THE SOCIAL LIVES OF ANIMALS

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How Co-operation Conquered the Natural World

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Introduction

Man is by nature a social animal; an individual who is unsocial naturally and not accidentally is either beneath our notice or more than human. Society is something that precedes the individual. Anyone who either cannot lead the common life or is so self-sufficient as not to need to, and therefore does not partake of society, is either a beast or a god.

Aristotle

In the rainforest of northern Trinidad, an abandoned house is gradually being reclaimed by nature. Lianas wrap themselves about its walls, while saplings venture through broken windows and push their roots through crumbling masonry. Animals, too, have seized the opportunity and have moved in. At the heart of the house, beneath a sagging staircase, a musty crawlspace provides refuge for an animal with a chilling reputation: the vampire bat. During the heat of the tropical day, the bats huddle in the cool seclusion of their lair, resting and gathering strength for the coming hunt. As night falls, the vampires stir into wakefulness. Their hunger sharpened by the daytime fast, they take wing to scour the forest in search of blood. They're seeking sleeping mammals; those that have dropped their guard. Any mammal might be targeted, from forest deer or peccaries to domestic livestock or even an unwary person.

In a forest clearing, a vampire circles cautiously above a tethered goat. The goat is unaware of the bat's presence, the faint noise of fluttering wings lost amid the many sounds of the Trinidadian night. Stealthily, the bat alights on the ground and scurries in its ungainly fashion toward its victim. It makes an incision in the goat's flank, cutting through the skin into flesh with scalpel-like teeth. As the blood begins to flow, the vampire drinks it greedily, consuming as much as a third of its own weight before the meal is finished. Once satiated, it leaves as silently as it arrived, and with its prey none the wiser despite a wound that continues to flow due to the anticoagulants in the bat's saliva.

Back in the safety of their dilapidated shelter, the bats who have had a fruitful night can begin to digest their meal. But not all of the returning hunters have been successful. The large mammals they seek as prey are few and far between, and many of those that can be found are alert to the threat posed by the bats. For these hungry individuals, time is running short: Failure to feed on just three consecutive nights can mean starvation and death. Yet this is where the vampire bat's behaviour belies its sinister reputation. Should one of its roost mates go without a meal, a well-fed bat will step in. Almost like a parent bird tending its chicks at a nest, the successful hunter provides for its less fortunate companions by regurgitating some of its blood bounty. And the next time tonight's lucky bat goes without, it can count on its companions to return the favour. In their struggle for survival, the bats have each other's backs, a strategy that works well for all in uncertain times.

Co-operation such as this is a hallmark of social animals. Though the extent to which vampire bats engage in each other's welfare is by no means universal, almost all animals that live in groups provide some degree of support to one another. At the most basic level, this might manifest in the form of what's known as social buffering. Essentially, this means that social animals, from tiny krill to humans, gain a clear and measurable benefit simply

from being near to their own kind and being able to interact with them. They are buoyed by the presence of others, supported by the collective. For our own species, this has never been more important. The recent experience of lockdowns and social distancing prompted by the Covid pandemic disrupted our connections and enforced solitude upon many. Little wonder, then, that a mental health crisis has subsequently emerged. Alongside this, the march of technology is gradually disposing of many of the day-to-day interactions that were once part of normal life. Self-service tills, automated tellers, ticket machines: all of them replace face-to-face encounters, while headphones lock us out of everyday discourse and the Web replaces real-time connections with virtual ones.

The question is: does this matter? I argue that it does. We humans are intensely social organisms. Our lives are interconnected with networks of friends and loved ones, and each of us plays a role in broader societies that define and shape our patterns of behaviour. This social tendency has enabled us to achieve far more than could ever have been possible were we solitary creatures. Moreover, the far-reaching effects of living alongside one another include everything from the development of spoken language to the ways in which we interact with one another in daily life. It even provided the basis for the evolution of the intelligence that is the hallmark of our species. Ultimately, our instinct for co-operation has provided the foundation for human civilisation. But this instinct didn't begin with the first people; rather it was something intrinsic to us, a legacy inherited through our shared ancestry with the animals that we live among.

Throughout the animal kingdom, countless other animals have adopted sociality to solve the problems that life poses. We can see how living in groups provides the platform for the success of so many such species. What's more, we can trace direct and important parallels between our own societies and those of the animals with whom we share the planet. These parallels, echoes of our own evolutionary journey, help us to appreciate how sociality

shapes our lives so fundamentally. By understanding animals on their own terms, we can understand ourselves, and our societies, so much the better.

Watching animals and studying their behaviour has always been my greatest passion. I've spent countless hours at it. Once, as a child, I lay on my front and peered into a tiny stream for so long that a stoat mistook me for a log and decided to come for a drink on the opposite bank, within just a few centimetres of my prone figure. When I looked up and came face to face with it, the astonished stoat leapt so high in the air that even its fleas applauded.

But being enraptured by creatures is one thing. Turning it into my life's work seemed impossible. Lacking the confidence to pursue my animal ambitions, and leaving school with a motley assortment of underwhelming qualifications, I drifted into an underwhelming office job. There I stayed for five years, stuck in a rut of my own making. I might have continued much in that vein were it not for the intervention of my manager. It took him a long while to realise the extent of my ineptitude, but once he did, he sacked me.

Forced to find a new direction in life, I pondered what I might do next. Could I put my meagre skills to use looking after the exhibits at Scarborough SeaLife Centre? It wasn't my dream job, perhaps, but the idea of working with animals, in whatever way, conjured happy memories of afternoons fossicking in rock pools or turning logs to look for creatures. The SeaLife Centre needed someone to tend to its assorted urchins, prawns and starfish. I reached out (to the management, not the animals). The SeaLife Centre reached right back to flick my ears. 'You need a biology degree to scrub algae off an old lobster,' was the gist of the reply.

At least now I knew what was needed. I enrolled at Leeds University, where I tried to find meaning in rote-learning amino acid structures. Two years in, just when I was reaching a crisis point in my quest for the degree, I met a kindred spirit in the shape of Jens Krause, one of the academics at Leeds. Here was someone

whose curiosity for the living world was as great as my own. Not only that, but he was also making a wonderful career of studying the behaviour of animals. All of a sudden there was a point to it all. I saw for the first time what I wanted to do. Everything was laid out before me, even if the path wasn't always easy. I like to think that the animals of Scarborough's fourth-busiest attraction wish me well, and can find it in their tiny hearts to forgive me for abandoning them.

The point of these reminiscences isn't just to show you, dear reader, how daunting I found it admitting to myself that I wanted to be a scientist. The point is how the purpose of my life became clearer just by virtue of coming into contact with another human being who shared my interests. The realisation that you need other people in order to help you understand your own mind and what you want from life is a common experience for many. Unfortunately, what is also common is the human tendency to undervalue this very need, and not to appreciate that community and collaboration are frequently the bedrock of progress and a meaningful existence.

The one aspect of human behaviour that has contributed more than anything else to our remarkable success story has been sociability – the ability to live and work alongside one another in groups, to co-operate. It has allowed us to find solutions to problems from prehistory to the modern day, to safeguard ourselves against predators and to hunt our own prey, to share information and learn from one another, to explore the globe and overcome a multitude of challenges. Since the first modern humans appeared in Africa around 300,000 years ago, society has changed and evolved with us. For perhaps the first 290,000 of these years, we lived as hunter-gatherers in small, nomadic bands. Then, as the world emerged from the last ice age, the warming climate and human ingenuity ushered in the Neolithic revolution, and we began to live for the first time in small settlements as agriculturalists. From there, human civilisation developed apace, accompanied

by other species such as cattle, goats, dogs – all social animals, like ourselves.

Modern human society is a mix of culture, relationships, law and conflict, and is composed of families, communities, cities and nations. We might imagine that in this regard we stand distinct from other animals, yet while our society is certainly different in character it is not unique. Many social animals organise themselves in similar ways. Moreover, they were doing so for millions of years before we appeared. Our social instinct, our society, has an ancient lineage and shares much in common with other social animals. In a world seemingly full of individuals navigating cityscapes and isolation, we arguably need these parallels more than ever. Why? Because they are a reminder of the fundamentals that shape behaviour, and studying the social behaviour of animals not only provides insights that are valuable in their own right, but also sheds light on the evolutionary basis of human sociality.

An obvious example of this is language. Communication is an essential facet of living in groups and interacting within a social milieu. The more complex the web of relationships, the more important it becomes. Language allows us to navigate our communities, to negotiate, to foster and develop relationships, to teach and instruct. In addition, it enabled us to assemble into coherent, co-operative teams, from the hunting parties of our ancestors to the organisations and institutions of the modern day. Alongside this, our cultures developed, codifying social behaviour and social norms, the rules by which we interact and a moral framework within which to operate. While human language and culture may not look exactly like any other language or culture found among group-living animals, that doesn't make us unique – it just makes us different. By learning something about how other animals live together, we can come to understand ourselves a little better.

More immediately, we can each feel the benefit provided by close personal friendships. These feelings operate not only at the level of our conscious brain, but also permeate our physiology

via hormones that in turn cushion us from the worst effects of stress. Having friends and family is good for us to the extent that those engaged in an active social life tend to live longer. It should come as no surprise to learn that the same may be said for other gregarious creatures. While the assistance vampire bats offer to their roost mates provides a compelling example of this, it is the intangible, enduring support garnered simply through interacting with a community that provides the most powerful aid to social animals. Here again, we can appreciate the common links that we share with the rest of the animal kingdom, even though this appreciation has been, perhaps, slow in coming.

Scientific research over the last half-century has forced a reappraisal of our understanding of animal sociality and co-operation. In more recent years, technology has afforded us remarkable insights into the behaviour of animals in swarms, schools, flocks, herds and even our own crowds. These insights have shown us that there are often striking similarities between ourselves and our animal cousins. Simultaneously, they have allowed us to better appreciate the complexity of animals, while recasting our own sociality as a fundamental animal impulse. Some baulk at the idea, believing humans to be separate and exceptional. Yet the difference between us and the rest of the animal kingdom is, as Darwin said, of a degree rather than of a kind.

Almost a quarter of a century on from my first fumbling attempts to work out my course in life, I can look back on a dream fulfilled and at a series of adventures. It's been an incredible privilege to study at close hand some of the world's amazing creatures and to grapple with the hows and the whys of their social behaviour. In the following chapters, I consider a succession of animals, beginning with the Antarctic krill and working through to our closest relatives, chimpanzees and bonobos. What all of these animals have in common is that they are social.

This word means many different things to many different people, but for the purposes of this book, I define a social animal

as one that is drawn to its own kind, that lives and interacts in groups. It's been my life's work to study these interactions between animals: how they relate to one another; how they connive and compete on the one hand and how they unite and co-operate on the other. This book is an attempt to distil the wonder that I still feel in the company of animals.

1

Brown Ale and Cannibalism

Krill and locusts form Earth's greatest aggregations, though their motivations differ …

The frozen south

I'm in Hobart, the beautiful capital city of the Australian island state of Tasmania. In front of me in the harbour is a ship, the *Aurora Australis*, Australia's Antarctic flagship. It's a vivid geranium orange, though patches of brown rust show through its paint – it's an old ship now and is starting to show it. You'd struggle to call this an attractive ship, but it is sturdy. It's proved itself as a veteran of countless trips south to the Australian bases – Macquarie Island, situated about halfway between Tasmania and the South Pole, and Mawson, Casey and Davis Stations on the Antarctic mainland. The journey to and from Antarctica is not for the faint-hearted; traversing the Southern Ocean means entering some of the most inhospitable waters on Earth. A combination of climatic conditions and the absence of land for shelter can create terrifying storms. In this part of the ocean, the winds can reach 150 kilometres an hour, well in excess of what feeble landlubbers would categorise as a hurricane. At such times, there's no clear distinction between sea and sky: the furious wind drives the surface waters into a maelstrom of spray, whipping the tops off mountainous waves that fling the ship around like a toy. Blizzards strike to produce white-out conditions. Icebergs lurk to claim the unwary.

Happily for me, I can put thoughts of nautical terrors aside. I'm here to visit the Australian Antarctic Division, situated safely

on dry land on the outskirts of Hobart. It's an impressive complex of buildings, decorated with breathtaking images of the frozen south, a part of our planet that few are lucky enough to see first-hand. Outside the entrance there's a triptych of sculpted penguins arranged as though they were having a chat at the back end of an enormous recumbent metal seal, while in the foyer huge pictures capture the ethereal beauty of the Antarctic. Even the food in the cafeteria is themed – you can get burgers that are named for polar scientists. Doubtless, the giants of ground-breaking early expeditions would be thrilled by their commemoration as a snack.

Splendid as all this is, it's nothing compared to the incredible work that's going on within. My particular interest is in finger-length crustaceans called Antarctic krill – I want to work out how and why they swarm. It's an important question because swarming is crucial to krill, and in turn, krill swarms are crucial to the survival of the entire Southern Ocean ecosystem. Here at the Antarctic Division lives one of the only populations of krill outside their natural habitat far to the south.

I'm met at reception by So Kawaguchi and Rob King, two people who've done more than just about anyone alive to unpick the mysteries of krill. Getting the krill here to Hobart in the first place is no easy matter. They have to be collected at sea and then mollycoddled for weeks on board before the *Aurora* returns to port with its precious cargo. Rob, a genial yet imposing man, described his first, eventful trip to the Antarctic. Heading south, the weather progressively worsened until the *Aurora* was facing thirteen-metre waves and vicious winds: a succession of giddying climbs up huge ocean rollers, each followed by a stomach-clenching lurch as the ship surfed down the wave's back. Each time the ship reached the trough, the bow crashed into the ocean and tonnes of icy seawater flooded the decks, then streamed from the gunwales as the ship staggered into the next climb. Making little progress into the teeth of a storm, the ship was like a boxer pinned on the ropes, taking blow after punishing blow from the waves.

Concerned at the damage that was being done, the master was forced into the decision to turn about – a perilous prospect in such seas since going side-on to barn-sized waves can easily roll a ship and sink it. All aboard knew that, if the worst happened, the prospect of rescue in a storm like this was slim. Even in immersion suits, a human being would find the sea temperatures here deadly. With the entire crew holding its collective breath, the ship began to edge around. At the mercy of the Southern Ocean, it was struck by three enormous waves in succession, canting it right over to its beams. But the *Aurora* is made of stern stuff, and each time it heaved itself up from the canvas until finally it turned its stern to the waves. Now running with the seas rather than against them, they could ride out the storm in safety. Rob describes this experience as 'highly engaging'.

Finally, after weeks at sea, the ship reached the relative calm of Casey Station, an Australian base on the Antarctic mainland, to be welcomed by the small contingent of highly skilled engineers, support staff and polar scientists, awaiting supplies and, perhaps just as importantly, new people to talk to.

Having arrived at Casey, Rob was itching to get to grips with the creature he has devoted his life to understanding – the Antarctic krill. It was summer and, now the storm had blown itself out, the conditions were relatively pleasant, with sunshine and temperatures edging above freezing. In front of the station, the bay was for once more or less free of ice. Rob decided to take to the waters in a small inflatable boat to see what he could collect in his net. Sitting at the stern of this boat, Rob was happily dipping for specimens when he felt what he describes as a presence. Turning around, he found himself face to face with a leopard seal that had risen silently from the water and was now looking him right in the eye. Not many animals – people included – are tall enough to look Rob in the eye, even sitting down. But leopard seals can be three metres long and weigh half a tonne. These are fierce predators, hunters of penguins and seals; they've even claimed at least one

human life. Who knows what the leopard seal had in mind, but a moment later, it seemed to give a clue as it opened its huge jaws to give a view of its formidable dagger-like teeth, set into a skull the size of a lion's. And then, as if content that the message had been received, the seal slipped back into the water and disappeared. Rob doesn't tend to take the boat out so often when he's at Casey now, but when he does, he makes sure not to sit on the side.

After all that, there was still the return journey to consider, the key part of which – for So and Rob, at least – was to collect the live krill that sustain the research programme back in Hobart. Another journey through capricious seas, interspersed with the exacting task of capturing delicate animals from the frigid waters they call home. And once they were installed in aquaria on board, Rob and So would have to be babysitters – krill are nothing if not demanding. You might wonder why people go to so much trouble for a load of measly shrimp-like creatures. To understand why, you need to see the bigger picture.

Making a krilling

Animals such as the leopard seal and a whole host of other large marine predators are drawn to the Southern Ocean to hunt. Whether directly or indirectly, what supports these animals is krill, small but superabundant crustaceans related to prawns. In fact, there are something like eighty-five different species of krill spread across all of the world's oceans, but the one most people think of when they hear the word is the Antarctic krill. For every person alive today, there might be 10,000 of these creatures in the near-freezing southern seas. Even though each one is only about the size of your little finger, collectively they outweigh us.

Krill are a keystone species in the Southern Ocean. This ecological term derives from the crucial role played by the keystone at the apex of an arch. Take the keystone out and the arch collapses.

So it is for krill in relation to the animals with whom they share their habitat. From fish to squid, from penguins to albatross, and from seals to the great whales, krill are at the top of the menu. At certain times of year many of these predators have diets comprising more than 90 per cent krill. If krill disappeared, they'd take the bulk of Antarctica's most charismatic and important species with them. For the predators, switching their diet to a different prey species is simply not an option; without krill, there would be no Antarctic ecosystem as we know it – no baleen whales, no seals, no penguins, no albatross, and none of the animals that, in turn, feed on those that eat krill.

Numerous though they are, Antarctic krill are not invulnerable. Twenty years ago, on the other side of the planet, a change in oceanic conditions in the Bering Sea drove the development of a massive algal bloom. Good news for these algae-eating crustaceans? Not a bit of it. It was the wrong kind of algae for the resident Pacific krill, the sister species of the Antarctic krill, and they couldn't eat it. Their population crashed, and with them went enormous numbers of seabirds. Salmon failed to show in the rivers, the emaciated carcasses of whales washed up on shores. The devastating knock-on effects of the slump in Pacific krill foreshadows what could happen if Antarctic krill were to go the same way.

For now, they are thriving. Drawn together into great aggregations, Antarctic krill can be seen from space when they gather together. A single superswarm might cover hundreds of square kilometres of ocean, staining vast swathes of the surface waters orangey-pink as they cluster in their trillions. Congregating provides krill with some protection from predators and may even help keep them afloat. Since they are heavier than the surrounding water, they start to sink the moment they stop swimming. Yet by gathering together, they are buoyed by the upwelling currents that result from the countless pulsing limbs of their fellows pushing water downwards. The swarm is essentially krill's life support system.

Much as we might think of invertebrates as instinctive creatures, devoid of any but the most basic responses and reactions, krill exhibit a fundamental trait shared by all social animals, including us – they hate to be alone. If they're isolated, they react badly. It's hard to know what panic might look like in an animal that doesn't have a face as such, but we can measure something akin to it going on inside their bodies. Since krill are largely transparent, it is possible to see their tiny hearts beating. Separated from the multitudes in the swarm, their heartbeat quickens. They show a similar response if they detect that whales are around. A raised pulse is a basic sign of stress. Clearly, they prefer company.

Nature documentaries rarely feature krill, but when they do it is as fall guys. We might get only a fleeting glimpse of these small crustaceans, usually portrayed as obliging little floating morsels, as they're swallowed by a leviathan. Krill, in other words, are little more than whale food to TV producers. But there's much more to them than this. For one thing, they are far from sanguine about disappearing down a whale's gullet. Despite the numbingly cold waters in which they live, they have surprisingly fast reactions when danger threatens. It takes only around fifty to sixty milliseconds from first detecting an alarm to triggering their escape response. To put that into context, that's about twice as fast as the reaction of an Olympic sprinter to a starting pistol. The escape response itself is dramatic – in the crucial first second following the detection of a threat, they may travel over a metre. Again, compared to a human sprinter, and scaling the krill to human size, that means that they would finish a hundred-metre race in under two seconds. With a little warning, they can even get out of the way of the cavernous gape of a feeding whale.

In short, catching them isn't as easy as you might think, even for the largest mouths on the planet. Challenging the common notion of whales simply turning up and harvesting the krill, a recent study of humpbacks in the endless days of the Antarctic summer showed the effort they have to put into feeding. The

whales lunged at the swarming crustaceans every fifteen seconds or so, minute after minute, hour after hour. With every mouthful, many krill are captured, but still more dart out of the way, leaving the feeding whales short-changed. It's exhausting work for the whales to satisfy their enormous appetites.

But while krill are first-class escapologists, it is their swarming that encourages the whales to focus their attention on them. So why do they collect in such vast numbers? The answer is that the krill are pursued by many different predators and swarming provides an excellent defence against the majority of them. Any predator that relies – as most do – on picking out its victims one by one faces a kind of sensory overload when confronted by myriad swirling krill.

The little crustaceans have another trick or two up their sleeves as well. According to one account, krill faced with an onrushing predator, such as a fish or a penguin, sometimes spontaneously shed their skin. Anticipating its moment of victory, the predator clamps down on what is now no more than the hollow shell of the krill's body, while the intended victim races to safety. Another oddity is that krill are able to light a battery of bioluminescent cells on their underside. As yet, no-one is certain whether this serves as a means of communication among themselves, or is used to confuse attackers with a pulse of light, or breaks up the outline of the krill in the ocean depths when they are attacked from below by a predator. Whatever the reason, this light show certainly adds to the mystery of these engaging little creatures.

Although the interactions between whales and krill are very much in the mould of a predator–prey relationship, it's not entirely a one-way street. To illustrate this, we can look at how whale hunting affected krill. Some two million whales were killed in the Southern Ocean by whaling ships between 1915 and 1970. In just about every food web, when you remove a key predator, the prey, freed from persecution, flourish. But this didn't happen for Antarctic krill. In fact, according to some estimates, the krill

declined alongside the whales. Oddly, the explanation for this is that feeding whales in some way helps to support the krill. Whales eat a colossal amount of food – for blue whales, this may be as much as four tonnes a day – and what goes in must come out. Whales typically crap near the surface of the ocean. If you've ever lain awake at night wondering what whale shit looks like, allow me to enlighten you. They don't produce a great whale-sized log; it's much more of a massive, explosive, nuggety cloud of Brown Windsor soup. This is something I learned as I watched from a boat, with an exquisite mixture of delight and horror, as a snorkeling colleague of mine was engulfed in one such gargantuan cetacean bum detonation. Anyway, the bits and pieces within the terrible cloud are buoyant and remain in the surface waters. Whale turds are full of nutrients, such as iron, phosphorus and nitrogen, which in turn are manna for the minuscule plants – phytoplankton – that the krill eat. So the whales and the krill are bound in an ecological cycle, the success of one supporting the other.

It's strange what you can find out in the course of research, but it turns out krill are partial to Newcastle Brown Ale. This isn't quite as left-field as you might imagine. It isn't as though scientists went through the drinks cabinet to find the krill's tipple of choice. The brown ale was chosen as an easily available source of dissolved minerals. The point of this was to test precisely what the animals find particularly attractive and, ultimately, how nutrient gradients in the ocean affect krill movement patterns. It turns out that krill are strongly attracted to one nutrient in particular: iron. This is something that dark ales have in abundance. In any case, so delighted were they to be presented with brown ale that the crapulous crustaceans had to be prised from the pipette that was being used to add the ale to their tank. In the wild, krill approach areas with high concentrations of iron-rich whale crap in anticipation of a bounty of planktonic food. When whales are active, krill typically spend more time at the water's surface gorging on the abundant phytoplankton that are fertilised by the huge mammals'

lavatorial habits. Well-fed krill grow faster, thereby giving themselves the best chance of reaching an age at which they can breed, even though being at the surface potentially puts them at risk of being eaten by the whales themselves.

Krill on our side – and on our menus

Aside from their role as the main players in the Southern Ocean ecosystem, there are other, less widely understood, reasons to appreciate krill. One has to do with their role in pushing carbon dioxide into the depths of the ocean, where it may be locked in place for centuries. Given the role of carbon dioxide in global warming, any reduction in this gas is a bonus for all animals on the planet. The vast numbers of krill are supported by tiny single-celled algae that bloom throughout the Antarctic summer. As they grow, these algal cells suck up carbon dioxide from the water. Krill gather the algae using feeding baskets – specially modified legs that mesh together, which they pull through the water as they swim. The krill take up the carbon in the algae and then spit out sticky globs of indigestible matter and poop out strings of digested algae, which sink gradually to the deep ocean. This process, whereby the krill export carbon from surface waters to the abyss, is known as a biological pump. The abundance of these crustaceans is such that they do this on a massive scale, moving enormous amounts of carbon out of harm's way. In fact, it's estimated that Antarctic krill remove approximately as much carbon as is produced by all the households in the UK every year. Although other algal feeders can also pack away carbon in a similar way, they are often far less effective at pushing it into the ocean depths – with the result that the carbon cycles back out of the surface waters and into the atmosphere much more quickly.

Very few of us have ever seen an Antarctic krill in the flesh, and at present it forms only a small part of the human diet. But krill

are nutritious and – even now, so far as we can tell – abundant. Fortunately for them, they're far from a taste sensation. I'm told that to perfectly mimic the experience of eating krill, you need to get a piece of toilet paper and dampen it slightly. Next, put it in the freezer for an hour, then remove and serve. Still, they are rich in protein and oils, and their potential both for human consumption and as feed in aquaculture is attracting interest. If there's one thing that, for now, might keep the krill out of our clutches, it's that catching them in large quantities remains a significant challenge. Not only are they typically found in some of the most dangerous seas on Earth, but the fine-mesh nets that are required to catch them clog rapidly, and the animals can be crushed as they are hoisted out of the water. Vacuuming krill out of the sea offers a solution to the net problem, but it doesn't avoid injury to the animals, and that's where the problems start.

Adapting to life in such an icy environment, where their bodies are at the same glacial temperature as the seas around them, krill are reliant on a bizarre internal chemistry. For instance, they possess some of the most powerful and unusual digestive enzymes known in nature. Enzymes are biological catalysts, vastly accelerating processes such as digestion. Our own enzymes, and those of most animals, slow down dramatically as the temperature drops. Krill enzymes, though, have some extreme working conditions to cope with. Consequently, they've evolved to be super-powerful. The amazing characteristics of krill enzymes have recently been harnessed for human medicine, treating wounds and infections, bedsores, gastrointestinal disorders and blood clots, to name but a few. Scientific advances on this scale are rare. When they do occur, though, it's amazing how often they emerge in the most unlikely circumstances, from research into what might loftily be regarded as unpromising animals. It's another reason to make sure that we do our utmost to not only safeguard krill but also to value all of the biological wealth of the planet.

The difficulties involved in fishing for krill are considerable,

yet the riches on offer to anyone who can solve these problems remain a powerful incentive. Fishing fleets from countries including China, Japan, South Korea and Norway are pushing into the Southern Ocean, seeking ways to exploit this massive and essentially ownerless resource. Quotas for fishing are set by international agencies with a view to conservation. The problem, however, is that no-one knows for sure how much krill is out there. Without accurate data, quota setting is something of a lottery.

Another potential problem is that the gregariousness of krill can be used against them. At certain times of year, a majority of their population may be distributed across a relatively small number of gigantic swarms, where a concentrated fishing effort could make a killing in every sense of the word. Add into this mix the potentially disastrous effects of global warming, which reduces the ice sheets on which juvenile krill depend for grazing, and ocean acidification, which among other things prevents krill eggs from hatching, and anyone who cares about the ecosystem of the Southern Ocean has real reasons for concern. To tackle this, we need good scientific data to inform our decisions. As Rob King says, this is the motivation that gets him to work each day to meet these challenges.

The krill programme

All of which brings us back to Hobart, and the Australian Antarctic Division. I set off with Rob and So from reception in the direction of the lab for my first meeting with the krill. Strange though it may seem, I'm as excited to see these animals as any of their arguably more charismatic brethren that I've come face to face with over the years. It's true they're not fearsome, like lions, or imposing, like the whales that eat them, but they are extraordinary in their own right. They come from a different world, a place of ice and storms and mystery.