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Noxious tide

The microplastics
making us sick



MAGAZINE

FASHION *forward*

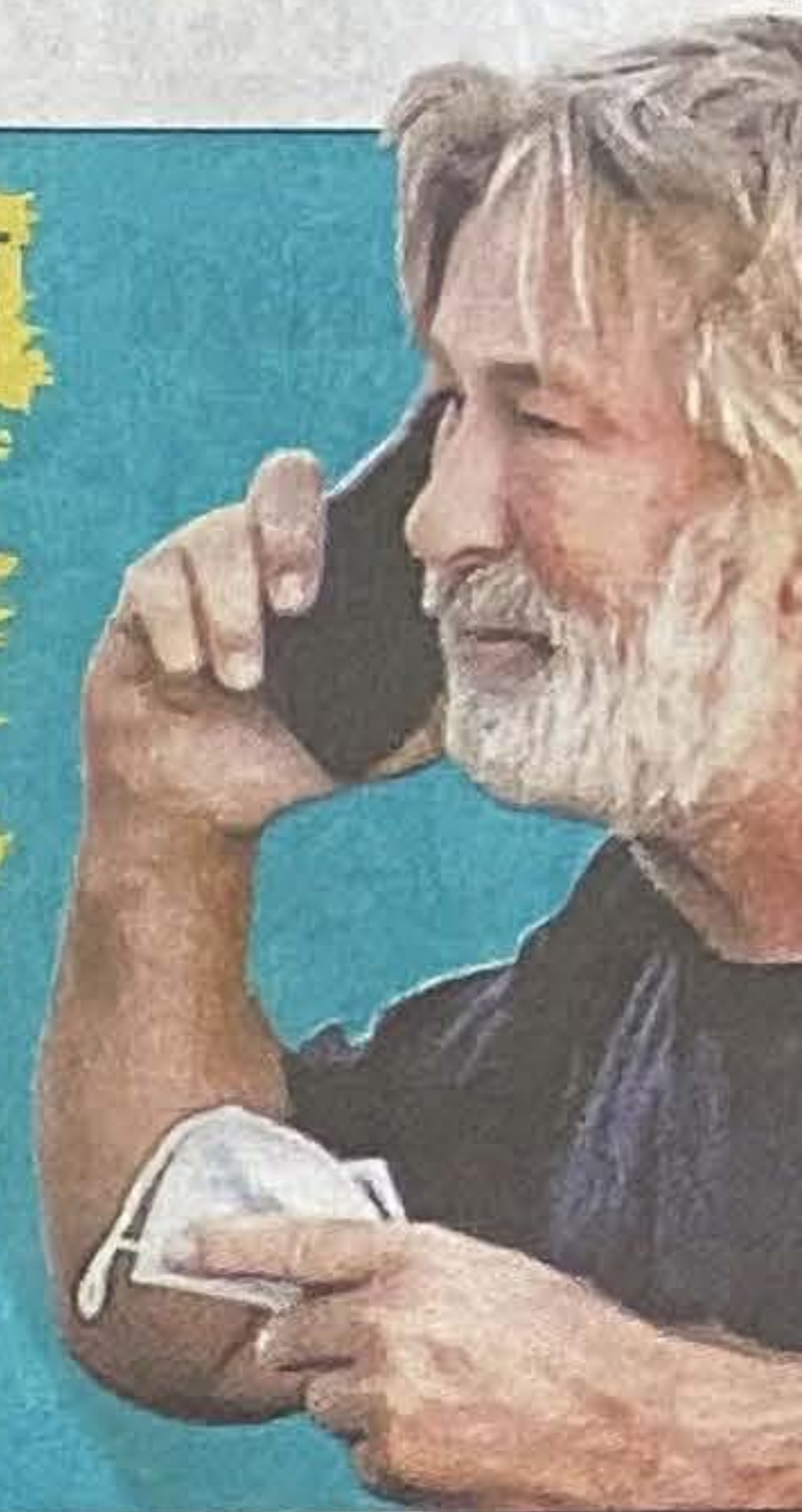
The children of the late
Carla Zampatti have a plan



BALDWIN SHOCK SHOOTING

Veteran actor kills
woman on movie set

NEWS {P5}



PLASTIC PLANET

BROKEN BITS OF TAKEAWAY CONTAINERS, TINY FIBRES FROM ACTIVEWEAR... MICROPLASTICS CAN NOW BE FOUND IN THE MOST REMOTE PLACES ON EARTH. BUT ARE THEY MAKING US SICK? AUSTRALIAN RESEARCHERS ARE ON THE CASE

By Roy Eccleston



It's the bottle caps you notice first, says marine biologist Michelle Blewitt as we stand on the shore of this idyllic little wetland in Port Adelaide. "Bang!" Her finger stabs at a red one. "Bang!" She spots another, half-buried in the silt. "Bang!" That's a blue one. But these are just signposts. Look more closely at the mud beneath the boardwalk and you realise the lids are the giant suns of a much larger universe – thousands and thousands

of tiny pieces of coloured plastic that have been washed down networks of suburban drains.

Carefully scooping a handful, Blewitt pokes through the multitude in her palm. "Those are nurdles," she says, identifying small grey discs that presumably came from a plastic manufacturer, since they are the raw material for the manufacturing process. "This," she says, pulling out a tiny stick that looks like a piece of water reed, "was a cotton bud. They're often flushed down the toilet."

But most of what is in her hand is unrecognisable, remnants of items that lost their identity long ago, broken up by sun, water and abrasion into ever-smaller fragments. There are yellow, blue and green bits, red and grey, clear plastic and white. These are microplastics – pieces less than 5mm across – and rather than break down, they just get smaller until they are invisible to the naked eye.

Floating in our waterways, blown as wisps in

the wind, they're a growing threat to the environment, where birds and sea life mistake them for food. But we are also drinking, eating and breathing them in. Researchers measuring microplastic in dust in Sydney homes determined the tiny fibres were being ingested and inhaled, with small children likely to breathe in the most. Scientists in Ireland found babies took in 1.6 million particles a day when formula bottles made of polypropylene, a common food container plastic, were heated. Investigators from the University of Newcastle and Macquarie University estimate humans consume, at the high end, about 2000 tiny bits a week totalling 5g – enough to make a credit card.

The big question is: does that make us sick?

Blewitt, who moved from Sydney's Northern Beaches to live in Adelaide, is program director for the Total Environment Centre's Australian Microplastic Assessment Project, which has just won a prestigious Eureka prize for science engagement. With little funding she's trained volunteers around the country to measure microplastics on beaches and by waterways in a bid to identify the hotspots, find solutions, raise awareness and change behaviour through education.

Growing up, Blewitt was fascinated by dolphins. That led to marine biology studies at Flinders University in Adelaide and a PhD at Macquarie University on the impact of human disturbance on bottlenose dolphins off the NSW coast. She recalls how years ago she conducted a necropsy of a turtle that had 225 cigarette butts in its stomach. Today, she says, it's not just larger sea creatures eating our waste: microscopic zooplankton are scoffing microplastic. And they're dinner for everything from tiny fish to whales.

These microplastics might be old bits of takeaway containers, or the microfibrils shed by activewear and fleeces (washing machines don't yet have filters to catch them). They could be plastic shed by tyres, or synthetic and rubber crumb used in playgrounds and all-weather sports fields. All contain chemical additives that can leak. As well, warns Blewitt, plastic can pick up new toxins from its environment.

And here in these lovely wetlands bordered by towering reeds and dotted with small islands – part of a bigger system designed by the local council to filter out pollutants before they reach the

nearby Port River and then head to sea – Blewitt and her volunteers have found more than 796,000 pieces of microplastic in just one square metre. That's the most she's found anywhere in Australia. "In places with high urbanisation you have a lot of stuff coming down stormwater drains and out into the river systems and waterways," she says. "Councils do a good job by putting in gross pollutant traps, but that captures the big stuff. Until now, no one has really taken an interest in the small stuff."

It's not just a problem for this spot, she says. More than 350 places around the country have been checked, many with significant levels. In Arnhem Land, plastics have been swept in from international waters; in Dee Why Lagoon in Sydney, rubber crumb and synthetic grass from artificial playing fields are a problem. But in various forms, "it's happening everywhere".

Plastics have made their way to the most remote places on Earth: Antarctica, the bottom of the Mariana Trench, Mt Everest. When CSIRO scientists sent down a robot submarine 380km off the coast of South Australia, they were amazed to find microplastics in large quantities. "We were looking up to 3000m in depth, up to a few 100km offshore within the Great Australian Bight, really remote areas," says CSIRO's Dr Britta Denise Hardesty, a Hobart-based research scientist who has studied plastic pollution for the past 15 years. The sample dug from the seabed showed a concentration of plastics greater than that found in the Indian and Arctic Oceans and 25 times more than research had suggested was likely – up to 13.6 plastic particles per gram. That allowed the researchers to make the first global estimate of microplastics on the seafloor – 8 to 14 million tonnes, more than 35 times the weight of plastic floating on the surface.

The researchers discovered something else unusual. "Where you found lots on the seabed floor, there tended to be much more at the ocean surface as well," Hardesty says. "So, you have these localised hotspots, even in these really remote areas. It just points to the fact there is plastic everywhere. It's out there, it's growing. And wherever you look, you're going to find it."

It's a wake-up call to address our overuse of plastic, she says. A decade ago, it was estimated that up to 12 million tonnes a year ended up in the ocean, equal to at least 16 shopping bags full

Choked: fish mistake microplastics for food

of plastic for every metre of the world's coastline excluding Antarctica. Hardesty says she's not an alarmist but is concerned. Plastic can kill birds and sea life, but many marine organisms and seabirds have evolved to spit out indigestible matter. A CSIRO study of birds fed plastic, including some likely to be contaminated with toxins, showed no serious intergenerational health issues. "Presence doesn't necessarily equal harm," she says. When it comes to human health, "we just don't have all the evidence yet. That said, none of us want to eat plastic."

"Plastic has its place and role in society, right? It's heart valves and artificial joints; we're talking on it, we write on it, we drive in it. Plastic is a part of our life and our society. And I don't think that people think we're going to get rid of it. It's just, what do we want our relationship with plastic to be, and what products do we really need it for?"

That's a question that became a campaign for Rebecca Prince-Ruiz in Perth. Prince-Ruiz had always prided herself on living as sustainably as she could. She was too stingy to buy bottled water, took her own bags to the supermarket and always filled her recycling bin. "I thought I was pretty good," she says. But in 2011 she visited a recycling plant – a materials recovery facility – and her world changed. Confronted by the volume of waste, she was appalled. "I think it hit home to me the impact of my choices and when I went to put my recycling out that night, I knew where it was going to go, and questioned what I could have done differently to avoid it." It wasn't so much a concern about microplastics, or ocean pollution, but just that "I've seen this, I can't unsee it, I've got to do something about it."

So that year she started the idea of a "plastic-free July" – a month when people tried to give up single-use plastics, in particular. There was little media interest but 40 people thought it was worth a go. "I've got to say it was harder than I thought," Prince-Ruiz admits. "You know, I went to buy my fruit and veg, and I was going to farmers' markets, but I was using all those little plastic produce bags. There was liquid soap in a plastic bottle in my bathroom, there was my takeaway coffee cup."

It became easier when people taking part began to share ideas. Despite the challenges, she found she'd struck a nerve. It turned out that a lot of people were concerned about the plastic in their life, and not just in Perth. This year, a decade after that first experiment, about 300 million people in 177 countries took part in Plastic Free July. Like many who worry about the impact of



'It's everywhere': Michelle Blewitt; below, microplastics

plastic, Prince-Ruiz says the key is to change the economics of plastic production. It's cheaper to make "virgin" or new plastic from petrochemicals than recycle old plastic. "Research came out in 2016 that only nine per cent of all the plastic we've ever made has been recycled," she says. "Of that, 10 per cent has been recycled more than once. The latest figures for Australia, from the 2018-19 plastics recycling survey, show the national plastics recovery rate is 11.5 per cent." Yet steel is 70-90 per cent recycled and paper 58 per cent, she says.

One of the key issues, Prince-Ruiz says, is that all plastics are not equally recyclable. "The number with the chasing arrows that we all think of as a plastic's recycling symbol is actually the resin identification code," she says. "It just tells us what sort of plastic that item is made from." Numbers 1, PET (polyethylene terephthalate, used for drink containers and clothing) and 2, HDPE (high density polyethylene, as in milk containers) are more valuable for recycling. But the rest, the plastics numbered 3-7, typically don't have much worth.

"Manufacturers love to put the recycling symbol on products but want to keep using 'virgin' plastic because it's cheaper than recycling and easier to do," Prince-Ruiz says. "Consumers have been



lulled into a false sense of security that the stuff they put in their recycling bin actually is recycled. Instead, the environment – and we – must pay for prices so cheap that plastic can be thrown away."

By 2019, Australians had become perhaps the biggest users of single-use plastics, according to a study funded by iron ore magnate Andrew Forrest's philanthropic body the Minderoo Foundation. The foundation's No Plastic Waste campaign estimated Australians were using 60kg a year of plastics that might stir coffee for a few seconds but last centuries. That was the most of any of the 20 top plastic consuming countries.

While their use is being reined in here through targeting of plastic shopping bags, plastic straws and cutlery, and container deposit schemes for drink bottles, overall plastic waste continues to rise. One of the biggest problems is plastic packaging, which makes up more than a third of plastic production. The Morrison Government this year released a national plastics plan which focuses on improving recycling of the 2.5 million tonnes of plastic waste the country generates each year. The plan aims for 70 per cent of plastic packaging to be recycled or composted by 2025 (a big ask: it was 18 per cent in 2019).

Prince-Ruiz says that's important but there's no way Australia can recycle or clean up its way out of the problem. The solution is using less plastic, and the government needs to create a national education program to help consumers realise the scale of the problem and how they can use less.

Professor Mark Patrick Taylor of Macquarie University, now Victoria's chief environmental scientist, co-authored a study of microplastic in 32 Sydney homes in 2019. For a month, people were asked to collect their household dust. Analysis showed that on average it comprised 39 per cent microplastics, 42 per cent natural fibres such as cotton, hair and wool, and 18 per cent natural-based fibres such as viscose and cellophane. Taylor says a quarter of the microplastics were small enough to inhale, and the study found children under six would have the highest rate of exposure, since they breathed more quickly, put their hands in their mouth more often, and were closest to the floor. The study also found there were more microplastic fibres in homes with carpet, but even hard floors created issues because the protective coatings contained polymers that produced fibres as they wore. The best remedy was to vacuum regularly.

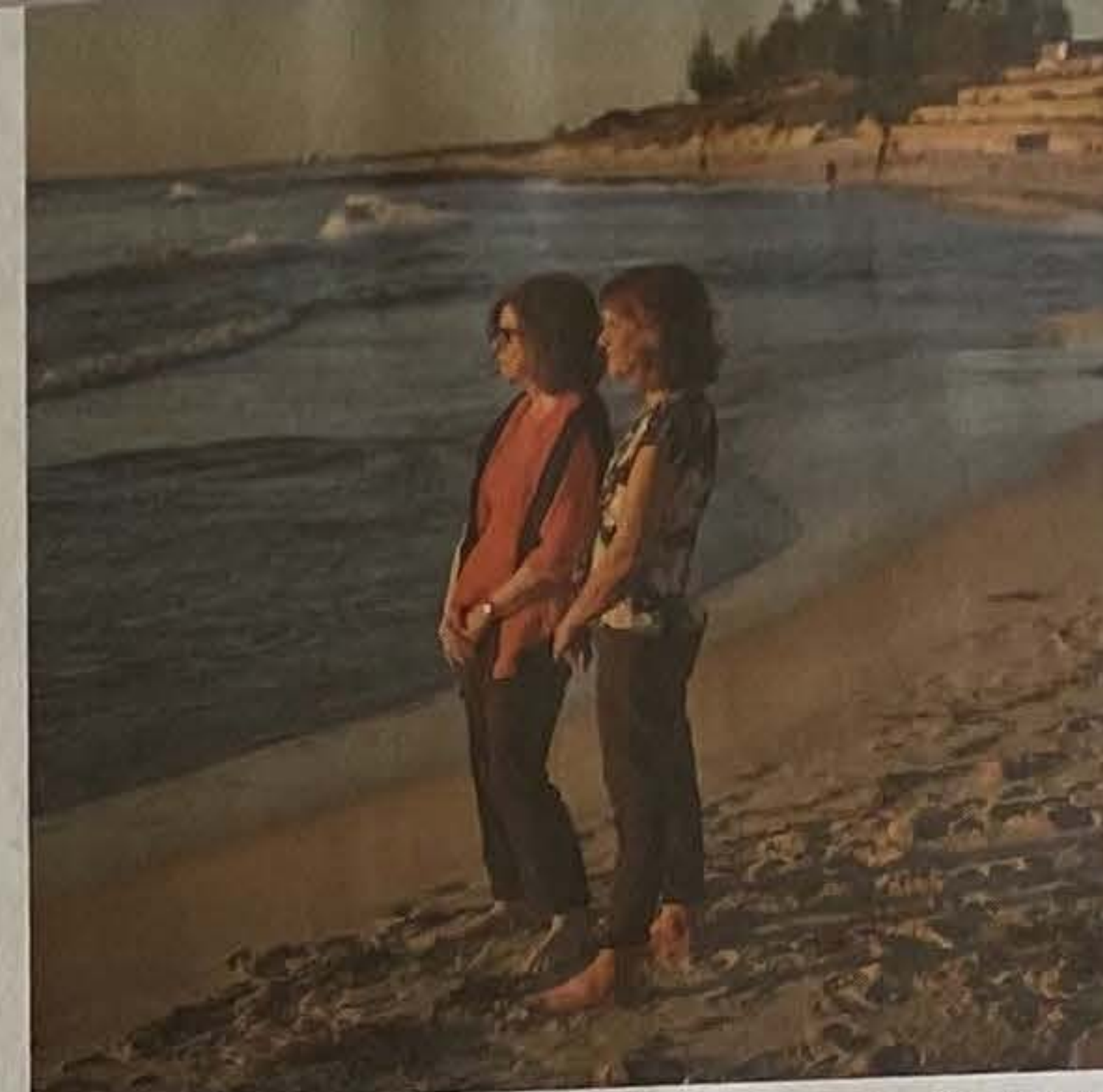
"We effectively live in a sea of microplastics," says Taylor. "There's no escape, and we do not know the consequences for human health. When

these microplastics lodge in your lungs, they're not going to biodegrade, and if you swallow them, some might pass out but some of these artificial particles can stay in your body and accumulate." He doesn't doubt they're bad for us. "It's not a matter of if, I suspect it's a matter of when we will determine that microplastics cause human health problems."

In Perth, Andrew Forrest is spending millions to have that question answered. Forrest, whose doctoral thesis at the University of Western Australia looked at the damaged state of the oceans, is funding research into the potential harm from microplastics and pushing for a new economic model to boost recycling. Forrest is lobbying for the big polymer producers – just 20 of them produce half of all single-use plastic globally – to raise the price of virgin plastic so that recycling is more economically viable, turning rubbish tips into mines. His ambition is for a "circular" plastic economy in which no new plastic is made and everything is created from the vast amounts recycled. (University of California researchers calculate plastic rubbish going into landfill and the environment could build a new Great Wall of China every year.)

Forrest has hired one of his PhD supervisors, neuroscientist Professor Sarah Dunlop, to head Minderoo's research into plastics and human health. Dunlop is convinced microplastic is dangerous. "It's causing harm to human and planetary health, and we have to stop it," she says. She believes recycling plastic is important but doesn't solve the problem – we need to redesign it to break down in the environment. She also argues that microplastic – which measures between one micron, or one millionth of a metre, and 5000 microns, or 5mm – is not the worst problem. Smaller still are nanoplastics and "we don't know how to measure them yet", she says.

She also worries about toxins that come with plastic. It's known that plastic leaks chemicals and attracts new ones from the environment. While the evidence that plastic directly causes illness in people has been equivocal, Dunlop says a review of scientific papers soon to be published will show cause for concern over the way the chemicals imitate our hormones, the messengers that regulate specific organs and cells. "It's ridiculous that we have to be trying to clean up the mess all the time and trying to prove harm after release and use of chemicals," she says. "What should be happening is proof of safety before release. It's the wrong way around... it's madness, absolute madness."



Harm: Rebecca Prinz-Ruiz, left, and Sarah Dunlop; Mark Taylor

Yet during the "Plasticene" era from the 1950s, hasn't human life expectancy risen? "There's consistent proof that there is a link to harm," she says. "Diabetes, or hypertension, cardiovascular disease, Parkinson's, Alzheimer's, they're all going up faster, far faster than we can explain by known genetic risk factors and known lifestyle risk factors. And sperm counts are going down at a dramatic rate. So there's something else going on. We're poisoning ourselves. We might be living longer, but I think most of us are living much sicker now."

Still, is there concrete evidence that plastic and chemicals are entering our bodies in toxic quantities? Minderoo has given \$4.5 million to University of Queensland scientists in the hope they will finally answer this question. The man heading the work, Professor Kevin Thomas of the Queensland Alliance for Environmental Health Sciences, has found sewage records going back 70 years that showed a sudden, unexplained surge of plastics in the mid to late 1990s – especially of polyethylene (from drainage pipes to plastic bags), polyvinyl chloride (construction materials to credit cards) and polyethylene terephthalate or PET (clothing, food and drink containers). Now, Thomas's team wants to identify if certain chemicals in plastics

leak out and make it into the blood, urine or brain. The focus is on bisphenols – bisphenol A, or BPA, has been removed from many drink bottles but replaced by others such as bisphenols S and F, which Dunlop says are "sinister substitutes". French researchers reported in April they were not safe, particularly for pregnant women and their foetuses.

Thomas also wants to develop ways to identify and quantify whether the plastic particles themselves get into the body. He says an adult consumes about 1000 plastic particles a day through food and water; mostly they pass through our gut to be excreted. Only very small pieces would make it into the organs, so Thomas is looking at less than 10 microns (100,000th of a metre). The key tool will be a mass spectrometer, which measures a chemical's signature. The work will put us closer to determining if plastics cause harm, he says. If the plastic or chemicals are in these parts of the body, "then you can start to look at associations" between their presence and disease.

Back at the Port River, the millions of tiny pieces that cram the shore underline the scale of the challenge. Plastic's virtues – low price, high resilience – are what makes it such a problem. There's evidence that some bacteria and moths can eat it, but mostly it defies speedy degradation.

That means there will be great interest in the work of Dr Xiaoguang Duan, deputy director of the University of Adelaide's School of Chemical Engineering and Advanced Materials. He's focused on microplastics that can evade the filters in wastewater plants and then head out to sea. Duan has devised an oxygenation process that turns the microplastics into harmless carbon dioxide and water, or a carbon product that algae can feed on. And it doesn't just work on the smallest pieces, he says – "it works for all microplastics". It would not solve the problem on a global scale and it's a long way from commercialisation, but it's more evidence of the focus on tackling this problem.

Blewitt has read enough scientific studies on the stuff in test animals to change her behaviour. No more plastic in the microwave at her house, just glass containers topped by paper towel that can be used as a napkin before heading to the compost bin. "It's a difficult thing to study in humans, because we can't feed people plastic to look at the long-term implications of that," she says of plastic's toxic potential. "The fact is that the basis of all critters on Earth, zooplankton, are seen consuming it and going through the food chain. It's only over time that we will probably see the repercussions of our consumption of plastics." ●



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