

► modern Europeans and to those that led to modern Native Americans. The team named these people Ancient North Eurasians.

No physical proof of this ghost population existed. Then, another group, led by Eske Willerslev, published genome-wide data from a recent find. They fit. The remains of a boy from Mal'ta in Siberia, dated to about 24,000 years ago, became the type specimen for the Ancient North Eurasians: a ghost made, if not flesh, then at least bone (M. Raghavan *et al. Nature* 505, 87–91; 2014). Other ghost populations have been predicted. As each new type specimen is discovered, more pieces of the puzzle slot into place, and researchers can reach even further back in time.

Reich details many other studies: of the phenomenal spread of the Yamnaya from central Europe to Asia's Altai Mountains some 5,000 years ago; of the Andaman Islanders and the populations of India; of ancient remains in North America, such as the 8,500-year-old Kennewick Man.

What his and other labs are uncovering is the tremendous degree to which populations globally are blended, repeatedly, over generations. Gone is the family tree spreading from Africa over the world, with each branch and twig representing a new population that never touches others. What has been revealed is something much more complex and exciting: populations that split and re-form, change under selective pressures, move, exchange ideas, overthrow one another. Genomics and statistics have drawn back the curtain on the sort of sex and power struggles you'd expect in *Game of Thrones*.

Reich also reflects on how his work can be misinterpreted by the public and those outside the field, in a heartfelt section that I can sympathize with. As soon as some genetic discoveries are published, they can become freighted with prejudices and polarized interpretations. We all belong to one species and we are all related. Yet when genetic differences between populations, for instance, are revealed, the media and interest groups can oversimplify and distort. Some pick and choose results to justify personal, and sadly often political or racist, beliefs. Others sweep the differences under the carpet. Yet, as Reich argues, we do need a non-loaded way to talk about genetic diversity and similarities in populations. This book goes some way to starting that conversation. ■

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People collect recyclable material at a dump in Guwhati, India.



INNOVATION

Waste mountain

Subhra Priyadarshini examines the wide-ranging impacts of India's throw-away culture.

In *Waste of a Nation*, an in-depth investigation of India's feeble fight against mountains of consumerist waste, are robust statistics, compelling history and telling case studies. The authors, anthropologist Assa Doron and historian Robin Jeffrey, also throw the occasional philosophical curve ball, such as: "waste is in the eye of the beholder." The result is both beguiling and disturbing.

As Doron and Jeffrey show, waste in India has generated a vast recycling culture — a world apart, of *kabaadiwalas* (garbage buyers), scavengers and 'rubbish rajas'. The authors reveal the complex cultural, social, political and religious hurdles that

hamper the country's struggle with waste, from unjust pressure on 'low-caste' Dalits to collect human excreta to unenforced environmental regulations.

Meanwhile, the mountain builds by an average 100,000 tonnes a day — a fraction of the US tally, but problematic nevertheless. India has few mechanisms for dealing with sewage and hazardous, wet, medical or electronic waste. And, like many other countries, it is losing the battle with megamounts of plastic. Until 1985, the country did not even have an urban-development ministry.

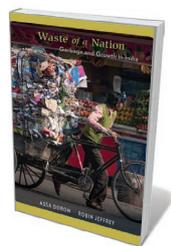
Municipal bodies are responsible for managing waste. But tradition — and the



ANUWAR HAZARIKA/REUTERS

labour-intensive nature of the sector — means that unorganized waste-pickers do most of the dirty work. Their job is to collect and segregate household, commercial and industrial waste for processing in centres where it is sorted for composting, recycling or energy generation. However, the reality rarely reflects this orderly progression.

Non-compliance is rife: waste is often not sorted at source. Ultimately, around 90% of unsorted waste is thrown into dumps. Meanwhile, the millions of scavengers and cleaners are not part of any organized waste-management system, and lack health, safety and legal cover. They face harrowing occupational hazards. Urban dumps in megacities such as Mumbai, Delhi and Kolkata can be clogged with excrement, rotten food, and liquid and solid household wastes that can promote infectious diseases and attract flies, rats and other vectors. Dumps can catch fire; burning tyres, for instance, emit volatile organic compounds and particulate matter. Doron and Jeffrey cite a suspected outbreak of bubonic plague in Surat in 1994 as an example of the breakdown of civic waste management. They point, too, to a community



**Waste of a Nation:
Garbage and
Growth in India**

ASSA DORON & ROBIN
JEFFREY
Harvard University
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in the brass-working centre Moradabad who extract metals from electronic waste. The illegal operation suffuses their lungs with metallic dust and chemical fumes, and chokes the nearby rivers with mercury and arsenic. In these lands of waste, humans end up being treated as waste.

Sewage, as *Waste of a Nation* underlines, is a prime concern

in a country where more than 560 million people defecate in the open. In 2014, the government of Prime Minister Narendra Modi set out to tackle the problem with the Swachh Bharat ('clean India') campaign, pledging to build 120 million toilets across rural India by 2 October 2019 — the 150th anniversary of Mahatma Gandhi's birth. In 2017, the project achieved a remarkable 70% coverage of rural areas. The sanitation

gap also inspired the 2017 Hindi film *Toilet: Ek Prem Katha*, directed by Shree Narayan Singh. Significant challenges remain, however. Untreated sewage is choking the mighty Yamuna river and parts of the lake system around Bangalore, for instance.

Despite India's tradition of frugality, the rise of consumerism contributes to these issues. The dark side of the economic liberalization of 1991 is the generation of new waste from mines, factories and industrial agriculture. The gradual switch from natural, biodegradable materials to plastics is changing behaviour even among the rural poor. For instance, twigs (*daatuun*) of the medicinal neem tree (*Azadirachta indica*), once used to brush teeth, have given way to plastic tooth-brushes. The latter are a recycling nightmare: separating bristles from the handle is labour-intensive and unrewarding.

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Doron and Jeffrey also discuss India's waste market. The world's largest 'ship-breaking' industry is in Alang. Here, retired ships are imported and dismantled, and their parts and materials — primarily steel — are sold for profit. India is also a leading exporter of hair, a market worth almost US\$400 million. Many Hindus have their hair cut in temples to demonstrate devotion, and much of the waste hair is sent to China to be made into wigs.

Doron and Jeffrey analyse the isolated, small-scale attempts of large Indian companies such as ITC and the Ramky Group to recycle waste profitably as well as hygienically, through state-of-the-art containment, neutralization and disposal technologies. For instance, Ramky's first project in 2000 was managing medical wastes for disposal at government-approved centres. By 2016, the country had just 198 approved disposal centres for more than 169,000 hospitals and clinics.

The authors rightly call for a sustainable system. To be practical, this must be motivated by profit, discipline, need, pride or better still, a combination of these. In 2013, China signed up to a 'circular economy' model devoted to recycling as much as possible. This is one approach to sustainability. But India has, as *Waste of a Nation* emphasizes, other strengths that could unite municipalities and individuals. One is its 40,000 civic organizations and action groups that could catalyse coalitions between *kabaadiwalas*, professionals, scientists, engineers, ethical businesses and, importantly, politicians. ■

Subhra Priyadarshini is chief editor of Nature India.