In 1909, Thomas Hunt Morgan proposed that the dipteran insect *Drosophila melanogaster* would be an ideal candidate for genetic studies. *Drosophila* are attracted to vinegar and other acidic breakdown products of fruit; hence they are commonly referred to as fruit flies. They reproduce quickly and do not have fussy nutritional requirements. Until the 21st century, they were the basis of much of our understanding of the genetic bases of human, animal and plant diseases, as well as our therapies for them. In honour of its great service to humanity, *Drosophila* was among the first multicellular animals to have its genome fully sequenced. Many scientists did not think twice about using an insect to draw inferences about people. In fact, Nicholas Strausfeld and Frank Hirth, in a paper published in the journal *Science* in 2013, point to deep similarities in how the brain regulates behaviour in arthropods (such as flies and crabs) and vertebrates (such as fish, mice and humans).

If we can learn about human cognition, behaviour and pathology by studying insects, how does this blur the boundaries between ‘us’ and ‘them’?

In making genetic comparisons between humans and other species, we can count strands of DNA, or genes (bundles of DNA with known functions). In epidemiological terms, these can be compared to counting individuals or groups such as households.

Ongoing studies into genetic similarities between species suggest that we could be, in some respects at least, 80 to 90 per cent genetically similar to cats, dogs, rats and cattle, a bit less so for chickens, and 40 to 60 per cent similar to various insects, including fruit flies.

This brings me back to re-examining my relationship to the cow in the corral, the cat in my lap, the chickens seemingly entranced by my singing, and to my grief at killing the lamb and the rat (but not mosquitoes and flies). Some of our genetic structures – those that translate into basic functional traits for preserving life – have evolved from common ancestors millions of years ago. These are our earliest collective memories, built into the very core of who we are. When I look into the eyes of a cat, or even a chicken, and when they return the gaze, are we recognising these unspoken, forgotten, shared genetic memories?

What of organisms that sense the world in other, nonvisual, ways? In the first decades of the 20th century, Jakob von Uexküll proposed that each organic being has its own perceived world. Since then, researchers have discovered that these *Umwelten*, as Uexküll called them, are created through senses we can barely imagine, let alone understand. I will not venture here into the lives of fungi or trees. I find it sufficiently confusing and distressing to consider my responsibilities to organisms we have labelled as animals.

Where do the memories reside that I share with these other species – not just the farm animals, pets and megafauna that have been the main concerns in my professional life – but also the tiniest of creatures underfoot, on my skin and in the air? What care and consideration do I owe them? Surely not just the glibly ambiguous assertion that we should not make nonhuman animals suffer. How would we know, when we have difficulty separating pain from suffering in humans?

I cannot find the words to articulate these memories, this joy, this grief, this knowledge.

Whatever action I take, walking, eating and excreting, incurs a cost to other lives, whether by killing and eating them directly, or by eating foods that they could otherwise have lived on. The most extreme impact my life has on other species is extinction, not just of their physical presence, but also of their memories, both those acquired within a lifetime and those embodied in their DNA, some of which are part of my own DNA. When organisms die and disappear, what are my responsibilities to those memories?

One of my colleagues once made the argument that every animal species that went extinct during our lives as professionals was a scaled-up, global failure of veterinary care. Any report of species extinctions would – indeed should, they asserted – evoke a sense of grief, loss and professional failure.

What then to make of the reports of an ‘insectageddon’, the global demise of trillions of individual insects, and probably millions of species, many of which we have yet to observe, study and classify? Is it my moral obligation to grieve the loss of unknown unknowns?

Where is the line between group-think and the corrective criticisms of our peers?

In public debates, extinction is often linked to the word *species*. Until recently, I thought somewhat loosely about the notion of species. Like all categorisations, the notion that living things can be sorted and definitively categorised into boxes can be useful. Certainly, it has been important for me professionally to be able to distinguish between cats, dogs, cows, sheep, pigs, elephants and giraffes. Once we stumble beyond individuals into the complex ecology of animal life, the classification system invented by wealthy Latin-speakers from Europe is more problematic. As Lulu Miller recently summarised in her book *Why Fish Don't Exist* (2020), Linnaean taxonomy has, even in recent history, perpetuated brutal and cruel cultural practices of racial, sexual and organismal superiority.

Often, in public, scientists have argued for the aspirations of science to objectivity: if we throw all our observations into the same data pool, will our prejudices and biases correct each other? Where is the line between group-think and the corrective criticisms of our peers?

How can we think categorically about slime moulds that under some conditions behave as animals, and in others behave as plants, some of which are described as giant single cells with thousands of nuclei? Do we lump them together in some ill-defined box of leftovers? And what of the dinoflagellates, which I have struggled to explain to my students and colleagues, when toxic marine 'blooms' have appeared that threatened the health of people and other animals? Some photosynthesise, some ingest prey, some are symbionts in coral reefs. Taxonomists seem to have side-stepped the most contestable of the technical classifications by referring to clades, which are modern species descended from a common ancestor. Even those classifications are contestable.

Taxonomy is closely related to the way we think about the relationship between science and the world we live in. Many of our notions about science can be traced back to a 17th-century gentleman soldier and natural philosopher. In his *Discourse on the Method* (1637), René Descartes declared that he directed his thoughts:

in an orderly way; beginning with the simplest objects, those most apt to be known, and ascending little by little, in steps as it were, to the knowledge of the most complex; and establishing an order in thought even when the objects had no natural priority one to another …

What we think of as science in the 21st century is almost all such object-based Cartesian activity.

The best science, so we think, is done in the laboratory. Some epidemiologists have argued that the most reliable studies are double-blind randomised controlled trials, in which animal or human subjects and pharmaceutical objects are randomised. As expected, such studies work well in a laboratory or hospital setting, where interactions with local environments can be (at least theoretically) controlled. These research designs provide, at best, weak evidence of, say, dietary, vaccine or drug effectiveness in the complex, uncontrollable world we inhabit.

Object-based sciences face challenges even with the simplest binary outcomes for individuals. How do we define whether or not a person has diarrhoea? I used to tell my students that you knew someone had diarrhoea if their excrement took the shape of the container into which it was deposited. How do we define health? My daughter, as a teenager, suggested that a healthy person recovered from illness more quickly than a person who was not healthy. These definitions are workable, but you will not likely find them in any formal scientific publications.

Cartesian methods have an even more difficult time addressing questions about changing social-ecological systems, or cascades of extinction. What kind of science can be used to refute, or prove, approaches to achieving Sustainable Development Goals? It is difficult to imagine, and impossible to prove using conventional, laboratory-based science, that the disappearance of various arthropods or trees or frogs is related to human health and survival.

The Universe is not, as Descartes implied, just a collection of ‘objects’. The Universe exists by virtue of a complex web of relationships among things. And yet, apart from the blatantly obvious forces such as gravity, our object-based science has failed to address the relationships among all those things. Barry Smit, a former Canada Research Chair in Global Environmental Change, suggested that we have sometimes focused exclusively on what we call hard sciences (the implication being that social sciences are soft) and paid insufficient attention to the very difficult sciences that address social change in relation to environmental changes. Even for gravity, we keep looking for a particle where this invisible force might exist.

Many of us have clung to this reductionist object-based science as a hedge against religious and political dogma, and because, under some circumstances, it 'works'. Object-based sciences have allowed us to describe, in fine detail, the structures of viruses, dogs, trees, planets, butterflies. We can do surgery on a cat that has swallowed a Christmas ornament or on a cow that requires a C-section. We can describe in awesome detail the dances and battles among birds, bees, gorillas, elephants, kangaroos and humans. We are amazed at the many different, sometimes unimaginable, ways in which dogs, bees and bats perceive the world we share. Inverting our telescopes and peering into the mysteries of bodies, we can create vaccines against spike proteins, alter the genomes of insects so that they cannot carry diseases of human interest, observe prions, which are alive only in a co-dependent sense, and which may or may not cause disease. We can detect, albeit fleetingly, what we think are the tiniest particles of matter and energy in the Universe; we give them names like quarks (from James Joyce's 1939 novel *Finnegans Wake*) and bosons (named after the Indian physicist Satyendra Nath Bose).

And is not the very contestability of object-based science an advance over certainty based on instinct, belief or ideology? We can at least search for various sorts of evidence or mathematical plausibility to advance arguments and counterarguments. These achievements of what Thomas Kuhn called ‘normal science’ are considerable. But if the idea of species is contestable, and if memories persist in some way among organisms, and if we are more than a collection of objects, but rather one tangled web of life, what falls between the spaces of all these objects. What is it that goes extinct, if not species?