The plastic legacy

The Carboniferous period around 350–300 million years ago left its geological mark in the form of rich deposits of coal and oil worldwide. It seems possible that the stratigraphic legacy of the Anthropocene will see some of that carbonaceous material reappear within a much narrower time window in synthetic form: as a preserved sedimentary layer of plastics¹.

The raw figures are sobering. By 2017, around 8,300 million tonnes of plastic had been manufactured, mostly over the preceding half-century or so². Around 30% of it was still in use; the rest has become waste, of which around four-fifths ended up as landfill. Plastic waste is found in most natural environments, including all the major ocean basins — where it can pose a serious threat to organisms and ecosystems, potentially (through ingestion of microplastic particles) including humans³.

At face value, it's puzzling how we could have reached this alarming juncture. The very features that made plastics so alluring in the days when they seemed a utopian wonder material — recall the famous line from *The Graduate* (1967): “One word. Plastics” — was always going to cause difficulties for disposal: their durability. As Lau et al.⁴ put it with devastating understatement, the problem was that waste featured in conventional economic models only as an “externality”, meaning that it could be conveniently shunted outside of cost–profit analyses. That, of course, has been true for the environment as a whole, which is in many ways why we have unthinkingly created the Anthropocene in the first place.

But can we undo or avert the worst of the damage? Lau et al. have

explored some scenarios for that — in effect, charting possible strategies towards zero plastic pollution in much the same way as we must now attempt to do for carbon emissions to avoid catastrophic global heating. The irony is that the two issues are almost complementary: turning fossil fuels into carbon dioxide damages the environment, but so does converting oil instead into carbon that may remain fixed in plastics for centuries or millennia.

The solutions, meanwhile, echo one another. Plastic waste, like carbon dioxide, needs to be captured rather than dumped into the environment; ideally it will be reused and recycled. It should be possible to produce some plastics, like fuels, from sustainable natural sources. But perhaps most of all, we need to find ways to simply reduce our profligate use of geological carbon resources.

To sharpen these ideals, Lau et al. use a model of global production, use and disposal of both macro- and microplastics to look at the effects and economic costs of several mitigation strategies over the period 2016–2040. In particular, they examine the relative effectiveness of reducing use, substituting plastics for other materials (for example in packaging), recycling, and altering collection and disposal practices.

For a business-as-usual strategy, plastic pollution will increase 2.8-fold in terrestrial systems and 2.6-fold in aquatic systems over this period. Even a portfolio approach that implements all of these solutions to a degree currently foreseeable doesn't eliminate plastic pollution, although it is reduced by 78% by 2040 relative to business-as-usual — which is a 40% reduction on today's level. Using the full suite of possible

Philip Ball

interventions also produced the lowest waste-management costs.

None of this would be easy to implement, and neither would it be a complete solution. Even the most optimistic scenario considered here still results in massive accumulation of plastic pollution, and further problems would come from mismanaged or poor disposal practices, especially open burning — which is common in emerging economies, and carries hazards for human health as well as producing greenhouse gases. But pressing needs can also be opportunities for technological innovation: to find ways of making greener plastics, whether from more efficient use of resources, cleaner and more sustainable feedstocks, or with better recyclability. As ever, though, technology cannot be a sticking plaster for problems that have socioeconomic root causes. □

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