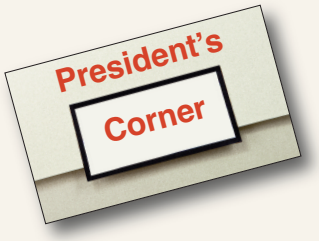

Sustainability

When I travel on aeroplanes, I love to look out of the window, either at the popcorn-shaped cumulus clouds or the striated repeating ripple-patterned undulatus clouds, or the wispy feathery cirrus clouds. While enjoying this ephemeral beauty, I marvel at the atmospheric phenomena (and their governing mathematical equations) that are behind these structures. From the vantage point of 10 km up in the sky, the miniature-looking features on the ground can also be enjoyed. There are hills and valleys, snow-topped peaks, wide open deserts, forests and fields, rivers and lakes. I find that I can easily flip between seeing the world as fragile or as resilient, for both are true.

Apart from continents drifting slowly apart, and the occasional impact of an asteroid, or volcanic explosion, the earth has been relatively stable for a very long time, perhaps as long as 4.5 billion years, and scientific estimates say that we have another 6 billion years to go until the expanding sun eventually burns out our planet.

Yet, we are so reliant on our planet being positioned where it is relative to the sun, so that we receive sufficient radiant energy to keep our world in the very narrow band of temperature and pressure that supports life. The unique properties of water (H_2O) allow life to exist on planet Earth, and we need fresh water on a daily basis in order to survive. When seen from afar, the atmosphere that provides the air we breathe seems like a very thin skin surrounding our world. The planet Venus is often seen as having some similarities to Earth – a solid surface, almost the same diameter, a similar mass, similar rock composition, and a comparable distance from the sun; but instead of our life-supporting mixture of oxygen and nitrogen in just the right amounts, the atmosphere of Venus is dominated by carbon dioxide and is completely covered by clouds of sulphuric acid. The temperature and pressure of the Venusian atmosphere are much too high to support human life.

My university final-year design project involved the production of a chloro-fluorocarbon (CFC) refrigerant that was seen at the time as a safe, harmless substance. Only a few years later, it was seen as responsible for the destruction of part of the ozone layer that protects our world. Bill Bryson, in his book *A Short History of Nearly Everything*, tells the story of a hapless Ohio inventor called Thomas Midgely, Junior, who set out to create a gas that was stable, non-flammable, non-corrosive, and safe to breathe. The CFCs he invented went into rapid production in the 1930s and were used in numerous applications, from air-conditioners to deodorant sprays. It took half a century before it was noticed that these long-lived CFCs were destroying ozone at a prodigious rate, and they were subsequently banned. This same inventor had also earlier in the 1920s invented tetraethyl lead, an inexpensive compound that was effective at stopping engines from knocking. Unfortunately, the widespread use of lead (a known neurotoxin) as a gasoline additive led to the death of numerous workers and to damaging the health of countless other people, despite the denials of harmfulness from the producers. One of Midgely's other inventions led directly to his own death in 1944, when he was strangled in the cord of a device he had created for turning him and lifting him in bed (as he was crippled by polio).

One of the controversies of our present age revolves around the extent to which mankind is causing climate change, and what can be done about it. The rapid increase in human population with the onset of industrialization led to the consumption of vast quantities of fossil fuels, with the result that the atmosphere now contains around 400 parts per million of carbon dioxide, whereas the pre-industrial atmosphere contained only about 280 parts per million. Much evidence has been presented to show that this has led to a progressive warming of the surface of the planet through the greenhouse effect.

Sustainability *(continued)*

The current rate of change in the mean temperature of the Earth is at levels that are unprecedented in the past 100 000 years, and it is this rate that distinguishes today's climate change from past fluctuations. The climate is also becoming more variable, with more extreme conditions becoming more frequent than in the past. Will human beings, and the intricately connected food chain and environment, be able to adapt to these changes fast enough?

Jared Diamond wrote a book in 2005 entitled *Collapse*, and subtitled *How Societies Choose to Fail or Survive*. *Collapse* presents an attempt to understand why so many past societies collapsed, leaving behind only ruined or abandoned temples, pyramids, and monuments. Diamond examines why ancient once-productive societies, including the Maya, the Anasazi of the desert areas of the American Southwest, the Easter Islanders, and the Viking colonies of Greenland, as well as modern ones such as Rwanda, have fallen apart. Diamond identifies five factors that contribute to collapse: climate change, hostile neighbours, collapse of essential trading partners, environmental problems, and failure to adapt to environmental issues because of various political, economic, and social factors. Deforestation was a major factor in the decline of Easter Island's Polynesian society, famous for erecting giant stone statues. Because trees take so long to re-grow, deforestation has more severe consequences than crop failure, and can trigger disastrous erosion, leading to the wind blowing off the island's thin topsoil, resulting in starvation. It's hard to imagine what the person who cut down the island's last tree was thinking. Environmental factors are not the only ones at play: policy also matters, as can be seen in the two countries sharing the Caribbean island of Hispaniola – Haiti is a failure relative to the Dominican Republic. Diamond also argues that humanity collectively faces similar challenges to those outlined for individual societies, and rightly warns of alarming trends in biodiversity, soil loss, freshwater limits (China is depleting its aquifers at a breakneck rate), and over-fishing (much of the developing world relies on the oceans for protein).

I have yet to meet someone who, when genuinely challenged, would seriously suggest that we should stop all industrial activity such as the mining of metals. For example, there is no doubt in my mind that the use of stainless steel in kitchens and hospitals has brought about a better standard of health and life for mankind in general. Perhaps the challenge for us in the mining industry is to use the resources of our planet responsibly, mining the minerals we need, but refraining from the profligate and greedy exploitation that has sometimes taken place. We should be mindful of the impact that mining has on the environment and society, and should take care to clean up after ourselves as best as possible, building in responsible mine closure and rehabilitation to our plans. We should admit that there are places in the world where mining should not take place, even if the pure profit motive would dictate otherwise. The conservation of our natural environment, scenery, and wildlife is something we owe to our children and grandchildren.

This resilient but fragile planet is the only home we have, so let's look after it well.

R.T. Jones
President, SAIMM