OUR BODIES, OUR PLANET

OUR BODIES, OUR PLANET

A Parasite's History of Us

Marcus Hall

REAKTION BOOKS

To my favourite centenarian,
Charles Chauncey Hall, Jr –
in awe and admiration, as always

Published by
REAKTION BOOKS LTD
2–4 Sebastian Street
London EC1V 0HE, UK

www.reaktionbooks.co.uk

First published 2025

EU GPSR Authorised Representative
Logos Europe, 9 rue Nicolas Poussin, 17000, La Rochelle, France
email: contact@logoseurope.eu

Printed and bound in Great Britain by Bell & Bain, Glasgow

A catalogue record for this book is available from the British Library

ISBN 978 1 83639 107 4

CONTENTS

PREFACE:
A Wormy World

I believe the single most undiagnosed health challenge
in the history of the human race is parasites.
DR ROSS ANDERSON in Valerie Saxion,
Every Body Has Parasites: If You're Alive, You're At Risk! (2003)

My grandmother loved to tell the story of how my own mother, when she was a little girl of about seven years old, was discovered to have parasites. A brief inspection at the toilet had revealed that there were little white worms in her stool. After attending to my mother's infestation and administering the appropriate medicine, everyone agreed that the real culprit was the family dog, an old collie that must have passed on these creepy crawlies to their beloved tomboy, who spent more afternoons exploring nearby vacant lots than she ever did playing with dolls. But upon a visit to the veterinarian, it was pointed out that the dog had no such worms, or at least had recently got rid of them. It was thus assumed that the one at real risk of contagion was the dog.

My mother may have been carrying a few roundworms, such as *Ascaris lumbicoides*, a fairly large intestinal worm that can reach a length of several centimetres, and which apparently did make appearances in suburban Chicago in those days. Or maybe the never-identified worm was just a simple tapeworm (*Taenia* sp.), or segments of it, which is also quite striking and potentially rather long. Yet the most likely candidate for my mother's early experience with her fellow travellers is the

pinworm, or *Enterobius vermicularis*, which were common inhabitants of kids' intestines in those days, as they are today. White and stretching a centimetre in length, like the others they are mostly harmless – as well as being highly human-specific. In fact most human intestinal parasites are not readily exchanged with dogs at all, since human and canine parasites are typically quite selective about their hosts – except perhaps for threadworms such as *Strongyloides stercoralis*, but even these are not very visible and not very worrisome. And so the family collie was an unlikely source of my mother's worms. Whether or not my mother was just parasitotropic – had an affinity for parasites – may be less important than simply acknowledging that today, children everywhere are probably not hosting as many parasites as they once did. For better, but possibly for worse, our bodily ecosystems are not as biodiverse as they once were.

✺

MY AIM IS to write parasites back into human history. This book's premise is that over the long run, creatures living in and on us have been altering and even improving our lives through their efforts to improve their own. I travel into the world of our intestines and our scalps to show how widespread these creatures really are, while tracing some of the ways we came to discover this mostly hidden world. Parasites of humans, micro and macro, ecto and endo, come in all forms and sizes and include single-cellular protozoa as well as multicellular worms and arthropods, many of which can be readily detected with a little practice. Health records show that today some 40 million Americans feed pinworms, 11 million Germans host roundworms and at least 10 million East Asians carry intestinal flukes. Such creatures range in length from a few millimetres to several centimetres, with one textbook asserting that '*Homo sapiens* rank among the most parasitized of all animals . . . our varied habitat and diet and our global distribution exposes us to more infections than any other species.' Little wonder that a well-trained parasitologist can find at least fifty different kinds of

parasite on a single person – and many others go unidentified. A more exhaustive count reveals that some 280 different species of intestinal worms alone can live in a typical human gut, and this does not include the many other creatures that burrow in our hearts and livers, between our toes, up our noses and in our armpits. Lice and fleas thrive on your neighbour's children, and on yours, and on you. Ninety-seven per cent of us play host to *Demodex*, a genus of tiny mites belonging to the spider family that snuggle in the hair follicles around our eyes. We are instinctively repulsed by these little freeloaders, but what collateral effects do they have on our lives and lifestyles, culture and arts, politics and dreams?[1]

Creepy crawlies also infest our farm animals and forest creatures, and use both in complicated multiple-host life cycles that may involve us. If you own a cat, there is a good chance that it has already passed on its *Toxoplasma gondii* to you: although such invisible parasites are not supposed to be very dangerous, some researchers have linked them to altering the very ways we think and act. If we classify bacteria and even viruses as parasitic, because many live and depend on their hosts, including us, our parasitic co-travellers number in the hundreds of millions of species, with raw numbers of *individual* parasites numbering in the billions, at least. The latest findings of the Human Microbiome Project are confirming the stunning range and diversity of creatures that call humanity home. In fact, it is now almost a cliché to point out that healthy adult bodies host ten times more bacterial cells than human cells – which is to say that if there are 60 to 90 trillion human cells in every one of us, then there are ten times this number of *non*-human cells being toted around by each of us, all day, every day, at work and play, at home and in bed. *Homo sapiens* is hardly a single species going at it alone, but a veritable superorganism carrying a Noah's Ark of creatures through life's journey.

Born from zoological and veterinary interests, the science of parasitology has gone on to show its relevance to human health, agricultural production, wildlife management and almost every other

field linked to the life sciences. In our fundamental activities of breathing and sleeping, eating and digesting, reproducing and ageing, our bodily creatures are interacting with us and with each other. Such interactions involve varying degrees of competition and cooperation – for hurting or helping us and the other creatures that depend on them. Within and between species, individual parasites compete with their hosts for resources, but they also cooperate with them to share and multiply resources. Instead of viewing our intimate creatures as simple pathogens that produce disease, many parasites can be re-envisioned as cooperators and symbionts. Humans and their army of parasites march together down life's path, often for the benefit of each other. If a *pathogen* causes disease, a *parasite* denotes a relationship – and even when parasites become pathogenic, most of them are not as problematic for their hosts as we may assume.

Biologist and social philosopher Peter Kropotkin (1842–1921) was an early proponent of cooperation who believed that evolutionary forces typically motivated individuals to help rather than hurt one another, especially when confronting challenging environments. A century later, microbiologist Lynn Margulis (1938–2011) was still celebrating cooperation as a key biological driver, manifested by such processes as symbiogenesis, whereby a simple cell or sequence of nucleic acids becomes incorporated into a larger, more complicated cell or organism. Margulis and her followers believe that key cell organelles such as mitochondria and chloroplasts originated as free-living organisms that migrated into larger cells, initially acting as parasitic creatures to eventually begin providing benefits to their hosts. In the long run, the proverbial parasite has not often acted as a simple freeloader that weakens or sickens the creatures that host it, but instead has shown itself to be a productive, even cooperative and beneficial organism for diversifying and assisting life on the planet.

It turns out that the first parasites, so named, were actually a guild (or profession) of humans who lived in ancient Greece and were in the habit of depending on wealthy patrons for their food and shelter

– which suggests an unbalanced relationship of taking and not giving. But such parasites were actually compensating their hosts for their meals and services in various ways, such as by providing them with good conversation or entertainment, and were so skilful at doing so that their relationship with their host could continue indefinitely. Successful (human) parasites and hosts were giving to one another in stable partnerships, with each understanding their duties that made their pacts work. Only if parasites lost their ability to entertain or soothe (or their host ran out of resources or lost interest) would their relationship break down, leaving the parasite and host to go their separate ways. Over the centuries, *parà•sítos* – 'eat beside' – was a term extended to the plant and animal worlds, and would eventually return to the human world as a biological metaphor, while losing much of its assumed reciprocity. Humans would be viewed as 'parasites' if they took more than they gave. To be 'parasitic' today means to be a selfish freeloader, but the term's etymology requires us to wonder whether a parasite may often be a vital and productive member in a give-and-take partnership. It is the cooperative nature of parasitism that has such enormous implications for life on this planet, including human life.

Within our human world, one might extend the metaphor of parasitism to the scenario of an irresponsible and often-absent employee, for instance, who is paid the same salary as a more diligent employee who never misses a day of work. Or a 'parasite' might be a university student who sees nothing wrong with slacking off on her studies while lazily relying on the financial support of her parents. Or perhaps human parasitical behaviour is reflected in the infant child who is suckled by his mother to survive and grow. All these parasitic individuals may be consuming more than they are producing. But there are functional and ethical reasons why, in each of these cases, our society may tolerate and even assist those who give according to their abilities and take according their needs. Noted historian William McNeill also leaned heavily on parasitic metaphors in his social interpretations of history, calling attention to upper-class 'macroparasites' who exploited

the lower classes, and to colonists who 'parasitized' newly settled lands for amassing untold wealth; McNeill offered explanations for why this kind of parasitism has long existed and is not always simply self-serving. Parasitism fulfills biological and cultural roles, and there may even be such a thing as good parasites or selfish hosts.

With such broad interpretations of parasitism, and multifarious assumptions about the roles that parasites can play, we can appreciate why these creatures merit our attention, and not just because of their tendency to infest other organisms. Parasites play crucial roles in the biological world and also in our cultural world, from food webs and ecosystems to immigration and politics, even to the Anthropocene and Gaia theory. I begin Chapter One by exploring the curious links between parasitism and human health, with long life as a proxy for

'Weren't they great hosts? / Weren't they terrific parasites?', cartoon by Dan Piraro, *Bizarro Comics*, 2011.

sustained good health. If we can suppose that parasites are not always bad for us, then the absence of them may actually pose health risks and even prevent us from living longer. One parasite that recurs throughout this book is the one responsible for producing malaria, a single-celled protozoa called *Plasmodium* that measures a fraction of the width of a fingernail and resides in our bloodstreams and livers, causing much human suffering and death. Yet because some strains of malaria parasite have co-existed with *Homo sapiens* for so long – essentially ever since our species has walked the planet – we must wonder about the other effects it is having on us besides causing illness. In the grand expanse of the last 200,000 years, this parasite has not managed to eliminate us, nor have we or our immunological systems managed to eliminate it. One can then ponder the mystery of how many people today – millions of people – continue to host *Plasmodium* in their bodies but never feel any ill effects. The question thus arises of what these parasites are doing to us if they are not making us ill. How are our lives and lifestyles, even our relationships and landscapes, being modified by this exemplary parasite that is so ubiquitous? The island of Sardinia serves as a starting place to ask these questions, since malaria was once so prevalent there but is today almost entirely gone. Now that the disease has been eradicated from that Mediterranean island, with the last case of endemic malaria being eliminated more than 75 years ago, what has changed, or will change, in the lives of Sardinians, and have such changes all been for the better?

My questions are largely historical, but I also rely on scientific insights to help make sense of any conclusions that can be drawn. Chapter Two tracks the accumulating discoveries of scientists over the years to show that many of the questions they posed a century ago are still relevant today. Harvard naturalist William Wheeler explained in 1928 that 'parasitism is an extremely protean phenomenon, one which escapes through the meshes of any net of scholastic definitions.'[2] Not even professional parasitologists now working in modern laboratories always agree on the definitions of their main creature of study, since

our understanding of a parasite can be so elusive. Some parasitologists assume that parasites are simply creatures that take more than they receive and so damage their host. Others counter that many parasites are maligned and misunderstood, and if they cause damage or disease, such activities are merely temporary distractions in a parasite's march towards becoming a cooperative and healthy partner with its host. The decorated molecular biologist and Nobel laureate Joshua Lederberg felt that even our most irksome parasites and pathogens are evolving to become less dangerous and less virulent over time. A disease's natural progression holds enormous implications for ourselves and for the creatures that depend on us.

It may therefore be a parasite's occasional benevolent effects that are its most surprising trait. Tracking the multiple benefits of being parasitized is the goal of Chapter Three, both at the individual and species scale. There is now significant agreement, for example, that a rich load of intestinal parasites can actually help us defend ourselves from certain diseases, or even mitigate such problems as auto-immune disorders thought to stem from our excessive use of antibiotics and parasite scrubs. The *Demodex* mite that lives on nearly all of our eyebrows is no longer considered a harmful parasite that should be eliminated, but a possible commensalist that goes about its activities without causing any damage – or even a mutualist that benefits us by cleansing our sebaceous follicles of harmful microbes. We would probably be in worse shape without our eyebrow inhabitants. Still other parasites may benefit their hosts through more unexpected and indirect means, as by boosting disease resistance, conferring psychological advantages or even promoting human equality, as we will see. Yellow fever, and the viruses responsible for it, have always been a scourge on those who contracted them, but even greater harm typically awaited those who initially avoided being exposed to this disease to then contract it later in life. Those who caught mild yellow fever in their youth built immunities that they could utilize later, as when confronting adversaries and enemies who lacked such immuno-experience. Here, the timing of being parasitized could offer

terrific benefits to the host. Indeed, the accepted thesis about the dangers of transporting lethal microbes across oceans in a 'Columbian Exchange', as elaborated by Alfred Crosby and others, gains new understanding when interpreted through the benefits of being parasitized. Old World parasites that unleashed suffering and death in the New World were, from a different perspective, simply compensating their hosts by providing them with crucial immunological advantages. Instead of viewing the transport of microbes as a simple process of spreading disease, the global exchange of microbes can be recast as cooperative projects between parasites and hosts. Hosts have been reaping more benefits from their parasites than they may suppose.[3]

Chapter Four focuses on what happens when people set out to eliminate their parasites, illustrating the often grave consequences to land and life that follow. By the mid-nineteenth century, drinking tonic water was a common malaria preventative, since the antimalarial quinine might be dissolved in liquids to provide a bartender's menu of prophylactic beverages. Yet not only did the *Plasmodium* parasite build resistance to this active ingredient of cinchona bark, but patients might suffer debilitating side-effects from this remedy, made more dangerous when concentrations were increased. In the tenacious struggle to separate a parasite from its host, many medical practitioners were slow to realize that their battery of antiparasitics often produced more harm than cure, especially by eliminating the benefits these parasites were providing. When the battle against malaria turned harder into killing the parasite transmitter, the mosquito, then human health as well as ecosystem health was further jeopardized when organic and inorganic pesticides settled across the countryside. Much of the silence of Rachel Carson's spring stemmed from humanity's battle with its parasites, even though some of these parasites were rather innocuous creatures that produced few or no symptoms. Asymptomatic parasitemia has been the rule rather than the exception in the human experience with parasites.

We can reap additional insights about our parasites by seeing them as a common household creature. Like our dogs and cats, our domesticated

lice, fleas and *Demodex* might protect us against dangers and discomforts when we provide them with habitat and food. Maybe we can even feel a sort of empathy towards our whipworms if they help us to avoid Crohn's disease. Traditional Chinese shamans assumed that a few worms in the gut and lice in the scalp were a sign of robust health, especially after observing that infirm and elderly individuals don't carry many of these parasites, or else lose them as their health conditions worsen, with the little creatures typically departing a failing body to seek a healthier one. Thinking like a parasite is the topic of Chapter Five, even if this is a challenging task, realizing that our own minds may never be able to enter those of a protozoa – such as *Toxoplasma gondii*, now found in more than a fifth of cat owners. Such intra-species thinking may nonetheless disclose that from the perspective of our fellow travellers, we hosts are the main parasite in this relationship, since the many and varied benefits that we reap from our parasites might mean that they are the ones that merit compensation. And even if it is difficult to pinpoint all the advantages that our parasites provide us, one can still appreciate the complicated interactions flowing between parasite and host. Since most parasites also host their own parasites, a parasite's interactions with its host are more complicated than expected, especially when we realize that a parasite's parasites typically host still smaller parasites – with all such parasites aiming to satisfy their hosts, else tensions mount, their unions disband and mutual symbioses disappear. The goal of this chapter is to convince us to show more empathy for our parasites.

One can also ratchet up, rather than down, to explore parasite–host unions at macro-levels of landscape, continent and biosphere. Predator–prey relationships can be envisioned as one species parasitizing another, with a group of foxes parasitizing while also hosting a group of hares: fox predation improves the cunning and vitality of hare species, even though an individual hare suffers. Individual detriment can provide collective benefit for humans as well. Feedback between an organism and its ecosystemic network reveals crucial dependencies between animate and inanimate worlds at the planetary scale, from

Ionic temple block showing a Greek ruler, probably Arbinas of Xanthos, flanked by helpers, with servants at left and a parasite at right, 4th century BCE.

lithosphere to hydrosphere and atmosphere. We arrive at Chapter Six ready to explore parasitical relationships in a Gaia system and see how *Homo sapiens* interacts with its macrohost, the whole Earth. All creatures, people included, construct niches for making life more viable on this planet. Can our insights about parasitism be harnessed to allow us to understand the human transformation of the Earth into an Anthropocene, the latest geological epoch in which human beings are the primary sculptor? If humans have become Gaia's principal parasite, our species maintains a special interest in keeping Earth inhabitable. When projecting from microbe to macrobe, one must remember that parasites evolve as the host evolves; that individuals may be sacrificed for the benefit of the species; that maladaptive parasites are replaced by more cooperative ones; and that the quest for better human health can usher in better earthly health. If humanity is not providing tangible benefits to the biosphere, Gaia mastermind James Lovelock could be correct in asserting that the living Earth will someday act to remove its most troublesome parasite: 'my fellow humans must learn to live in partnership with the Earth,' Lovelock warned, 'otherwise the rest of creation will, as part of Gaia, unconsciously move the Earth to a new state in which humans may no longer be welcome. The virus COVID-19 may well have been one negative feedback. Gaia will try harder next time with something even nastier.'[4]

We finish our parasitic journey by exploring how we can begin to bring back some of our key parasites. With modernity stripping us of a spectrum of bodily creatures that our ancestors once carried, the act of consuming probiotics or receiving faecal transplants becomes a way of restoring and rewilding some of our former microbiomal diversity, the focus of Chapter Seven. Just as we conserve endangered species in reserves and parks, our bodies can become refuges for rare species useful for preserving our own and our world's health. There may be real merit in reintroducing roundworms or flatworms to our intestines for counteracting the rising incidence of multiple sclerosis, say, or rheumatoid arthritis, Crohn's disease and Type 1 diabetes. Various parasitic worms, assert a team of immunologists, if 'applied in a controllable clinical setting, could relieve inflammatory disease yet minimize the adverse effects of the parasite'. One also wonders if there have been successes in restoring parasites to other creatures, at larger scales. How far has *Homo parasitus* benefited the planet, and how can our human epoch be kept inhabitable? A clearer understanding of parasitism makes us wonder how well we are nurturing our own parasites, and how we can better nurture our planetary host.[5]

My call, then, is not only to better acknowledge and appreciate our bodily organisms, but, more importantly, to appreciate and save our partnerships. We live with other beings, small and large, within and on and around us, including other humans, who depend on us, and us on them. The parasitical record suggests that our co-creatures often bring benefits to us, sometimes as they also bring us grief, individually or collectively. By extension, our human species can bring benefits to Earth, or at least has brought such benefits in the past. We can realize that the human body is a union of mutualists, just as on the planetary scale, the biosphere is a union of mutualists. We can realize that the human body is a union of mutualists, just as on the planetary scale, the biosphere is a union of mutualists. It is from our microbes that we can better learn to live with our macrobes.