THE ABSTRACT IN CONCRETE*

REPRESENTATIONS OF TRANSFORMATION

In this article, I intend to achieve two ends that I know are difficult and I am sceptical that I can indeed achieve them. The first is to convince the reader that cement and concrete are interesting materials, worthy of more than a casual consideration. My second purpose is to encourage civil engineers to always search for humanism in their professional work – because to be a Civil Engineer means to be continuously engaged with important questions of the human condition.

Most people, whether consciously or unconsciously, are attracted to what I shall call, the "great human narrative" of transformation through journey. We find the narrative attractive because it appears prominently - as a leitmotif - in much of the way in which we construct our religious and cultural understandings of ourselves. The journey narrative speaks strongly to our sense of identity - both as belonging to a group (tribe, nation, human, etc) but also as individual (adult, academic, gardener, etc). We recognise these identities as having been formed through difficult intellectual, spiritual and often, physical journey. Importantly, we think of the personal as well as the shared journey as a process towards a better understanding of complexity – towards a more enlightened view of the world and our place in it.

Many religious narratives carry these themes of transformation through journey. Great spiritual leaders like Abraham, Jesus, Mohammed, Moses and Buddha all undertook journeys that left them and their followers fundamentally transformed. In the case of the prophet Mohammed, Muslims consider his (relatively short) journey from Mecca to Medina as such a seminal ransformative moment in the conceptual development of Islam, that they mark their calendar by this event. Jesus' journey from the Garden of Gethsemane to the site of the Crucifixion captures the Christian imagination with equivalent power. We recognise that those involved in such a process are no longer able to see and understand the world as they did before undertaking the journey.

Of course, the narrative of transformation through journey is not limited to the religious sphere - and our socio-political imaginations also draw strongly on this theme. In more recent times, Mao Tse Dung gave inspiration and impetus to a political movement in China by undertaking his Great March; Nelson Mandela speaks of South Africa's "Long Walk to Freedom" and, in the United States of America, the journey of the Pilgrim Fathers continues to be celebrated as an important narrative in constructing their national identity.

In reflecting on cement and concrete as materials as well as the ways in which we respond to these materials as researchers, I have been struck by the parallels with the great human narrative of transformation through journey. While cement and concrete are not unique in this character, I use it because of both the subject of its importance in civil engineering as well as the fact that, very simply, it is the research area that I know best. In this article, I intend to consider these connections and make the case for concrete and our roles as researchers – as an exciting example for the metaphor of transformation through journey.

It is easy to recognise that the journey from a mixture of limestone and clay to cement clinker and then to a garden pathway or the Three Gorges Dam is an irreversibly transformative journey. The process of hydration – to most people in the concrete industry, a phenomenon not deserving of a second thought – is as complex as the human condition can be. And, like the transformative development of human individuals and communities, the process demands - and releases - enormous amounts of energy.

As figure 1 shows, cement itself is a celebration of the principle of diversity and the idea that humans are irreducibly plural in their world views, opinions and, given a particular set of circumstances, will arrive at a wonderful array of different outcomes – sometimes completely unpredictable.

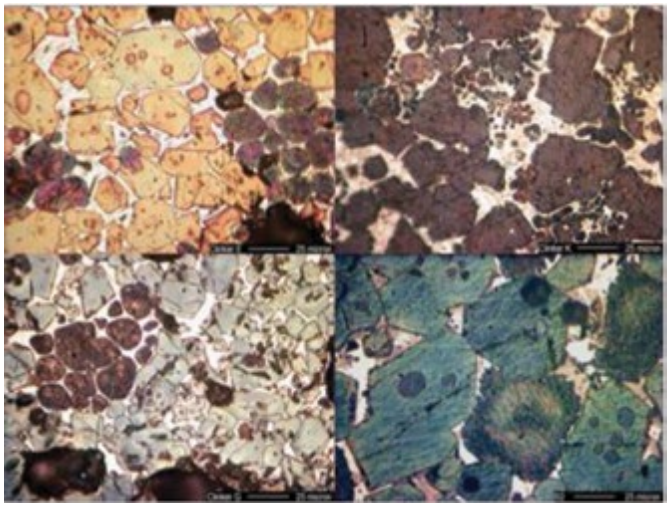

Figure 1: The irreducibly plural nature of cement. Optical microscope images showing crystal structure of four South African cement clinkers – all used to produce CEM I cement (with thanks to my colleague and one-time student, Dr. Peter Graham, who produced these images).

Por: ***Yunus Ballim***
Professor, Construction Materials;
School of Civil & Environmental Engineering
University of the Witwatersrand, Johannesburg, South Africa.

yunus.ballim@wits.ac.za

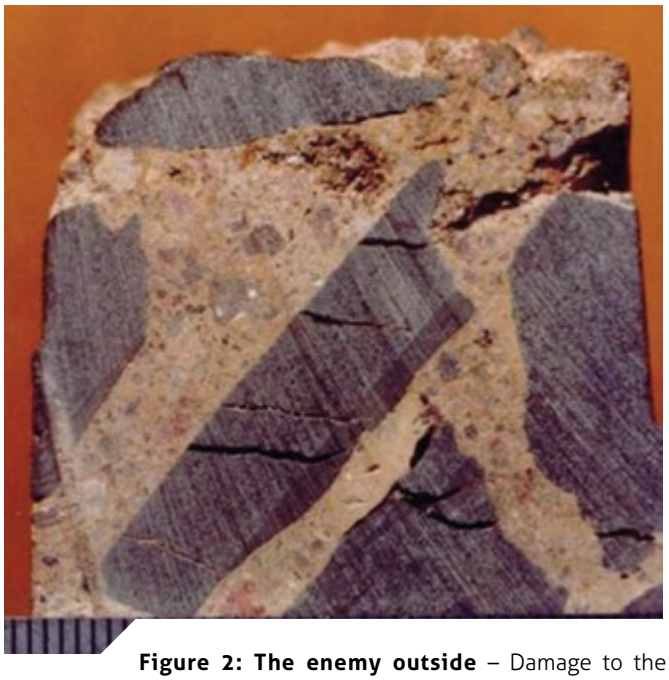

Figure 2: The enemy outside – Damage to the near surface zone of concrete on which sodium sulphate was regularly spilt in a production process (the scale at the bottom of the picture is in mm).

The domain of concrete durability, deterioration and repair also reflects much of the challenges faced by individuals and communities. Deteriorating agents stand as bad ideas that, even in small and apparently innocent presence, can completely unravel fabric and structure. Sometimes the harmful ideas are from without (see Figure 2) and sometimes the destructive ideas are infused through the community (see Figure 3). The result is to turn a material system that is considered to be persistent and of long-term value, into a crumbling mass that people look on with a nervous shake of the head (see Figure 4).

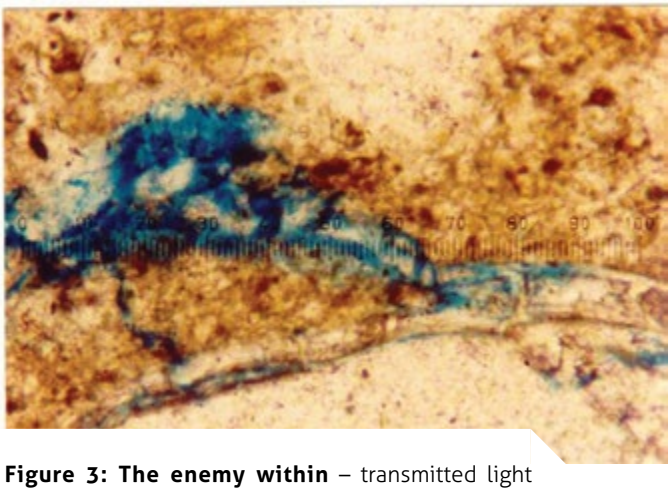

Figure 3: The enemy within – transmitted light microscope image of expansion and cracking due to alkali silica reaction. (I included a blue dye in the impregnation epoxy used to prepare the thin section. 1 division on the scale marker = 10 µm)

Figure 4: Sidewalk level of large concrete elements showing signs of serious ASR damage.

I would now like to turn to one of my favourite narratives – Virgil's Aeneid, in which Virgil recounts the journey of the Trojan hero Aeneas after the fall of Troy, to his founding of the city of Rome. This narrative seems to me to have important messages to us as researchers and intellectuals as we embark on the path of research and the search for a better truth. (Incidentally, I do subscribe to the idea that the best of science is about finding better wrong answers.)

Despite loud warnings and protestations from the High Priest of Troy, Laocoon, the Trojans choose to bring the destructive idea of the wooden horse into the city's walls. They see the horse as a celebration of their victory and an acknowledgement of a new beginning for them – now that the all consuming old questions of the bothersome Greeks have finally and completely been solved. However, the horse is pregnant with danger and, once within the midst of the city, this misinterpreted idea leads to the sacking and destruction of Troy. The Trojans miss the point that is always acknowledged by good researchers – ideas or theories are no more than representations of reality and that, as such, can have very different meanings when viewed from different directions.

Aeneas realises that he has to flee the crumbling city, leaving behind the comfort of all that he knew and trusted – the ideas that he was willing to defend against all enemies - to face life as an exile. He runs from the city carrying his aged father on his back and holding the hand of his young son, to meet with equally concerned colleagues, where they will make plans for the journey that lay ahead. Aeneas abandons the city carrying the burden of his past on his back and holding the hand of his hopes and dreams for the future. In many ways, like Aeneas, the researcher is in a sort of intellectual exile – acknowledging the weakness of past ideas and driven by the hope of a future with more clarity of meaning in an enormously complex world. Furthermore, carrying the burden of our past and our hopes and dreams for the future, we too come from afar to gather in conferences, undertake sabbatical visits and meet with equally concerned colleagues across national boundaries, to make plans for our future intellectual journeys.

To return to the religious narrative, let me conclude by turning to the journey of Moses after winning the freedom of the Israelites in Egypt and leading them on the path to the "promised land". At a point on the journey, when Moses is in spiritual retreat seeking guidance from God, his followers begin to doubt the idea of the "promised land". They see that the path ahead is difficult and beset with danger and their confidence flags. The road sign is clear but it points to a path that they are not sure they have the courage for. Some among them propose to build a symbol of worship where they are encamped – in other words, they choose to worship the road sign instead.

This new idea catches on and soon they have support to build a golden calf - not a stone or a wooden image but one made of gold. God's response is to make this recently liberated group of people wander in the desert for 40 years. One generation of this group has to die in the desert because they are un-transformable. The idea of an ability to freely search for truth is so alien to their understanding of the world that a new generation, unfettered by the limits of a world view constructed in a time of slavery, will have to pick up the path. In our daily lives as researchers and intellectuals, we must be careful not to be counted amongst those who have to die in the desert because we hold so rigidly to our theories that we are unable to even contemplate the possibility of a light being shone on our subjects from another direction. It is the possibility of an alternative view that makes our lives as researchers so exciting – and this is to be celebrated.

Civil engineers are important members in the community of "organic" intellectuals and must drink deeply from the world of ideas. But we must also remind ourselves that, in those last few minutes before we fall asleep, when we don't have to present a posture to anyone, intellectuals say a six-word prayer:

"I may have been wrong today"

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