind of plant. One gives us a connection to a plant; the other gives us information about a group of plants. Both should be valued.

If you are interested in the common or scientific names of the plants below, please look them up using the PlantNet, Google lens or similar app. They will give you the correct botanical as well as the common and indigenous names for plants. But for your own sake, I encourage you to give all living things in your care unique names, just as we do for our loved pets and humans. Something special can be gained from the universal name, and something differently special happens with a personal name.

Below are a few of my beloved succulents. Top left is Dragon tongue; top right is Moonlight. Below Dragon tongue are Octopus and Starburst, with Hippo foot below Moonlight.



## APPROACHING INNOCENCE

How can adults retain their childlike innocence?

As you may be aware of by now, I think of science education as a route, not to making money, but to meaning-rich experiences that open us up to the magic of reality. The type of pleasure, joy and courage required to keep having such experiences changes as we age. This piece of poetic prose captures the challenge of staying young and fresh. I have deliberately played with some religious ideas in the poem without referencing them so as to not upstage the experience.

Something powerful and liberating happens when our thinking, feeling and action align with something bigger than ourselves. Only experience can teach us this.

### To experience the familiar as though for the first time.

Infatuation is when we fall in love with the feelings that arise in us. To be in love with adoration,  
To adore our appreciation of a bird flight, a whale breach, music, texture, touch....

Our capacity to experience enjoyment and pleasure in life is an important part of our nature. Periodically we lose this capacity through **failure, Fear, Guilt, Depression** or **wrong thinking**.

When it ~~FEELS~~ we feel reborn to the world.

Possibly the closest thing to being innocent again.

To awaken is to **know**; and to *rightly value* what you *know*.

Accompanied with a deep appreciation of the experience,

We can feel complete in ourselves and completely saturated by the experience all at once. In these moments we approach the True Nature of a thing.

To crave these moments is the artist-scientist's infatuation.

Being moved to moments of intimacy

With an "Other" is unconscious and

*easy*

When the experience is

*new*.

As we get older everything-becomes-familiar, then

We need to

*Let go*, and be *OPEN*, thought ... full,

In our *pursuit*,

*compassionate* and **courageous**

## COVID'S ADVOCATE

This story was written in August 2021 and has only received language editing since. At this stage, most of the world was still in lockdown with South Africa being in a full lockdown. In 2021 the general assumption was that Covid-19 arose from natural causes. The vaccine had already been out long enough to know that it did not prevent you from catching the virus, but that it could make the illness less deadly.

There are many people who are afraid of nature. Snakes and spiders and other wild animals scare many of us because we believe they are deliberately out to get us. Nothing could be further from the truth. Having had many encounters with snakes, my experience is that they are much more afraid of us than we are of them. When Covid-19 arrived, this fear of nature received an automatic reinforcement, much to my annoyance. The unfairness in blaming nature becomes obvious when we consider how we have benefitted from all the actions of nature in the past that enabled us to evolve into what we are today without any help from ourselves.

There are many ways to get students engaged with a topic. One way is for them to write about or enact an imaginary scenario related to the content. The following story is an example of this.

This piece was written as a defence for nature and her wisdom. It is held in an imaginary court with this piece as the opening argument for the defence of Covid-19. [Feel free to create your counter arguments as you read :)]



‘Esteemed Angels and Gnomes of the jury.

‘In this trial, the prosecution will try to prove that my clients, Mister Covid-19 and Mother Nature, are guilty of mass murder. This will not be necessary. My clients have accepted responsibility for this. The prosecution will further try to show that my clients are guilty of a range of crimes; of disrupting the global economy, of sowing fear and terror into all of humanity, of preventing the healthy development of children’s education, and of creating an even greater disruption to the world than most wars. It is these accusations which my clients deny. It is these that I aim to prove are not the deeds of my

clients, but are created by humans themselves.

‘What the prosecution is not going to show, is that all the actions of my clients were acts of self-defence. Instead, they will try to show malicious intent; that even once the situation was severe and people were dying by the millions, that my clients then devised new variants to combat the world-wide human effort to stop the slaughter. Again, my clients will not deny this. The prosecution, however, will try to avoid you from recognising the extreme circumstances that my clients themselves faced. In this trial, I believe that once I have shown you the situation from my client’s perspective you will release them and call humanity to account for their actions before this court. [Gasps from the gallery.]

‘It is true that Mister Covid, accused number one, was sent to human beings by Mother Nature, his co-accused, to do a job. Angels and Gnomes of the jury, I know that you are aware that humanity would not exist at all were it not for Mother Nature. So, you may be asking your esteemed selves why, despite this, Mother Nature would bring such an illness upon her own children.

‘In this trial I will try to prove that Mother Nature brought Mr Covid into our world to awaken humanity to some very important matters. Firstly, she has seen that people now make up one third of the mass of all mammals on Earth. She regards this as having overstepped the natural balance of what life on Earth can bear, and I will bring evidence of this before the court. If human beings had left the rest of mammalian life to live free as she had intended, she might still have been OK with that, but almost all the rest is livestock raised to feed humanity. People have left less than five per cent living free, and this includes rats and mice (Root-Bernstein 2011)! Moreover, humans remove more and more of the natural habitat of this remaining wildlife. And it is not just the land they use, they destroy the oceans with overfishing and pollution, and they pollute the air with poisonous gasses, loud noises, electromagnetic communication-smog and night-lights. Not content with this, they even pollute the heavens with their space junk.

‘I think you can understand that without some intervention, Mother Nature would be standing before us not just accused of the current charges, but of negligence towards all of life on Earth. I will show the court how her hand has been forced, and that even as we speak, she is needing to use ever

stronger measures with flooding, fires, drought and heatwaves, because humans continue to be concerned with their survival alone. In this, out of a misdirected sense of compassion, humans want EVERY person to survive despite its toll on nature and even upon their own future. In this courtroom I will show how the so-called “crimes against humanity” of which my clients have been accused are forced not by her hand, but by the hand of humans themselves.

‘The other accused, Mr Covid, stands before you as the real public villain in the eyes of humanity. I have already heard it spoken in the press that many would have preferred him to stand alone in the dock, that having Mother Nature here with him might make you, the jury, less inclined to incarcerate and punish him as harshly as they believe his crimes deserve. Indeed, you will be hard pressed to find any single mention of Mother Nature in all the millions of news reports on the pandemic. Humans don’t blame Mother Nature for Mr Covid’s actions, they say that it is him and him alone that is the cause for all this death and disruption.

‘We can all understand that humans are upset. No suffering is good to see or experience. But with whose suffering are humans concerned? I aim to show this court that the suffering of Mother Nature far outweighs the suffering that Mr Covid has caused. In fact, I will argue that Mr Covid, different from the stance taken by most others who have been sent in the past to teach humanity such lessons, has put powerful measures in place to protect the lives of the young and healthy upon whose survival humanity depends.<sup>22</sup> I will show the court how it was only after been blocked on every front that Mr Covid was forced to develop variants to make sure that the job would be done. As we have already seen, Mother Nature is putting ever more pressure on him and has even begun to implement alternative plans as her faith in Mr Covid wanes.

‘I will show the court the anguish of my clients in having to create ever more powerful tools for the job. I will show how, had humans been humbler in their response to this pandemic and allowed Mr Covid to do what he needed, the human population would indeed have been severely affected with many hundreds of millions dying, but that by now [August 2021] the pandemic would almost be over. Currently, even with Mr Covid doing his best, the

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22 The initial variant targeted immune compromised and older people, with the death rates of those under the age of fifteen being almost zero.

human population is still increasing at an alarming rate (Worldometer 2021). Had Mr Covid been allowed to do his work, the rate at which the human population is increasing would instead have become roughly its rate of decrease. This is hardly asking for too much considering the uncontrolled human population growth recently. Further, humanity would have realised their selfish nature and as they always do in such circumstances, turned their minds to matters greater than themselves. Their hearts could have opened even more to their already growing recognition of the collective suffering of their fellow human beings. They could have used this as an opportunity to make a fresh start for their own moral betterment. They could have increased their compassion and intimacy among themselves as well as with nature, all of which would have led to an increased meaning in their lives.

‘I aim to show the court that at present the humans are not only avoiding this most urgent change, but are increasing the suffering of humanity through their removal of basic freedoms. Not only are human hearts not opening to the suffering of nature, they are also not opening to the suffering of their own kind. They now look at each other as potential threats of infection. By thinking that they are protecting themselves, they are hardening their hearts and forcing nature to use ever more powerful tools for the job, tools that will claim the lives of many more children than originally planned.

‘By now, dear jury, the humans are aware that their efforts to curb the virus through vaccinations is only serving to undermine confidence in their science. Their vaccinations may be reducing the severity of the virus, but they are not creating the promised barrier to catching or preventing the virus’s transmission or mutation. I will show that neither of the accused have any wish to remove human trust to empower themselves through science. I will show how Mother Nature has nothing but the deepest love for humanity and joy in watching their awakening. I will show the court how she makes all her resources available for people to do with as they please. Mother Nature has done this from the start and never rebuked mankind for its myriad cruel misuses of these gifts as they slowly learned to flex their abilities and grow their understanding.

‘Angels and Gnomes of the jury, I will conclude my opening address with one final and most important point. In the past, when Mother Nature had the need to change earthly conditions to allow space for new developments,

she allowed for the mass extinction of species. Each time she did this, the new conditions allowed new species to develop, resulting eventually in the arrival of human beings. Ever since then, in her efforts to awaken humanity, her actions were swift and deliberate, and the many skills and brilliance of the humanity of today is testimony to the fruitfulness of her approach. After each of her interventions, human abilities and empowerment have always inevitably grown stronger. And yet now, having the power and freedom to obstruct the wise course of nature for the first time, humans ignore all possible lessons from the past. The prosecution will try to convince you that humanity had no choice but to defend themselves from Mr Covid. They will try to show that Mr Covid has overplayed his hand with so much threat and cause of death. It is not my intention to avoid you seeing the ongoing suffering of humanity and their world. The opposite is true. I want you to feel as deeply as my clients, the pain and devastation caused to humanity so that a deeper compassion and selflessness may find its seat in our hearts. But I will ask of you to broaden your deliberations in this case, and consider not just humanities current pain, but also their future devastating pain should Mr Covid, under the instructions of Mother nature, continue to be obstructed in his duties.

Thank you

## **SECTION 4:**

### **THE RESULTANT PICTURE OF OUR TIME**

This section presents an overview of the key developments in human experience since the time of the industrial revolution. It is not meant to be comprehensive or accurate either psychologically or historically, but rather to give a rough picture of the enormous shift in human consciousness over time. It gives us a picture of our present challenges and teases our thinking towards imagining the type of consciousness we may have in the future.

It starts with a poem by Wordsworth that expresses our loss of indigenous intimacy with nature, followed by a piece on the scientific thinking that caused this loss, but which brings its own promise. This drama is resolved with two stories of experiences where our intimacy with nature becomes enriched by our scientific understanding.

The final piece puts this evolution of consciousness into a science-education context.

## THE WORLD IS TOO MUCH WITH US

In 1844, a French philosopher, Auguste Comte (1976) presented his understanding of how humanity should conduct their thinking in his day. He called this approach Positivism, and in it he rejected all mythological and religious thinking as primitive, belonging to a past age. In their place, he promoted pure material evidence and logical reasoning to know reality. It is this positivist approach that has become the ground conceptualising of life for many people who reject a belief in God or the existence of a spiritual world. One of the fruits of positivism was the solid ground that it gave to scientific endeavour and its consequent applications in technology, politics and economics. This is the ground upon which the industrial revolution was built.

From an evolutionary perspective, positivist thinking encourages practitioners to let go of all previously held notions of reality and to focus only on the established facts of science. The power of objectivity and sobriety for problem solving that this gives is immense. It forces us to liberate ourselves from traditional thinking as well as cultural and religious allegiances. This empowers the positivist to build their wreality from the ground up, and to logically follow their thinking up to an understanding of the most complex phenomena. The mental strength required to obtain such a complete grasp of phenomena often translates into an experience of liberation. The problem that remains for the positivist is to then find some way to reintegrate the originally rejected mythological and religious thinking, so that the needs of our inner life, as expressed by Wordsworth below, do not get lost.

Roughly 40 years before Comte described his positivism, William Wordsworth wrote the following poem, as the industrial revolution had already taken hold of much in English culture. This poem is a response to his experience of alienation and a loss of intimacy with nature.

### **The world is too much with us**

The world is too much with us; late and soon,  
Getting and spending, we lay waste our powers;  
Little we see in Nature that is ours;

We have given our hearts away, a sordid boon!  
This Sea that bares her bosom to the moon;  
The winds that will be howling at all hours,  
And are up-gathered now like sleeping flowers;  
For this, for everything, we are out of tune;  
It moves us not. Great God! I'd rather be  
A Pagan suckled in a creed outworn;  
So might I, standing on this pleasant lea,  
Have glimpses that would make me less forlorn;  
Have sight of Proteus rising from the sea;  
Or hear old Triton blow his wreathèd horn.

1806

By William Wordsworth (1980)

## EMPOWERING SCIENCE

The following piece was written out of the awareness of the dangers to which Wordsworth alludes in the last piece. For many years I have wrestled with ways of thinking about the experience of alienation with the accompanying loss of personal intimacy and meaning that can result from the positivist mindset. Here is a piece that tries to distinguish between a healthy empowerment of the mind through science as I see it, and its materialist usurper.



Science is a truly human affair. It seems that the human faculties required for a modern scientific approach developed slowly in us, and for the last few hundred years, as we turned our attention to the world of matter, much of humanity has become open to viewing the world in this way. The freedom from superstition, manipulative attitudes and restrictive practices based solely on external authority, were mostly dispelled as we gained the ability and tools to determine reality for ourselves. Our journey into science has resulted in empowerment of the individual through self-confidence in right thinking and action.

Unfortunately, all too often, we find the attitude being expressed in scientific circles that only certain human faculties are valid when doing science. Some “subjective” faculties are regarded as hindering scientific progress, and have been side-lined. Also, more and more, science is funded by industry and business with the selfish aims of generating findings which suit their financial and power interests (Gyles 2015: 1011). The truth, reality, empowerment and liberation which good science promises are then reduced to cold hard facts with a seemingly unchallengeable authority that disempowers individuals.

In South Africa as in many countries, the science classroom, that should be about the joy of empowerment and discovery, has been reduced to mountains of content and methodology. Perhaps worse than all else, this approach can make science really boring to teach and learn. With so little critical thinking and problem solving from practical experimentation, so much mathematics and mechanical formulae use, and so much emphasis on learning the “correct

answers”, the promised liberation of mind is all but extinguished. The human journey which led us to science is then ignored.

Plucked from our humanity, science education is in danger of being only for clever kids who do it for the opportunities, money and power it can bring. An empowerment of a very different kind.



## FRITJOF CAPRA STANDING ON THE PLEASANT LEA WITH SHIVA'S CASCADES

This piece is the first of two successive pieces that show uplifting experiences as a result of a deep immersion into a scientific relationship to the world.

Capra's experience can be seen as a modern response and healing to Wordsworth's soul-anguish, expressed two pieces back. It can also be seen as a redemptive response to the mechanised approach of much of current science education as depicted in the last piece. I see it as having drunk to the bottom of Heisenberg's glass of the natural sciences, where God is waiting [see the piece, *Heisenberg drinks from the cup*], or the coming of Feynman's scientific age [see the piece, *Feynman: This is not yet a scientific age*].

Fritjof Capra used his expertise as a particle physics researcher and his interest in Eastern mysticism to experience a meaningful relationship between physics and spirituality. He starts his book, *The Tao of Physics* (2010), with a moving personal experience where he felt the relationship between science and spirit. This is not surprising as the aim of Capra's book is to show a meaningful relationship between objective science and our subjective human inner-life. Capra gives us this story to show why he is convinced that understanding quantum mechanics requires both left-brain rationality and right-brain intuition.

... while 'sitting by the ocean on a summer's afternoon, watching the waves roll in and feeling the rhythm of my breathing, ... I suddenly became aware of my whole environment as being engaged in a gigantic cosmic dance... I "saw" cascades of energy coming down from outer space... I felt its rhythm and I "heard" its sound, and at that moment I knew that this was the dance of Shiva, the Lord of Dancers worshipped by the Hindu's.'

## THE COST OF MY PERSONAL PENTECOST

This is the second of the two pieces that illustrate the powerful personal experiences that can result from a deep immersion into science. This was my experience.

Under apartheid in South Africa, all white men were forced to do two years of military service. The alternatives were to flee the country with the prospect of going to jail if you returned, or just going straight to jail for six years. There was the option of trying to prove that you were a pacifist which would have resulted in two years of community service, however, the government made this very hard to do, and besides, I am not a pacifist. After I had finished my university teacher training, I was called up to the army. I was 23 years old at the time. This story is of an event that took place after about six months of being in the army and as you will see from the start of the story, I was moving inwardly towards a religious life in a way that did not discourage my passion for science or sexual love. [See the piece *e and me* for the initial stimulation while studying undergraduate science that awoke my interest in religion.]

This story tells of my most life-changing and powerful experience. The story and its analysis have formed the backbone to my understanding of what all religions refer to as enlightenment, being reborn, heaven, nirvana, paradise and so on. There are also several people alive today who claim to have such experiences (Adyashanti 2014; Freke 2009; Sadhguru 2009; Tolle 2022). Having also read up on near-death experiences, I recognise that my experience had several of the same aspects, and that it would be termed a near-death-like experience, as I was nowhere close to death at the time (Facco and Agrillo 2012; Greyson 2021; Moore 2017).

Many stories in this book have encouraged the introduction of subjective qualities into our scientific studies. This story is told to encourage us all to find bridges between our personal spiritual experiences and our scientific analytical minds. We need to trust that subjectivity and objectivity bring us a deeper understanding when they work together. I have included a reasonable amount of build up to the story as I believe that it contributed to me having the experience. This story hopes to show the powerful subjective nature of spiritual experiences as well as the objectivity, evidence and reason that can be used to understand them.



In 1987, after I had finished my science degree and education diploma, I had obtained leave from the army to attend a seminar 1 000 km away in Cape Town. This was for people who were thinking about becoming a priest in the Christian Community. The seminar was one of those few occasions where I said almost nothing and listened a lot. On the evening after the close of the seminar, I attended the 21st birthday party of a close friend. Here I danced with a girl that I had met briefly before and liked a lot. She was trying hard to have a good time, but despite her efforts it was clear that she was not happy and was wrestling with some personal troubles. I experienced a strong feeling of care for her.

I went back to the army and returned to Cape Town about two months later. On the train ride home, I felt a great sense of fullness at my swelling love and anticipation for everything that I was going to do. There was only one other Englishman in our train compartment, and we started a conversation in English on such a convoluted level that our Afrikaner companions could not understand us. He had gone to a brother school to my SACS, and we were feeling quite superior watching the expressions of confusion on the faces of our companions. It became a bridge too far for me when we started mocking them for their lack of comprehension, and I reverted to speaking normal English and including our companions in the conversation. This act of care softened and strengthened my already present fullness of love and joy in life, and I felt this sincerely towards all my companions. I got off the train at Rondebosch Station and walked on the road beside the tracks towards Newlands where my mother lived. My whole inner life seemed to be magnified as I looked at the familiar world around me with unbridled openness, love and confidence. On the other side of the tracks, I could see the house of the girl from my friend's 21st and felt an upswell of loving and sexual arousal as I pictured her vividly in my mind.

I then recalled, with tremendous clarity and compassion, her inner pain and discomfort at the party. In this moment I also became aware of how powerful and clear my imagination was. It was as vivid and present as my normal eyesight, and it continued through the rest of this experience.

My mental picture then instantly changed. My desire for her left, and was replaced instead with a deep loving care that dispelled everything else from my mind.

While still seeing her as though she was physically in front of me, I was focussing on her beauty and suffering. This seemed to cause my compassionate love to grow of its own accord until it burst through the top of my head. At that moment, I was suddenly no longer able to use my physical senses. The mental picture of her also disappeared, and I now saw that I was in a world of darkness encircled by about seven large tongues of flame. I was also a tongue of flame, not unlike an enormous candle flame.

As flame, I was blessedness, powerful, incineratingly hot and blindingly bright, and yet all of this felt infinitely more health-giving and joyous than anything that is possible to experience “normally”. I could feel that I was entering down into my body through the top of my head. The bottom of myself-as-flame was burning away impurities and blockages in my abdominal area. As a flame, I was a powerful healing fire that was trying to take hold of my body which seemed ill-suited for the job and needed transformation. The feeling of health and healing in my body was so powerfully blissful that I soon wished for it to never end.

In that moment of wishing, it ended. I found myself back in my body walking on the road towards my mother’s home.

In the months and years that followed, I felt both blessed and cursed by the experience. I was blessed in that I now knew from first-hand experience an aspect of the nature of the Kingdom of Heaven, and that the usual descriptions of it do not come close to doing it justice. I was also cursed in that I was no longer interested in anything of this world. The bliss and blessedness of that world was so beyond anything I’d ever felt that this life seemed like a cursed one. I longed to be back in that world and believed that I had been rejected as unworthy because I had chosen my selfish desire to keep the feeling of blessedness above the selfless compassion for another’s suffering. I felt like I had literally been invited as a wanderer on the biblical highway, to the “wedding”. Having been found to not be wearing a proper “wedding garment”, was thrown out, bound “hand and foot” into the “outer-darkness” of “weeping and gnashing of teeth” (Matthew 22:1–14). It seemed to me that our normal world is in fact the world of outer darkness for one who has been so cast out.

Once I had come to terms with my feelings of blessedness and rejection I could reflect more clearly on the experience and made some remarkable subjective findings. One significant realisation was that I had indeed had an experience of heaven, paradise or Kingdom of God. This was confirmed for me by the references to the burning bush in the Old Testament and the Pentecost event mentioned in the New Testament where tongues of flame descended on the disciples.<sup>23</sup> It was further confirmed from a Hindu source, where Atman, the flame that is a piece of Brahman, the spiritual world, descends onto the enlightened ones (Srinivasa Ayyangar 1938).

Another realisation of importance was that the Kingdom of Heaven is indeed within. This is often mentioned in religious texts, however, I had not realised that we literally go inwards into our mind. I also realised that I was an independent being from my body when I recalled how I distinctly identified with being flame and not with my body. It was my re-identifying with my body as it experienced the healing fire that resulted in my rejection from that world. One further thought on the experience is that I-as-flame was penetrating down into my body. I had not drifted off and lost contact with my body, but was in fact, trying to heal my body as though I was trying to transform it to become a suitable home for my flame-self. It felt like I-as-flame was literally trying to be born into my body. It seemed to indicate that this new self, my Spirit Self, was not an existence to be had only in some separate heaven, but within our physical bodies in this world. It gave me a new understanding of Buddhist and Hindu enlightenment as well as the Christian idea of being born again, or of being born of the spirit.

I now looked at the events of Pentecost with a new insight and concluded that during the 50 days between the resurrection and Pentecost, Christ might possibly have been preparing the flame-body for each human being as a true redemption from the hardening effects of this world. Much of what seemed like nice religious stories were now becoming intellectually sensible as subjective proofs based on my personal, experiential evidence.

OK, but where is the link in this story to science education? We can use this story together with other stories in this book of where unusually

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23 This is predicted by John the Baptist as a baptism of fire, as expressed in Mathew 3:11 and Luke 3:17. It is described in Acts 2:3, where tongues of fire divide and descend upon some disciples. In the Bible, this event is preceded by a rush of wind and is followed by speaking in tongues, called glossolalia.

meaningful insights and experiences occurred, to try and identify the aspects of science education that played a role in bringing them about.

In all three of, *e and me*, *Seeing the music dragon* and this story, I was feeling particularly happy, confident, open and loving before the insights occurred. In each case my entire inner joy, strength and attention was moved onto something [the weed in *e and me*] or someone [the audience and musicians in *Seeing the music dragon*, and the girl across the tracks in this story] other than myself. I think of this as a picture of me having loosened my attachment to myself and placed this attachment to the other. Something of this loosening seems to be a part of each of these experiences. Having analysed stories of people who claim to have had enlightenment experiences, I noticed that these same elements seem to be present in one form or another in their stories (Adyashanti 2014; Sadhguru 2009; Tolle 2022).

It is only through looking at these experiences with objective rationality that we will identify exactly what the possible keys are for awakening such meaningful experiences in our lives. There is, however, another crucial role that science education adds to these experiences. The strength of our objective, rational mind that is required to loosen our connection to ourselves is exactly what is fostered through science education. Our ability to selflessly devote our thinking to understanding mathematics, chemistry and physics is a training that develops our faculty of imagination and abstraction, so that when we get a mental image, we hold it clearly in mind and work upon it with new information. This is often how we test our understanding in science. It is also how we test and grow our wreality.

In summary, I have concluded that without my training in science I would not have been able to have these experiences in the same way. I believe that my science training strengthened my mental faculties to bring my fully awake consciousness into knowing things that may seem very different, but are similar to how scientists gain new insights into their work. It is the same way in which new insights will arise when we devote our full efforts into addressing a problem in science.



**Figures:** The picture alongside was painted during my Waldorf teacher training about four years after the experience of being flame. My body is in blue and myself as flame is the yellow-orange with the surrounding flames in red (Mirkin 2021a).



The picture alongside was taken at a Hindu yoga centre in Pretoria. In many Hindu and Buddhist sculptures, there is a flame depicted on the head of the enlightened ones.

## THE SCIENCE EDUCATION TAKEAWAY

Before the industrial revolution, almost all of humanity placed God, various gods, and/or nature spirits at the centre of our attention. We attributed our health, happiness and prosperity to these non-physical beings (Harari and Perkins 2014). Since the industrial revolution, our attention has increasingly turned away from the spirit towards matter and energy, to science, to ensure that life goes well. This shift moved us to prioritising things over beings. In the process it led to enormous destruction of indigenous and religious cultures, almost all of whom were originally forced to change, and then later chose the improved standard of living and economic prosperity of science over their historical beliefs.

The Wordsworth piece depicted our universal loss of the ideas, beliefs and cultural practices that helped us retain our intimacy with the “beingness” of the world. Nietzsche (2024) recognised that when we turned our objective, rational thinking to the physical world, we stopped seeing the spiritual within it; we killed God. This distanced us from our historical and traditional practices and beliefs. Scientific thinking must own the responsibility for this. It must also own the creation of our ever-more powerful tools of destruction; used intentionally in war and unintentionally in the harming of our cultural and natural environments (Attenborough 2020; Hancock 1962).

It is important that we remind ourselves of the potential challenges as well as the gifts of sciences liberating and empowering ability. When we prioritise sciences potential to empower our consciousness as opposed to our worldly power, then we bring our focus back to the human being and our living relationship with our world. It is not just me who knows that our work in science can bring us personally meaningful and enlightening experiences, almost all science Nobel laureates have prioritised their engagement with the arts in their lives (Root-Bernstein 2011), and around half of them have retained or grown their religious and spiritual lives at the same time (Dimitrov 2010).

From the perspective of positivist materialism, spiritual experiences are regarded as delusional. Their attention is focussed on the extraordinary fruits of science and scientific thinking in improving almost every aspect of our

practical lives. Even poor people today live with things that the kings of old did not have. Materialists will continue their deep scepticism until they too have spiritual experiences. Videos of people who use Kodachrome glasses to see colour for the first time, or who have an operation to be able to hear sound for the first time, are common on the internet (Newsflare 2020; Willis 2017). In most cases, such people are deeply moved when they experience it for the first time. It is not that these people did not know that sound or colour existed. Others had told them about it. It is because the reality of experience will always trump the impact of our shadowy thoughts, and these experiences are like revelations. Likewise, the many recorded near-death experiences, telepathic communications with animals or nature spirits, and memories of past lives, tell us of people who do not doubt the existence of the spiritual world in some form.

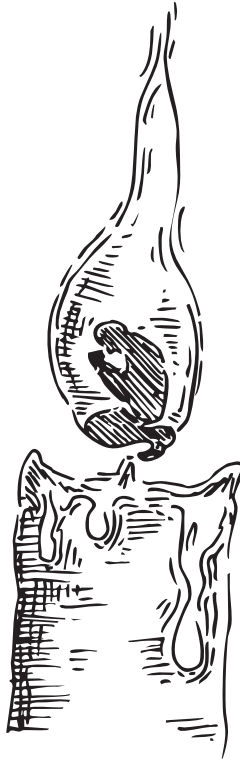
All indigenous cultures and religions, including some ancestors of yours and mine, held beliefs about the existence of spiritual beings of some kind. Is it not a form of blind arrogance that convinces some of us that we know the truth and declare that our ancestors were all deluded? Even Comte, the father of positivism, who regarded all religious belief as a primitive way of knowing, knew that science was placing itself outside of ultimate truth by adopting a purely materialist perspective (Comte 1976). Comte chose positivism because of the solid ground that it would give to science. He was right in his assessment of science, yet he knew this would not give us ultimate truth. His awareness should at least open the door for science education to recognise that scientific materialism is missing something important.

As science education researchers, we must stay open to our own inner experiences so that our students will find us ready to use our scientific thinking to develop all our human faculties while growing our scientific understanding. If we have the courage to follow Plato in examining our wreality, then we can use the gifts of our scientific thinking to empower our students not just in their grasp of matter and energy, but also in fulfilling their wreality's evholutionary task.

Our thinking, feeling and willing all need to align within our wreality to reach our full potential. Evolution has already shown that mind is more powerful than body, otherwise we would not have become the most dominant species on earth. If our evholutionary task is to manifest a mind that lives in

intimacy with nature and spirit, then we must learn to be even less attached to the body, to matter and to put our attention back onto the development of our mind.

If we broaden our horizons to see beyond materialism, science education can give us the solid ground needed to become trained and disciplined in the very kind of thinking that can help us on our way forward.



## FAREWELL

Dear Reader

Thank you for sharing these ramblings with me.

We have shared many thoughts, pictures and stories from so many human lives; so much food for thought from science education.

What you believed before you started reading this book has possibly not changed; such is the nature of the mind, however, if these stories have touched your heart as much as your head, there is a chance that you will be open to new ideas and inspirations, shaped by your own inner moral landscape which will receive shaping in return.

And may this lead you to a dialogue of trust between heart and mind, so that your own meaningful experiences will be whirl-winded into an evolutionary compatible wreality. Then we shall stand together, as researchers and practitioners in science education, on Wordsworth's 'pleasant lea' and not feel forlorn, but like Fritjof Capra, feel enlivened. And if we persevere, drinking to the bottom of Heisenberg's 'glass of the natural sciences' and wrestling to achieve a semblance of Plato's 'examined life', we shall stand as brothers and sisters with some of the greatest hearts and minds of humanity at the birth of Feynman's 'scientific age'.

May your journey be blessed

Philip



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*We Don't Teach Science* is not a conventional education research book. It is messy, bold and deeply personal. For readers who value strict adherence to scientific orthodoxy, the book may seem frustrating and at times, irresponsible. For readers who enjoy iconoclastic voices, provocative ideas and raw storytelling, it will be a stimulating, intriguing and inspiring read.



NON-FICTION

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