

TIMES EVOKE

AN AGE OF INNOCENCE

Many of us, in innate simplicity, imagine the environmental crisis as an affliction impacting faraway mountains, remote rivers and distant glaciers. But this crisis is much closer home — it can even be found within our own selves. The ecological crisis is simply a human-driven imbalance of chemicals on Earth's surface and atmosphere. But these also enter those living on Earth, breathing its air, drinking its water, consuming its crops — and using all these to create products we never knew we couldn't live without.

Chemicals drive this story of commercialisation — and contamination. The World Health Organization (WHO) estimates 60,000 chemicals are used in commerce. Humans experience these daily, from pesticides, petroleum products and processed metals to pots, pans, detergents, fabrics and cosmetics. These encounters may seem banal — but are far from benign. The WHO finds such chemicals took over two million lives in 2019, driving heart diseases, respiratory illnesses, nervous system damage, reproductive impairments and cancers. Listing chemicals of great concern — including asbestos, benzene, cadmium, lead and mercury — the WHO highlights their ability to lodge inside our systems, triggering layer after layer of reactions.

Yet, their bearer products seem so ubiquitous, few contextualise them against the strange profusion of certain diseases — National Geographic lists how from the 1980s onwards, autism, leukemia and childhood brain cancers have risen, likely propelled by contamination of our physical surroundings, leaching into our internal environment. The World Bank finds only 40% nitrogen in fertilisers is absorbed by crops — 60% escapes into air or water, used by humans whose health impairments amounted to \$6 trillion in 2019 or 6.9% of global GDP.

However, there are solutions. As Times Evoke's global experts emphasise, education about products and exposure is vital. So is a 'regulatory revolution' — chemical contamination can be controlled by enforcing strict rules. Developing sustainable chemistry is also essential, described by the United Nations as minimising hazards, enabling non-toxic circularity and protecting workers and consumers. In 2023, the Global Framework on Chemicals was established, enabling governments, civil society and the private sector to unitedly understand chemical exposure better. Join Times Evoke to learn more and seek a true age of innocence, where the natural world — of which you are a unique part — may enjoy a pristine life.

'Lead exposure caused millions to lose health — removing it from petrol was a global achievement'

Philip J. Landrigan is Professor of Biology at Boston College. Speaking to Srijana Mitra Das at Times Evoke, he discusses some of the most hazardous chemicals impacting human health:

What is the core of your research?
I'm a paediatrician. My life's work has focused on increasing knowledge about toxic exposures in the environment and how these damage children's health. Children are much more sensitive to hazardous exposures than adults — I study why, what chemicals do to children and how we can prevent these negative effects.



Why are children particularly vulnerable to such chemicals?

Children are at great risk because they are in the process of growing and developing. Especially during the nine foetal months and the first two years after birth, often referred to as 'the thousand days of life', every organ and system in a child's body must develop from a small number of cells in an embryo into billions by the time the child is born. Those processes of development are extremely complex and choreographed — they operate on a strict time sequence.

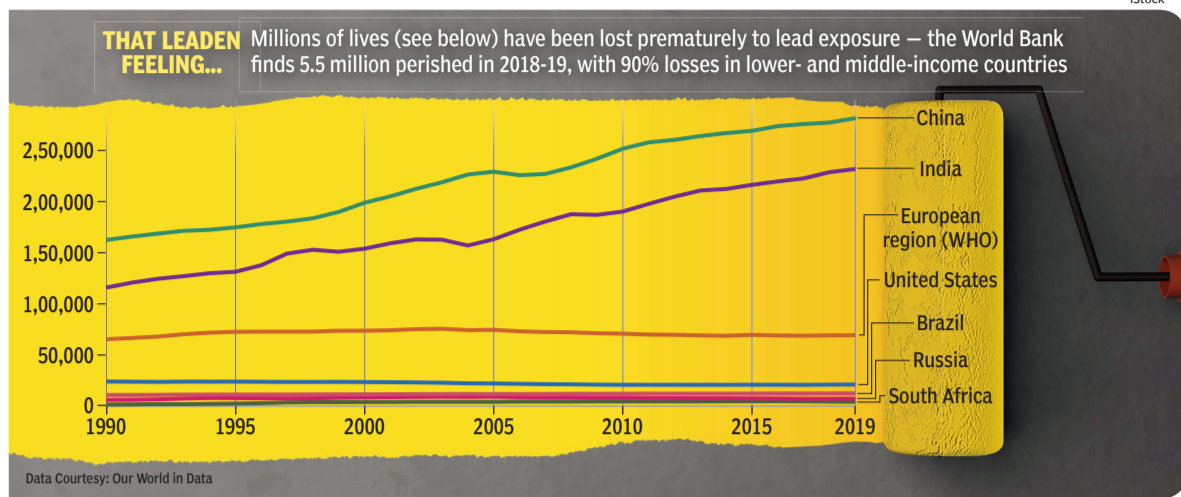
Now, if a toxic chemical like lead or those carried by air pollution gets into a baby's body, it can disrupt those delicate developmental processes. Also, virtually any chemical that gets into the body of an expectant mother also enters her baby and damages its tissues. Depending on the kind of chemical, different organs are affected and a range of diseases follow — if the child's brain is impacted, there could be a loss of IQ and an increased risk of autism. If a lung is damaged, it faces a greater risk of asthma. If a chemical disrupts the hormones or endocrine glands, the baby could suffer birth defects of reproductive organs.

Please share your insights on lead — how does this impact people and how did your findings cause a change in the United States?

Lead has been recognised as a toxic chemical since antiquity, with the ancient



A MINER PROBLEM? Once, lead exposure was thought to be limited to workers



Romans, for instance, writing about lead toxicity. But for centuries, it was seen only as a problem for mine workers, labourers in metal smelting units, etc. It was in the 20th century, when the global production of lead increased very substantially and this began to be put into consumer products from paint to toys, that the first cases of lead poisoning were seen around 1900. Since then, lead poisoning in children has been recognised worldwide. Initially, the only form doctors could diagnose was very acute high-dose poisoning, a terrible disease I have seen myself in children who risk coma, convulsions and even the loss of their life. But in the 1970s-80s, we began to recognise how lead could damage children at lower levels, including those previously thought to be safe — this damage was principally recognised in the brain and nervous system as a loss of IQ, shortening of attention spans and disruptions in behaviour.

WEAPONS OF STEALTH

In the mid-20th century, lead exposure was widespread in practically every country, also because lead was added to petrol in large quantities as a chemical called tetraethyl lead, intended to help automobile engines work better. But this came out of tailpipes and exhausts, causing pollution and impacting people — most children on Earth born between the 1950s to the 1980s grew up with too much lead in their bodies. That caused a massive erosion of intelligence in kids.

My colleagues and I recognised this around 1975 — we began to work on the US government to do something. We succeeded in persuading the American government to take lead out of gasoline

over a five-year period — from 1975 to 1980, we then saw a massive decline in American children's blood lead levels. That continued — in 1975, the average blood lead level in a child in the US was 20 micrograms. Today, it's about 1.5 micrograms. We saw a 95% reduction in the US and since then, many nations, India among them, took lead out of petrol. Hence, there have been declines in children's lead levels worldwide.

Of course there are other sources, including batteries and battery recycling plants, globally — we haven't solved the lead problem entirely but by getting it out of gasoline, we made enormous progress. A further happy consequence of this is that in the US, the IQ of every child born since 1980 increased by about five points. Our economist colleagues have estimated the benefit of this to the economy — for each annual cohort of children born in the US since 1980, the economic benefit is about US \$200 billion as kids with a higher IQ are more creative, more productive and generally earn more. Since it's been around 40 years, if you multiply \$200 billion by 40, there has been a total economic benefit of eight trillion dollars — an almost unimaginable sum.

What are other common toxic chemicals?

Pesticides are designed to kill living things like insects and weeds — but many are toxic for humans as well. A family of organophosphates causes brain damage in children exposed in the womb. Another toxic group is weed-killers or herbicides — the most worrying one is glyphosate which is used worldwide. This is known to cause cancer — the

World Health Organization (WHO) has termed it a probable human carcinogen. Yet, people continue to be exposed to it.

Asbestos is also very toxic. It is a mineral which is mined, the biggest producer being Russia. It is used in building materials, roofing tiles, concrete asbestos pipes, etc. It is cheap, durable and resists heat and fire — but it's also a powerful cause of cancer of the lungs, throat and ovaries. Most exposure occurs for workers making concrete pipes, in construction, etc. The WHO states asbestos to be one of the most powerful cancer-causing agents on Earth — sadly, many countries still use it because it's inexpensive.

Given such challenges, what gives you hope to keep striving for planetary health?

I feel hopeful on seeing the successes that are achieved when people recognise a problem and agree to remedy it. One example is taking lead out of gasoline worldwide — many fewer children are suffering from this exposure now than just a few decades ago. Another is the great progress several countries are making against air pollution which is very hazardous. The US reduced its air pollution by 77% since 1970 by passing laws



DRIVING CHANGE: Scientists pushed for removing lead from petrol, saving lives

THEY JOINED THE DOTS...

Chemical contamination was first highlighted by marine biologist Rachel Carson — her 1962 book 'Silent Spring' sparked the environmental movement, spotlighting the dangers of chemical pesticides to birds and other species. Carson also wrote of the health impacts these had on humans, including causing cancer — her visionary work brought about a ban on DDT in the US and led to the establishment of the Environmental Protection Agency (EPA)

Erin Brockovich, an American paralegal, found evidence of groundwater contamination with hexavalent chromium in Hinkley, California — in 1993, she built a case against a gas and electric company using this against corrosion, its waste water entering local ponds, causing illnesses. Brockovich's activism led to the case being settled in 1996 for a considerable \$333 million

Dolores Huerta, civil rights icon, feminist and labour activist, coined the Spanish slogan 'Si si puede' or 'Yes, we can' — which inspired Barack Obama. Huerta campaigned for farm workers to be protected against pesticide exposure which was causing child deformities and cancers. She even braved a baton-beating by a cop, using the proceeds in a case against him for bolstering farm workers' well-being — at 87, she remains a visionary

Research: WomensHistory.org, Encyclopaedia Britannica, CNN

and regulations and ensuring strict enforcement. Many nations have improved their ambient air pollution — I hope India will too. India is certainly making progress on household air pollution due to Prime Minister Modi's initiative. A third example is how we are finally beginning to see improvements on climate change — it's early days yet but the recent COP28 deliberations are cause for optimism. Finally, countries are acknowledging fossil fuels are a fundamental problem. We must transition away from them fast and equitably

BROKEN EQUATIONS
Pesticides caused declines in ospreys, falcons and hawks. But DDE, a compound of DDT, even impacts black-legged kittiwakes living in the Arctic. Scientists find high levels of lead, mercury, manganese, etc., from pesticides to non-stick pans, in black-legged kittiwakes in Alaska — these damage the birds' reproduction, their numerical decline worrying those who admire the seabird's haunting 'kitti-waa-ke' cry



Chemical contamination threatens Earth's greatest predator, Orca whales, found from the UK to Japan. They could collapse in 50 years due to polychlorinated biphenyls (PCBs), once used in paints, coolants, etc., now banned but still in cables, leaching into food webs. As orcas eat other species, they absorb PCBs via biomagnification — these cause them immune system and reproductive disorders



Synthetic PFAS compounds, per- and polyfluoroalkyl substances, are called 'forever chemicals' because they remain permanently in air, soil, water and the body. These are used in cleaning products, plastics, electronics, etc., and spread via rivers, winds, tides and rain — scientists now find them in polar bears, affecting motor skills and growth, the animals thus paying the price for our commodities



'Lead chromate was being used to brighten turmeric — it damaged adult health and child IQ, costing trillions'

Jenna Forsyth is a research scientist at Stanford University's School of Medicine. She tells Times Evoke about her discovery of lead added to turmeric, its effects — and how this hazardous practice was stopped:

There are dangerous materials all around us in our daily lives — sometimes, these are in the most innocuous places, like within the spices we use in everyday cooking. Jenna Forsyth, part of a Stanford University team, conducted research which delved into the surprisingly high blood lead levels found in people in rural Bangladesh. Searching, she finally found the source — turmeric.

'My goal is to understand and identify lead exposure sources and eliminate them.

I have a practical, applied aim of making change,' Forsyth told TE. She also explained why lead is such a worrying presence. 'Lead is toxic at all levels to us. When life forms were developing naturally, lead was nowhere part of the system — it entered our biosphere only after industrial production grew. Adults exposed to it suffer harsh cardiovascular impacts and damaged kidney functions. Lead is also a potent neurotoxin — it has drastic effects on the long-term cognitive development of children. A World Bank study suggests the adverse outcomes from such reduced IQ in kids can be over a trillion dollars a year of lost economic productivity — if you add disease and mortality due to lead's cardiovascular effects, this becomes five times greater.'

Forsyth, who has a background in engineering, had earlier studied contaminants in Kenya, Australia and Costa Rica. During her PhD, she was focusing on water and sanitation when her advisor, Steve Luby, shared data which suggested higher than expected levels of lead in blood samples from



HEALTHY: Turmeric is seen as beneficial



FIFTY SHADES OF YELLOW: The turmeric crop looks green in its fields but its rootstalks, from where the spice comes, can often appear a dull brown — this is where the hazardous practice of adding lead chromate to brighten it can take place

rural Bangladesh. 'This was unexpected since those areas mostly have paddy fields and river tributaries. There are hardly any polluting industries there while the global ban on leaded gasoline is also enforced. So, you wouldn't expect dominant lead sources in such a place. After we saw the data, I began to conduct an epidemiological and environmental science set of studies to understand and determine these sources. Exploring a host of possibilities, we also interviewed stakeholders in the production, consumption and regulation of turmeric. We went to mills, wholesalers and spice markets, collecting samples of turmeric, colourants and soil for analysis — in the lab, we found turmeric was the dominant contributor. It contained high levels of lead and some chromium. We worked intensively across the supply chain with our in-country partner and found lead chromate pigments being added to turmeric. These are a bright yellow powder used in paints, dyes for furniture or colouring plastics — here, they were being added to turmeric roots during the polishing stage.'

Turmeric is a member of the ginger family and is made from the rootstalks of Curcuma longa — at the end of the growing season, farmers let the green tops dry out and dig up the roots. Workers then remove dirt from these, washing and steaming them

before these are dried. The roots are then polished manually or by putting them in drums. 'Producers try to get the outer skin of the turmeric off a bit,' Forsyth explained. 'They want to show the inner yellow colour since consumers like that. However, you can shorten this process or cover up blemishes by adding lead chromate. The compound is cheap and environmentally motivated.'

There was a history to the practice. 'In the 1980s, Bangladesh experienced a huge flood — this impacted the old way they dried turmeric, using only sunlight. This strange climatic event made it impossible to do that — meanwhile, owing to the unseasonal moisture, turmeric had turned dark inside. Producers were desperately seeking a solution to salvage the whole crop. Lead chromate was a quick way out,' Forsyth added, emphasising, 'The producers did not know of its harmful effects and so, using this became a common practice.'

Concerns over such turmeric began to travel. 'A study published in 2014 suggested some lead in

turmeric could be impacting children in Bangladesh. This gained public attention with the US Food and Drug Administration (FDA) picking up on it. There was a lot of recalled turmeric from South Asia,' Forsyth recounts. Even as the West's need for turmeric, used in mass-market products like readymade pasta dishes to speciality coffees, was reconsidered, doubts over adulterated turmeric focused attention on the fragmented supply chain in Bangladesh. 'Local turmeric has a different supply chain from the export-bound crop. Companies exporting were quick to act on precautions to ensure no lead chromate entered their supply chain — but internally, this was still rampant in loose turmeric.'

Forsyth and her colleagues aimed to root out this harmful practice. 'We published our findings of how lead chromate in turmeric impacted people in peer-reviewed scientific journals — this helped the Food Safety Authority (FSA) of Bangladesh take

A TRAVELLER: Turmeric lattes to pasta, the West likes the spice



credible action. With the FSA, we planned an awareness campaign for consumers. This wasn't simple as there is no off-the-shelf test to determine the presence of lead chromate in turmeric. There is a colour metric test which could work for roots but not effectively for powder — so, if a consumer was buying roots, they were now encouraged to choose less colourful ones. 'This message really worked. Of course, the way turmeric is polished, with mechanised drying, can make the root look very yellow even without lead chromate — but when this is used, there is an extra layer of powder consumers can spot on roots. However, there is no way to discern this in powder — so, it's advisable to go for a reputable company's packaged product but that doesn't help the less economically advantaged who often can only afford loose turmeric powder,' Forsyth pointed out. 'They should buy less bright-looking roots from trusted suppliers and have these ground in bulk. Consumers in Bangladesh pooled together with neighbours to do this affordably. That helped them avoid adulteration from chickpea powder and other non-hazardous elements which also cost consumers.'

The authorities meanwhile were focused on ending the lead scourge. 'Officials would conduct public inspections in markets and use equipment to check lead in turmeric stocks. Sellers were warned the FSA would act against those who used this, applying fines and other punitive measures. We also started to use an improved detection technology — the X-ray fluorescence analyser — which was expensive but gave a qualitative sense of lead in turmeric. This wasn't consumer-level but it gave the authorities rapid answers. In 2019, we worked with the FSA using this screening — they then applied swift regulatory enforcement. That really disincentivised producers,' Forsyth said, adding, 'Within a few months of this combination of awareness, detection and policy enforcement, the prevalence of lead in turmeric in Bangladesh dropped from about 47% to zero. We also tracked the blood lead levels of polishing workers — we found a 30% drop.'

Forsyth and her colleagues continue to track and analyse blood lead levels of the broader population. They have also conducted a widespread screening of turmeric across South Asia — those findings will be published soon and could help safeguard the health and well-being of millions.

READERS WRITE

Dear Times Evoke, Reading TE is a true eye-opener and the article about Iceland's tectonic activities (23rd December) was just wonderfully evocative! In this concrete jungle, Times Evoke serves as our beautiful outlet into the world of nature. Reading about these volcanoes was mindboggling and ignited a yearning to learn more, particularly as climate change's effects are growing clearer. — Sangamitra A. Padmarajan, Mumbai

TOI's Times Evoke deserves high praise for clearly explaining the intrinsic geodynamics of Earth atop Iceland's widening tectonic plates, due to which volcanic eruptions have been rising since 2019. Scientific research of the inner structure of volcanoes, as explained by volcanologist Rikke Pedersen, gives us a better understanding of possible eruptions. Thank you for a most interesting feature, TE! — Amarjit Singh, Patiala

Once again, I was so happy to see another extraordinary article in TE through which I got to learn so many new and interesting facts about Earth. Rikke Pedersen's TE interview explained when and why volcanic activity takes place. Thank you, TOI, for giving us valuable and well-presented information which improves our scientific understanding. — S. Naga Sri Kalyani, Vijayawada

I was astonished as well as awestruck after reading Rikke Pedersen on the geographical structure of Iceland which has tectonic plates spreading apart, increasing the chances of volcanic eruptions. I am so grateful to TE for bringing out such crucial facts and drawing our attention to important topics. Thank you, TE! — Debadrta Ghosh, 15, Kolkata

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