From *The World of the Butterfly*

(*Sommerfuglens verden*)

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**A lasting friendship**

I have been immersed in the world of the butterfly since I was a young boy. When I turned seven, my mother sewed me a net and purchased some ether from the pharmacy, and I was soon the owner of a small but promising collection of butterflies. For my birthday that year I also received the very first book I could keep as my own, and it was about butterflies. I often flicked through the pages to find the image of the huge swallowtail – in my mind, it grew into a creature of mythical proportions. And this was no accident. With its black-and-yellow markings, forked hind wings and sharp, darting flight, the swallowtail is the Rolls-Royce of Nordic butterflies. Biologist Carl von Linné deemed it the quintessential butterfly, and gave it the name *Papilio machaon* – ‘papilio’ simply means ‘butterfly’ in Latin (while ‘machaon’ is in honour of an esteemed Athenian soldier who led an army during the Trojan war). It is a single representative of a large family, Papilionidae, which has hundreds of members in warmer climes, including some of the world’s largest and most magnificent butterflies.

I soon came to understand that the swallowtail inhabited a place beyond my world of cabbage whites and peacock butterflies. But sometimes, the improbable happens. On a walk through the forest one day my family and I had stopped beside a small lake, when all at once and completely without warning a black-and-yellow marvel appeared, cruising straight towards me. All I had to do was reach out with my net, and then it was mine. I have often admired the swallowtail’s quick, darting flight in the years since then – my seven-year-old self must have been extremely lucky. With my mother’s help, I transported the butterfly home unharmed and professionally euthanised it – much to my older sister’s great disdain. I still have it to this day.

Many years would go by before the swallowtail crossed my path again. But as a university student, I lived close to a large wetland area outside Munich. There were meadows of blue iris and reeds, leas with rare orchids and loose clusters of willow, and beside the river kingfishers nested. There were also scattered patches of tall parsley, and on several of them, openly and easily visible, sat beautifully ornate caterpillars, which I immediately recognised as those of the swallowtail.

On a whim, I decided to take them with me, hammer together a cage and observe their development into adult butterflies. With a dozen or so caterpillars in my bag, I hurried home.

That spur-of-the-moment decision would have unexpected consequences. What had started with the simple joy of collecting changed direction and became a learning arena for ecology, evolution and natural science. I ordered books, kept logs, and found caterpillars of ever more species. All of them had their ecological preferences and habitats, with friends and foes, sorrows and joys – a wellspring of knowledge that was in a constant state of flux.

And the caterpillars did well. They grew large, and one day they crawled down from their plants, found themselves a sheltered nook within the cage, and pupated. A couple of weeks later, black-and-yellow wing patterns were visible through the thin pupae walls, and the following morning a group of magnificent butterflies sat on the netting. I released them where I had found them.

But not all of the butterflies emerged. Two of the pupae instead took on a sallow colour, and all at once out crawled some nasty-looking flies – that gave me something to think about, too.

And then there were other pupae that didn’t hatch, even though they looked healthy. I only discovered the reason for this later on. True, it was still high summer, but indoors, where the cage had been, there was less light and more heat than there was outdoors. And the caterpillars carefully monitor both these conditions. In particular, they pay close attention to the small changes in day length. Because this knowledge is vital – not for them, but for the offspring they will bring into the world once they have become butterflies. Shorter days mean that autumn is approaching, and to emerge in October would be fatal: their offspring would then have nothing to live on. Their upbringing in my student room had unexpectedly initiated their hibernation – or diapause, as it is known. And swallowtails only overwinter as pupae.

But where did the caterpillars acquire this knowledge? It’s a question I still ponder. Because think about it: the swallowtail is widespread from Algiers in Algeria to Alta in the far north of Norway. It’s a strong flyer, and can travel great distances. This means that the caterpillars risk growing up under different light conditions and day lengths than the generation that preceded them. If their hibernation is to be triggered at the right time, their physiology must have some sense of the latitude at which they happen to find themselves. And that calculation is fairly complex. In Bodø, in Northern Norway, the days are long in June, but the summer is very short, and the plants upon which the caterpillars feed wither early. Even the first generation’s caterpillars seem to realise this, so they go into hibernation as pupae as early as just after midsummer, even though the days are still long and light. In Provence, France, it’s the opposite. Of course, in June the days there are shorter than they are in Bodø, but the day-to-day changes are nevertheless much smaller. From this, the caterpillars’ physiology seems to ‘understand’ that they are at a latitude at which the summer will last longer. So south of the Alps, the butterflies emerge at day lengths at which they would never dream of emerging a few thousand kilometres further north – that is, they adapt their threshold for hibernating to the latitude of their location. A study revealed that the caterpillars of an eastern tiger swallowtail (*Papilio glaucus*) changed this threshold by half an hour for every degree of latitude north. In northern Michigan, the caterpillars required more than 16 hours of daylight to prevent them entering into hibernation, while ones in Florida needed just ten hours. This indicates that they physiologically ‘know’ their current latitude.

In fact, it seems that swallowtails also know their altitude above sea level. In the Alps, their hibernation is triggered earlier than in the lowlands – this is sensible enough, because the summer is shorter in the mountains – but nevertheless strange, since the day length in the mountains and the lowlands is the same. We have no good explanation as to how the caterpillars achieve this, but day length probably isn’t their only source of information. Many caterpillars can also perceive the condition of the plants on which they live, for example.

It turned out that the swallowtail has other talents, too, and some of them would likely have pleased Charles Darwin. Because it is of course part of evolutionary theory that new species take shape in much the same way as trees grow new shoots. But then, shouldn’t the forests actually be full of all kinds of transitional life forms? This question also bothered Darwin. Because the truth is that species appear to be stable and like themselves everywhere; neither great tits nor liverwort have changed since Carl von Linné wrote about them 300 years ago.

But I would like to have told Darwin about the swallowtail. It exists across the entire northern hemisphere – *but is it really the same species?* Butterfly collectors have argued about this for generations, because they are constantly showing each other all kinds of local variants. There are so many that some collectors collect only them, and they still occasionally discover new ones – often featuring small but nevertheless stable differences, which maintain their distinctive features even though outsiders often come fluttering in from other regions. British swallowtails are for example smaller and a slightly stronger yellow than their continental counterparts, and they continue to remain so despite their French relatives constantly wandering in. In North America, it’s even worse, because there the swallowtail crosses with several closely related species to form stable hybrids. Several forms that were thought to be separate species have turned out to be hybrids of this kind.

In short, the swallowtail is a creature without entirely clear species boundaries. On the one hand it adapts to local conditions, but at the same time it mixes easily with close relatives. It is entirely itself, but also flexible. It effortlessly travels hundreds of kilometres, and finds partners wherever it ends up. But this still doesn’t seem to destabilise the local forms. How the butterfly manages this is a bit of a mystery. Sometimes, it can be due to something as strange as the caterpillars’ local food preferences. On Corsica, there are for example both ordinary swallowtails and a close relative (the Corsican swallowtail, *Papilio hospiton*), which is darker and has a shorter tail. The two species easily form hybrids, and there is probably a certain flow of genes between them. This might have led to the species boundaries being erased over time, if it wasn’t for the fact that the Corsican swallowtail insists on laying its eggs on the giant fennel (*Ferula communis*), which grows almost exclusively on Corsica. Diligent researchers who studied the caterpillars’ tastebuds (!) discovered that the Corsican swallowtails much prefer the local foliage than the caterpillars of the common swallowtail. And that seems to be enough to keep the two species more or less separate.

This kind of thing would likely have pleased Charles Darwin. If this fluttering phenomenon is able to continue to live its life across the globe, certain variants will presumably gradually grow more isolated, and end up becoming a separate species. The swallowtail comprises a species complex in which both the splitting and merging of species is underway: the creation of species in real time!

As we will see, this astonishing ability to combine variation with stability is just one of the butterfly’s many fascinating qualities, and we will take a closer look at many of them. But first, we need an overview of the butterfly’s world.

**Who’s who**

This isn’t an encyclopaedia, but we do need to know what we’re talking about.

Most people associate butterflies with sun-filled summer days, but the world of the butterfly is much larger than that. There are many more butterflies out and about once the sun has gone down. Because the tiny grey moth that flits around your bedroom is also a butterfly. As are the larger nocturnal moths, which swoop through the air above the lilac bushes on light May evenings. Some butterflies are dazzlingly colourful, others we hardly notice; some are small as mosquitoes, others large as birds. Both butterflies and many moths take nourishment through a thin proboscis that lies coiled up like a tiny steel spring beneath their heads, and which can be unrolled to become a long drinking straw.

A first classification is to distinguish between diurnal butterflies and nocturnal moths. Butterflies, which are active during the day, are generally more colourful than moths, which are active at night. But such a distinction can cause confusion, because several moths are active during the day, and of those that are, many are also more colourful.

First some important families of diurnal butterflies. Even back in the time of Carl von Linné, the swallowtail was regarded as the quintessential butterfly. There are 600 species in the swallowtail, or Papilionidae family, and we will later become acquainted with the Apollo (*Parnassius apollo*), which belongs to it. The family is recognised by the inner edge of the hindwings, which is slightly curved, and where the subsequent wing rib is often extended backwards, to form a tail. The swallowtails include some of the most iconic of all butterflies, including the large South Asian birdwings (*Ornithoptera*).

Many common butterflies, such as peacocks (*Aglais io*), red admirals (*Vanessa atalanta*), mourning cloaks (*Nymphalis antiopa*) and small tortoiseshells (*Aglais urticae*), belong to the family of brush-footed butterflies (Nymphalidae), which are found all over the globe. A common feature is that their forelegs are reduced to two furry stumps, which are held curled up beneath their heads, almost like small arms. Many of the butterflies that appear in this book, such as the monarch (*Danaus plexippus*), blue moon (*Hypolimnas bolina*) and silver-washed fritillary (*Argynnis paphia*), belong to the brush-footed family. Their caterpillars often covered in spines.

Other families of butterfly include the whites and yellows (Pieridae) and gossamer-winged butterflies (Lycaenidae). The first, as their name suggests, are white or pale coloured. Some of them, like the common brimstone (*Gonepteryx rhamni*) and green-veined white (*Pieris napi*), are among our most common butterflies. Their caterpillars are smooth and free of hair, and often blend in with the plants on which they live. The gossamer-winged butterflies are small, and often fly close to the ground or between rocks, grasses and herbs. In this book, we will become more closely acquainted with two of them – the large blue (*Phengaris arion*) and the chequered blue (*Scolitantides orion*).

But then there are all the others, those that are active at night – that is, the moths. This group is much larger, and there is also great variation between its members.

[Chapter continues]