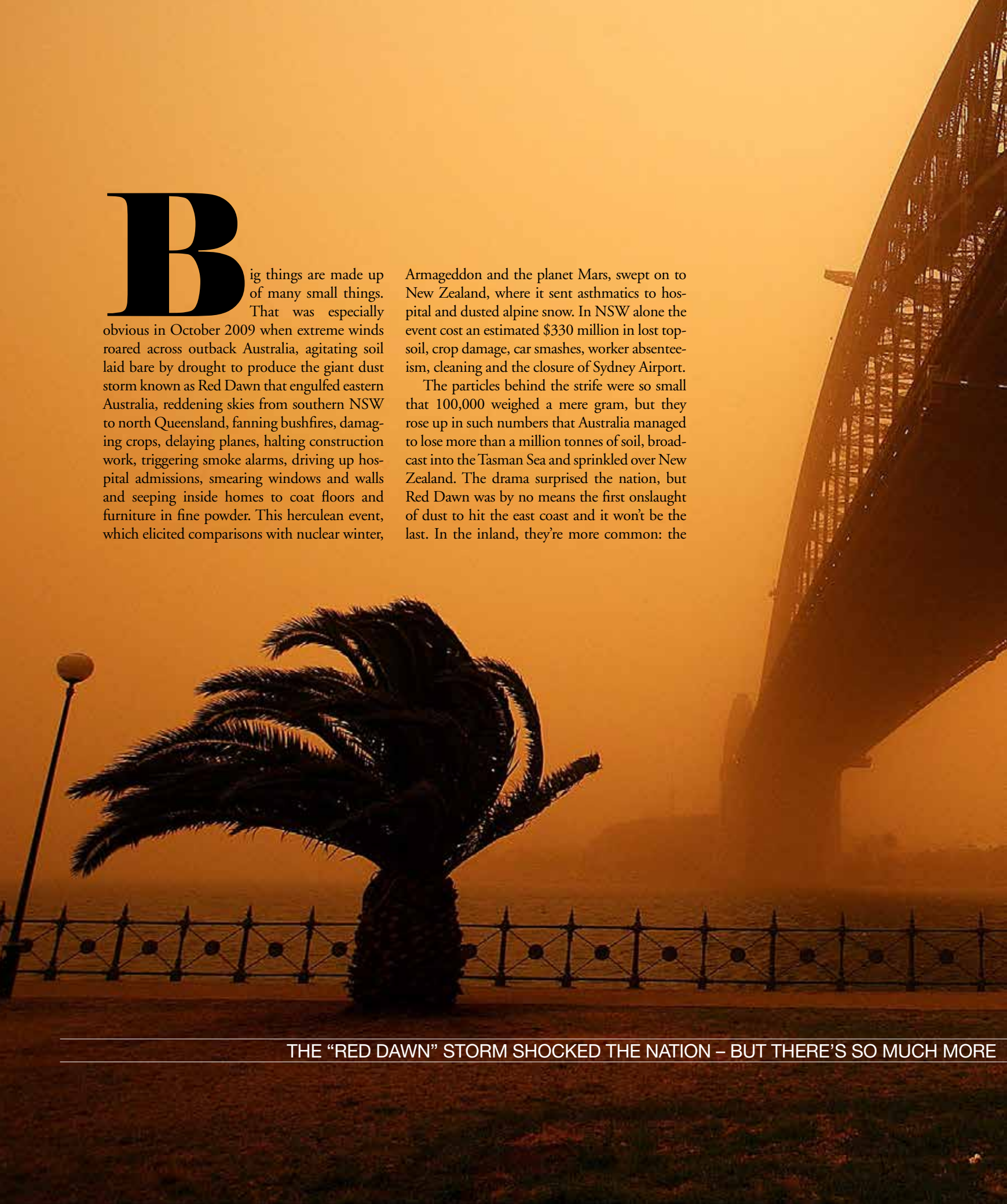
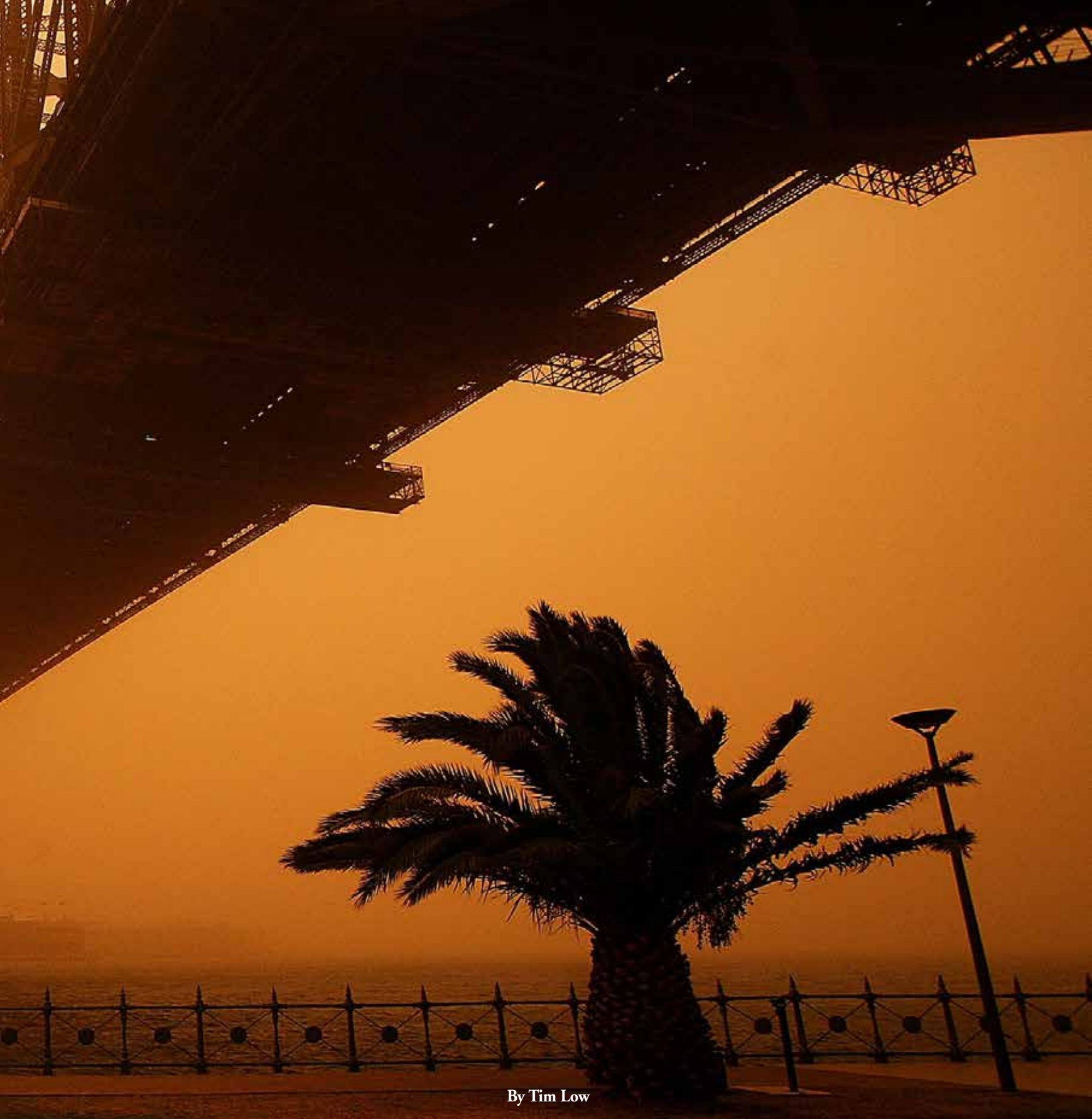


Big things are made up of many small things. That was especially obvious in October 2009 when extreme winds roared across outback Australia, agitating soil laid bare by drought to produce the giant dust storm known as Red Dawn that engulfed eastern Australia, reddening skies from southern NSW to north Queensland, fanning bushfires, damaging crops, delaying planes, halting construction work, triggering smoke alarms, driving up hospital admissions, smearing windows and walls and seeping inside homes to coat floors and furniture in fine powder. This herculean event, which elicited comparisons with nuclear winter, Armageddon and the planet Mars, swept on to New Zealand, where it sent asthmatics to hospital and dusted alpine snow. In NSW alone the event cost an estimated $330 million in lost topsoil, crop damage, car smashes, worker absenteeism, cleaning and the closure of Sydney Airport.

The particles behind the strife were so small that 100,000 weighed a mere gram, but they rose up in such numbers that Australia managed to lose more than a million tonnes of soil, broadcast into the Tasman Sea and sprinkled over New Zealand. The drama surprised the nation, but Red Dawn was by no means the first onslaught of dust to hit the east coast and it won't be the last. In the inland, they're more common: the

THE "RED DAWN" STORM SHOCKED THE NATION – BUT THERE'S SO MUCH MORE



By Tim Low

TO DUST THAN MEETS THE EYE. SO WHAT'S IN IT, AND WHY IS IT SO IMPORTANT?

# TRUE GRIT

most recent in Bedourie, western Queensland, when day turned to night last December and dust enveloped the town for more than 90 minutes. Australia is one of the great dust-producing lands, the main source in the southern hemisphere. If Australia faces a drier future, it will be a dustier one as well.

When it enters the sea, dust can make a big difference. The iron that makes our deserts red is a potent fertiliser for plankton, the primary producers in the ocean. Red Dawn wasn't studied as a fertilising event, but dramatic dust storms in 2002-03 were linked to a drop in carbon dioxide in the atmosphere, which was attributed to plankton taking in more carbon because they were photosynthesising more. So, farmers who flog their paddocks help the fish in the sea by helping the algae that sustain marine life. Some scientists have warned that to plant millions of trees to reduce carbon dioxide could backfire if there is less dust from degraded lands reaching the sea, although that conclusion has been disputed. Australian dust is first-class fertiliser, with 50 per cent more iron than the global average.

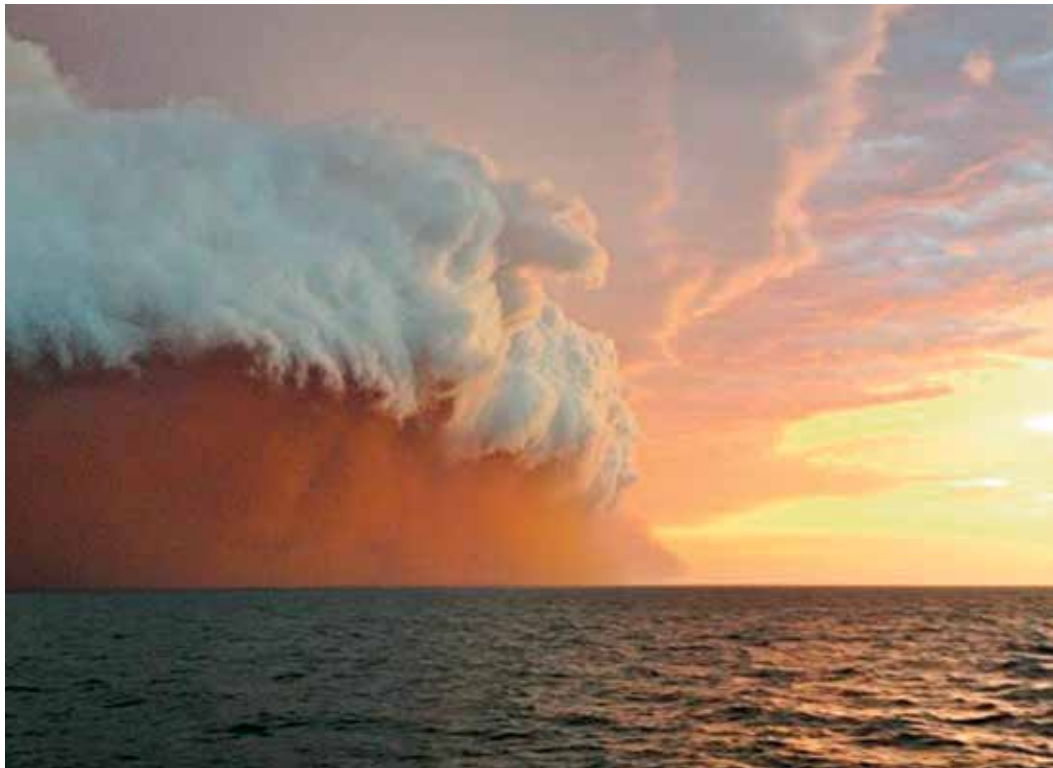
Dust comes and goes everywhere. Dust from the Lake Eyre basin – Australia's dust hot-spot – is thought to reach the Philippines, Antarctica and Patagonia, carried on the prevailing westerlies. It may well be fertilising Borneo rainforests, just as Saharan dust fertilises the Amazon and central Asian topsoil enriches Hawaii. Like the internet, dust connects the world. New Zealand receives so much dust from Australia – up to 200,000 tonnes in a single event – that Australians go there to study it. Scientists can tell where in Australia the dust comes from by testing which of 25 trace elements it contains; some grains found on Fox Glacier were traced back to Wilcannia in western NSW. Before reaching New Zealand, Australia's dust grains dance past the smokestacks of coal-fired power stations and mines, acquiring pollutants such as lead, nickel, copper and zinc, which show up on New Zealand glaciers at high enough levels to cause concern. Smoke from bushfires journeys across as well, and spores of wheat rust, a feared disease that ravages whole crops.

**Dust is rich in information. Places in which** it accrues are archives, able to inform us about past climates (ice ages are super dusty), past wind directions and past activities. In a peat mire in Kosciuszko National Park, some of the lead in the dust can be traced to the first mines at Broken Hill in the 19th century and to Australia's first leaded fuel in the 1930s. Industrial arsenic, zinc, copper and cadmium are also stored in that remote alpine site. The mire shows that Australia became much dustier after 1869 as farmers opened up the land and rabbits chewed it bare, to reach an acme during the Federation Drought. There was so much topsoil in transit then that, to quote one observer, "Every fence, at some point or other, was so far buried that stock could go from paddock to paddock." One pastoralist wrote about "three parts of this country blown further east".

Australia today is less dusty, because many of the grains that could blow away have done so, and because landholders have embraced Landcare and the National Soil Conservation Program. The dust that settles in our homes is a bit of everything. There are mineral particles from soil and buildings, fibres from wood and paper, fragments of foam rubber and plastic, paint flakes, food particles, soot from cooking, the droppings of cockroaches and silverfish, pet dander, human excretions and secretions, and other organic debris such as the desiccated moth our shoe may have crushed into the carpet. Near open windows there are more grains of sand, leaf particles and pollen, while the soft grey dust under the bed is less diverse and dominated by shed skin and textile fibres. The ingredients of most importance to humans include mite droppings, pollen and lead.

The animals that dominate our dust are tiny mites. Hordes of dust mite species find their way into homes to live in flour and other dried foods, on pets, mice and pot plants. Of the true dust specialists one home rarely has more than 10 species, with as many as five in a carpet, one of which is apt to dominate. The world's most successful dust dweller, likely to be in your bed and mine, is a minuscule mite with a very long name, *Dermatophagoides pteronyssinus.*

Fodder for dust mites includes the flakes of bacteria-laden skin we constantly shed, along with pollen grains, fungi and plant fibres. They do especially well on the dried semen found on



sheets, a rich source of protein and sugars. In our beds they do best at the warm foot end and worst in the hot central zone our bodies occupy. They prefer the sheet and blanket above us to the quilt or bottom sheet. They like buttons and seams. They burrow up to two centimetres into foam mattresses, which by holding moisture suit them better than mattresses with springs. The air turbulence we create when we slide into bed, and the thermals generated by our heat, ensure we inhale mite droppings left on our sheets.

Dust mites lurk in carpets, sofas, curtains and even mould on walls. They can crawl only a few centimetres a minute, but they are adept at hitchhiking. When some dyed mites were released onto a sofa they soon appeared in other rooms and within 10 days were in the family car. So when we visit friends, mites on clothes are part of our entourage. A cardigan can carry well over 200. Dust mites turn up in Antarctic field stations and even in the Mir Space Station.

Being barely a third of a millimetre long, dust mites come to our notice only if they make us wheeze. They are the main cause of asthma, the most common chronic disease among Australian children and a problem for many adults. Because dust mites are less than efficient at digestion, their droppings are rich in digestive enzymes which are so chemically active that many people, including me, suffer allergic reactions.

Other components of dust that can irk our airways include fungal spores, flakes of skin shed by pets, and pollen. Grasses, she-oaks and other plants that rely on the wind to shift their pollen release prodigious amounts. Around the world, pollen and mite allergies are increasing. The favoured explanation is the hygiene hypothesis, which posits that our cities and homes are so clean that we imbibe too few microbes to keep our immune systems active enough to prevent exaggerated responses such as allergies. Children and adults alike need exposure to the microbe-rich dirt of rural or natural landscapes.

The good news about dust is that one constituent is not the problem it was. Australian homes now harbour less lead, thanks to a phase-out of lead-based paints in the 1970s and leaded petrol by 2002. Now that our fuels are lead-free, the main concerns are with the ultra-fine particles that bypass the filtering systems in our airways to contribute to fatal heart and respiratory diseases. Red Dawn was rich in ultra-fines, but in cities, by a large margin, cars are the main source. A study on rats showed that when these particles are inhaled some of them reach the brain, where, in sufficient numbers, they probably do great harm.

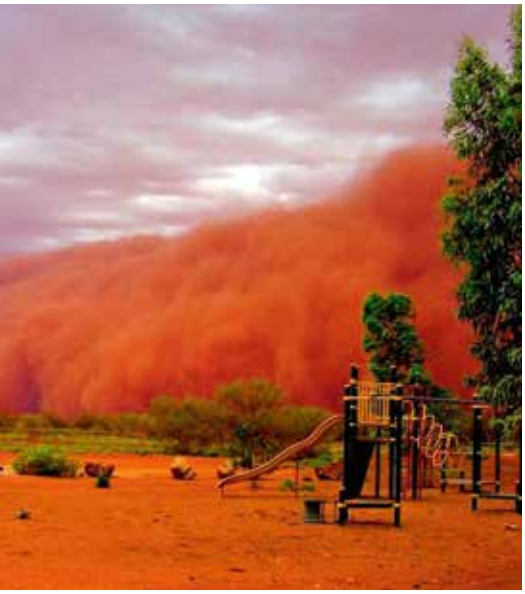
**An emphasis on all that is bad about dust** does it a disservice. Without dust there would be more carbon heating up the atmosphere, fewer fish in the sea, less soil on some valley floors and, importantly, next to no rain – because raindrops need particles to form on. Mineral dust and soot from bushfires, floating thousands of kilometres above Australia, make summer downpours possible.

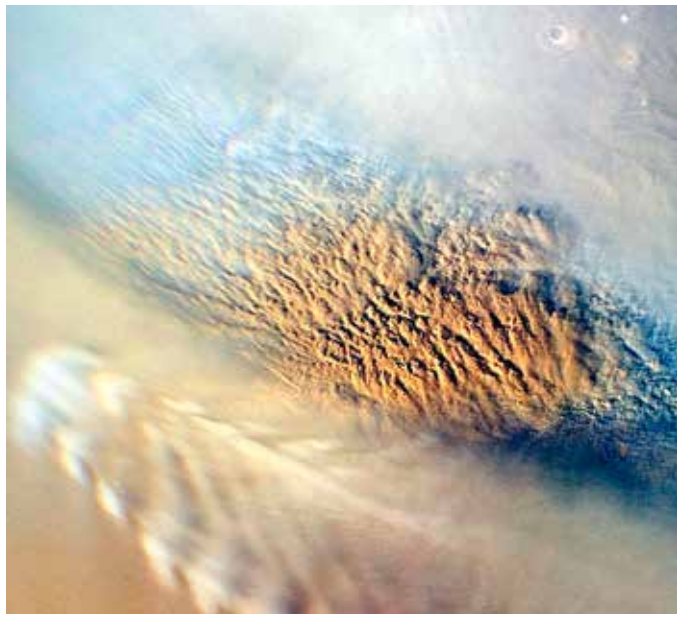
Scientists are excited by growing evidence that live bacteria and fungi in the troposphere, and perhaps algae and pollen as well, act as nuclei for rain. More than 2600 species of bacteria were found in air that reached North America from China. Penicillium mould has been detected 77km above the ground. The sky is very alive. Hundreds of thousands of microbes can exist and breed in a cubic metre of air, although their numbers drop off with altitude. Bacteria have been found in the centre of hailstones. Scientists have proposed that by increasing cloud ice, bacteria even contribute to thunderstorm form and lightning ferocity.

The story of dust is ultimately the story of everything, because the world is made of and influenced by dust. Our planet formed from coalescing dust and gas, so that as children of the Earth we are all made of dust. Cosmologists look to extra-terrestrial dust for insights into the universe. The Curiosity Rover was sent by NASA to Mars to see if Martian dust would disclose proof of past life. Stardust was a space probe that collected dust from comet Wild 2 in the hope that comets preserve primordial dust from early in the life of the universe.

Our world reveals itself as a very different place when, in all its forms, dust becomes the focus. Dust reveals the power of tiny things to harm us, help us, shape our world and teach us about ourselves. Red Dawn forced millions of Australians to grapple with the stuff, but we shouldn't need a colossal storm to remind us that dust is important. ●

Tim Low is a biologist and writer





**Dramatic:** left, a dust storm nears WA's Pilbara coast in 2013; Umuwa, SA, 2009

**Cosmic insights:** NASA image of a dust storm on Mars

PHOTOGRAPHY: GETTY IMAGES; AFP / BRETT MARTIN