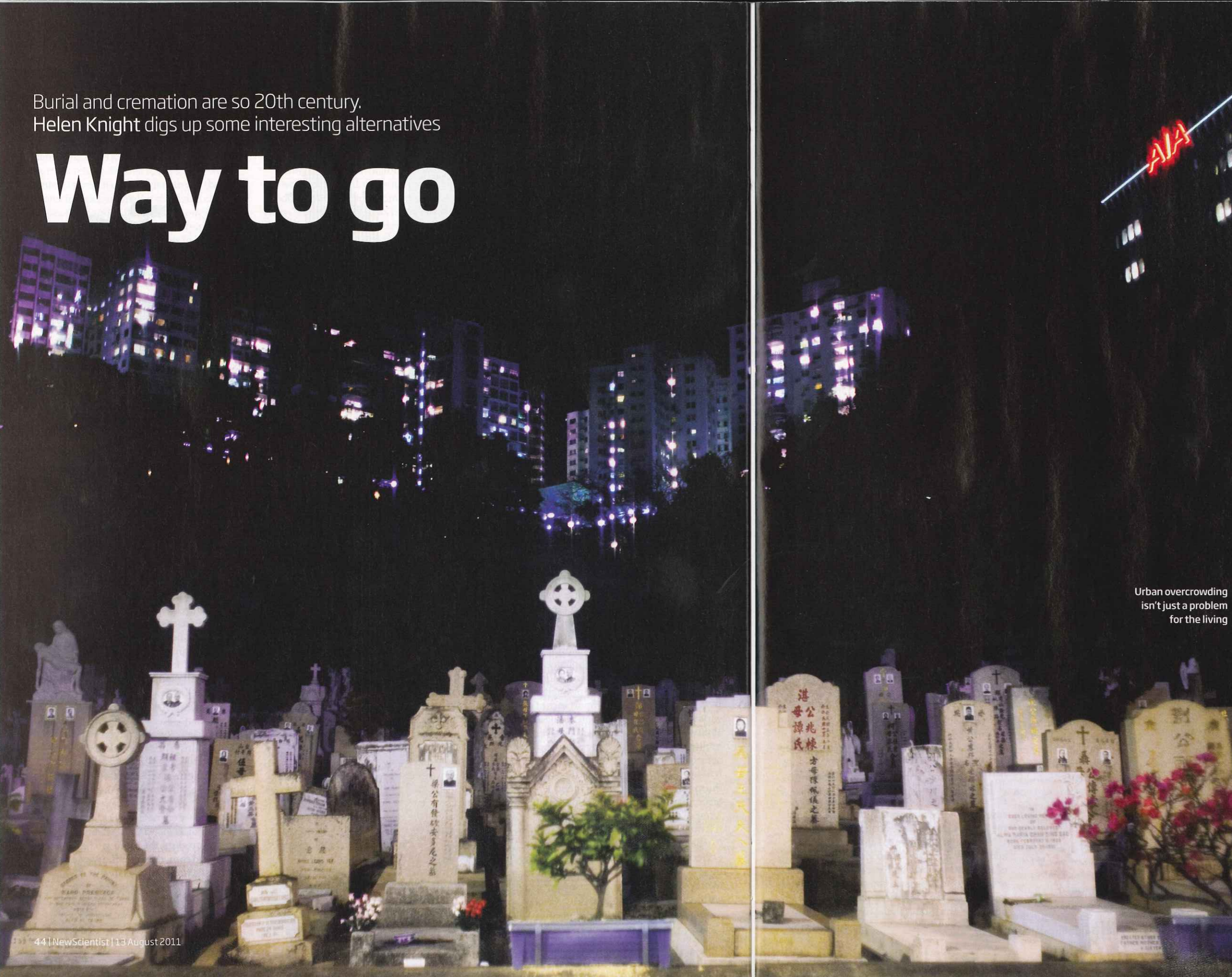


Burial and cremation are so 20th century.
Helen Knight digs up some interesting alternatives

Way to go



Urban overcrowding
isn't just a problem
for the living

IN AN out-of-the-way corner of a cemetery in east London, the graves are being dug up. Bodies are lifted out of their coffins, placed in hessian bags and lowered into a communal grave nearby. Once full – it can take 80 corpses – it will be covered over and a new one opened. This may seem a harsh way to deal with the remains of people laid to rest less than a century ago, but there is no space left for new graves. If this popular graveyard is to remain open, the only solution is to reuse old plots. So they are unearthing bodies at a rate of about 10 per week. So far, over 300 have been moved, and another 1000 graves are earmarked for reuse.

With over half of the world's population living in cities, lack of space is a growing problem in urban cemeteries. Cremation cannot be the solution. For one thing, it already far outnumbers burials in some of the most overcrowded countries, including the UK and Japan. What's more, while cremations are on the increase in the US and other countries, many people still want to have their remains buried. Besides, cremation has problems of its own, not least that it consumes large amounts of energy and releases greenhouse gases and toxic emissions. So while few of us give a thought to what will happen to our bodies after we die, some people are starting – if you'll pardon the pun – to think outside the box. The reuse of grave plots is a simple solution. Others are more radical. In a field not noted for innovation, our 21st-century exit strategies are set to get creative.

Although recycling old graves will inevitably seem macabre to some, in fact it has a long history. In continental Europe the practice has been going on since the introduction of a Napoleonic law two centuries ago. In some European countries burial plots are guaranteed for as little as 20 years, after which the remains are dug up and the space freed for someone else. In the UK, however, the reuse of graves older than 75 years in London has been legal only since 2007, and even then cultural sensitivities prevented it actually happening until 2009. "There appears to be a sentiment in Britain that grave reuse is disrespectful to the dead," says Hannah Rumble at the Centre for Death and Life Studies at the University of Durham, UK. Yet British attitudes towards reburial are more liberal than some. In the US it is not practised at all. Instead, pathways and roads in New York cemeteries have been narrowed and even closed off to squeeze coffins into every available patch of land. "Until we change our cultural mindset, we will always have a



To liquefy a corpse, heat under pressure and add potassium hydroxide

Combust, refine, recycle

In many countries cremation is more popular than burial. That may save on grave plots, but it has other environmental impacts. In the UK, three-quarters of people that die are cremated – amounting to 414,000 people in 2010. A busy, well-managed crematorium uses about 35 cubic metres of natural gas to incinerate a body at close to 800 °C, releasing some 400 kilograms of carbon dioxide. Then there's the toxic mercury from dental fillings: British crematoria produce 1.34 tonnes of mercury emissions a year, accounting for almost 16 per cent of the nation's total. Cutting this could make cremation altogether greener.

In 2003, the UK and the 14 other European countries signed an OSPAR Commission recommendation in which they committed to reduce mercury emissions from crematoria by 50 per cent by 2012, and 100 per cent by 2020. To meet this commitment, crematoria have begun installing mercury-capturing filters. These use cold water to cool the exhaust from the cremation chamber down to 140 °C, before passing it through a filter to remove the mercury. A by-product of the process is uncontaminated hot water, so some crematoria are looking at ways to reuse this, including heating buildings and producing electricity.

One idea, announced by Redditch Borough Council in the UK earlier this year, is to use waste heat from the town's crematorium to heat a nearby swimming pool. Some commentators found it unpalatable. "Whenever you are dealing with dead bodies, there will always be people who don't like what you are doing, and that's fine," says John Troyer of the Centre for Death and Society at the University of Bath, UK. In fact, most of the heat will come from combusting the fuel rather than the body. The 280 kilowatt-hours of heat energy captured from the crematorium will meet nearly half the pool's heating needs, reducing its greenhouse gas emissions by 104 tonnes each year, or around 5 per cent of the council's carbon footprint. What's more, the scheme will free up £14,500 per year that the council can use for other services.

Such benefits can help people reassess their gut reaction to schemes like these, says Troyer, who is working with the Haycombe Cemetery and Crematorium in Bath to improve its heat-capture technologies. "When such a story first breaks, the opening salvo is always from one or two people in moral outrage, but by the end of the week it has usually come full circle, with people saying this is actually a very good idea."

lack of burial space," says Rumble. "Grave reuse is a sustainable way forward."

But a lack of space is not the only problem. Primped cemetery grounds are often awash with pesticides, and the use of formaldehyde in embalming releases carcinogenic chemicals, too. It was the realisation that a traditional burial is far from green that led Ken West, a former manager of Carlisle Cemetery in the UK, to pioneer "natural burial" in the 1990s. It entails interring the unembalmed corpse within a simple cardboard or willow coffin in a shallow grave to ensure it decomposes naturally and quickly. If a headstone is used at all, it is a rock or piece of rough-cut limestone placed flat on the ground. Often just a tree marks the spot, and sometimes GPS coordinates are the only way to identify the grave's location. Once a natural burial site is full the land either becomes a conservation area or managed woodland, or is returned to its previous use as grazing land.

Today there are over 200 natural burial sites in the UK and they are also springing up in the US, Canada and Australia. Critics sometimes complain that the rural location of sites means bereaved families must drive a considerable distance to visit, leading to greenhouse gas emissions. Rosie Inman-Cook, manager of the Natural Death Centre in Winchester, UK, defends their green credentials. "A family who have had a natural burial 40 miles away are only likely to attend the site once a year on anniversaries, for example, because there is nothing there to tend," she says, pointing out that people often cover a much greater distance than that visiting local graveyards.

Making a splash

The idea of fading into the landscape may appeal to some, but others will want to make more of a statement in the hereafter. The US company Eternal Reefs can help. Based in Decatur, Georgia, it offers to encapsulate your cremated remains within a concrete ball. This can be decorated and customised by your family before being lowered into a coral reef, either off the coast of Florida or South Carolina, or in Chesapeake bay. The balls are up to 1.8 metres in diameter and help to support the existing reef structure and encourage growth of more coral and microorganisms, creating new habitats for fish and bivalves such as mussels and oysters. "[The augmented reefs] are there for recreational diving and fishing, and in both cases they help to take pressure off the natural reef," says George Frankel of Eternal Reefs.

It is not a cheap place to finish up, though, adding between \$3000 and \$7000 to the cost of a cremation that would normally come in at around \$1600. However, you can rest in peace knowing that you have done your bit for the environment. "States in the US buy reef balls



on a commercial basis for their fisheries management programmes," says Frankel. "So we like to say that we're building public reefs with private money."

Of course, reef burial still requires a cremation. An average cremation consumes around 35 kilowatt-hours of electricity and releases some 400 kilograms of carbon dioxide into the atmosphere, according to the Natural Death Centre. Then there are the toxic mercury emissions – a growing problem as more and more people are dying with their own teeth, and the mercury-containing fillings therein, intact. There are moves afoot to make traditional cremations more environmentally friendly (see "Combust, refine, recycle", left), but a few pioneering companies have started to rethink the whole process.

Sign up for alkaline hydrolysis, for example, and your corpse will be liquefied rather than burned. The body is placed in a pressurised chamber, which is then filled with water and potassium hydroxide. After heating at 180 °C for about 3 hours, all that remains is softened bones ready to be crushed up, and a sterile, light brown soup of amino acids and peptides. This liquid contains no DNA and can be safely disposed of down the drain, or used as a fertiliser. The developer of the system, Resomation, based in Glasgow, UK, has already

"Your cremated remains can be encapsulated within a concrete ball, which can be decorated by your family before being lowered into a coral reef"



installed one "Resomator" at the Anderson-McQueen Funeral Home in St Petersburg, Florida. It should be up and running by September. Another unit awaits installation at a funeral home in Canada, and the company has further orders in the pipeline, according to managing director Sandy Sullivan.

Sullivan cannot confirm the cost of alkaline hydrolysis, as this will be determined by the funeral company offering the service, but he says it is likely to be similar to a conventional cremation in the UK. That typically costs about £2500 (\$4000), including the service and flowers – more expensive than the average cremation in the US, but still cheaper than a typical burial, which costs at least \$7000. What's more, the overall carbon footprint of alkaline hydrolysis is 34 per cent lower than that of cremation, according to carbon-accounting firm Sustain, based in Bristol, UK. "With the public becoming increasingly concerned about the environment, this allows people to express that concern in their final act on the planet," says Sullivan.

Addressing the same concerns in a different way, other innovators have turned to freeze-drying. Swedish company Promessa Organic, led by Susanne Wiigh-Mäsak, has developed a process in which the corpse is first frozen in liquid nitrogen and then vibrated to break it down into a powder. The powder is then heated under pressure in a vacuum chamber so that the water evaporates off at a low temperature. Next, a detector of the type used in the food industry uses magnetic fields to seek out any metals and mercury, which are removed. The remains, once powdered and purified in this way, can be buried in a corn-starch coffin in a shallow grave, where they will turn to compost within a year. "This really gives people the chance to become soil again,"

At up to \$8500, sleeping eternally with the fishes doesn't come cheap

says Wiigh-Mäsak. "It means death is not the end, but the beginning of new life in the soil." The company is hoping to build its first facility in Sweden by the end of 2012.

Taking a similar approach, Cryomation, based in Woodbridge, UK, plans to freeze corpses to -196 °C in liquid nitrogen, before drying them in a vacuum. Working with researchers at the University of Hertfordshire in Hatfield, and several commercial partners, Cryomation has built a prototype device and plans to begin testing it on human bodies later this year. "There does seem to be a genuine interest in a third choice [to burial and cremation]," says Cryomation's Richard Maclean. "We are not trying to replace anything, but to offer an alternative that is better for the environment." He points out that composting the freeze-dried remains creates no atmospheric emissions. A recent study for the UK's Carbon Trust that took into account the energy used in producing the liquid nitrogen found that the process's carbon footprint is just one-third of that generated by a cremation.

Of course, it is one thing to come up with a new, greener form of burial, but quite another to persuade people to adopt it. For many, the choice of what happens to their body after they die ultimately comes down to cultural beliefs and instinctive preferences. Maclean is fully aware of this. However, he believes freeze-drying has intrinsic appeal. "My colleagues and I have stated in our wills that we wish to go this way," he says. "For me, the idea of chilling out in liquid nitrogen seems a very peaceful way to go." ■

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