De fabulis, artibus et scientiis

Historia Physiologiae

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There Is Grandeur in This View of Life: De schoonheid van de evolutie

Stefaan Blancke and Johan Braeckman

Op het einde van zijn beroemde boek, *'On the origin of species'*, schreef Darwin dat evolutie 'uit zo een eenvoudig begin een eindeloze reeks vormen, prachtig mooi en schitterend' had voortgebracht. Nochtans had hij in de bijna vijfhonderd pagina's daarvoor uit de doeken gedaan hoe de levende natuur tot stand is gekomen door natuurlijke processen die worden aangedreven door dood en eindeloze verspilling.

Toch waren zijn woorden meer dan enkel troost voor zijn publiek. Darwin was van jongs af aan bezeten door de natuur. Nu hij het mechanisme had ontdekt dat soorten deed ontstaan en hen aanpaste aan de omgeving, keek hij niet met minder verwondering naar het leven dat hem zo mateloos boeide. Integendeel, evolutie had zijn kijk verrijkt en de wereld was er alleen maar mooier op geworden: 'Er is grandeur in deze visie op het leven', schreef hij. Nochtans was het niet vanzelfsprekend om schoonheid te vinden in de evolutionaire kijk op het leven.

Voor Darwin dacht men dat God de wereld had geschapen min of meer zoals we die vandaag terugvinden. Hierdoor kreeg de wereld een diepere bedoeling, en aangezien ze het werk was van een algoed wezen, was ze ook de best mogelijke. De mens was geschapen naar Gods gelijkenis en kreeg met zijn intelligentie en taal een bijzondere plaats binnen het geheel.

Darwins theorie maakte voorgoed een einde aan deze opvattingen, ook bekend als respectievelijk de *great chain of being* en de natuurtheologie. In de plaats kwam een natuur zonder hoger doel of zonder moraal waarin elk individu verwikkeld was in een verschrikkelijke strijd om het bestaan en de mens slechts een dier onder de dieren is.

Toch heeft Darwin gelijk dat door de ontdekking van evolutie door natuurlijke selectie en andere mechanismen, de wereld er veel mooier op geworden is. Niet in de zin van lieflijker, maar wel doordat we een dieper inzicht hebben gekregen in de wereld en in onszelf. Kortom, we kregen een veel rijker wereldbeeld in de plaats dat ons daarenboven de verantwoordelijkheid en de vrijheid gaf zelf aan een betere wereld te werken. Niettemin, ondanks haar verklarende en motiverende kracht, blijft evolutie veel tegenstand kennen, zowel onder gelovigen als in de sociale en humane wetenschappen. Ironisch genoeg is evolutie zelf daar de belangrijkste oorzaak van en draagt de tegenstand uiteindelijk ook bij aan onze verkenning van de schoonheid van evolutie.

Chapter 5

There Is Grandeur in This View of Life: The Beauty of Evolution

Stefaan Blancke and Johan Braeckman

Introduction

In the final paragraph of 'On the origin of species', Darwin comforts his readers with the idea that the mechanism of natural selection, which he aptly describes as a *war of nature*, allowed *endless forms most beautiful and most wonderful* to evolve. As the poet Alfred Tennyson pointed out in 1849, nature might be *red in tooth and claw*, but still, the ruthless competition between organisms has driven them to evolve wonderfully diverse colours, ingeniously complex adaptations and extraordinary behaviours. His consoling words were not simply rhetorical, intended to sweeten the bitter pill that he had offered his readers in the nearly five hundred pages before, but they probably came straight from the heart.

Darwin had been a nature lover all his life. The story of the young Darwin who put a bombardier beetle in his mouth so that he could collect another insect is widely known. So is the drawing by one of his classmates who portrayed him riding a giant beetle under the words *Go Charlie!*. Later on, before he embarked on the journey with the Beagle that would change his and our lives forever, Darwin considered a life as a vicar so that he could spend hours and hours studying the wonders of the world and, thus, the creation of God. By 1859, his belief had largely dissipated, but his admiration for the works of nature had anything but diminished. After Darwin had found the mechanism that could account for the natural wonders he had been studying his entire life, he became ever more enthralled by biological phenomena, examining them in great detail. Clearly, the progress of scientific knowledge does not necessarily detract from our appreciation of the beauty of nature.

Nevertheless, the idea that science and aesthetic experience are antithetical is quite popular, both in the sciences and the arts, and with the general public. By probing into nature, science allegedly takes away the awe and mystery. In the poem *Lamia*, the romantic John Keats complains that science (cold philosophy) *will clip an angel's wings, conquer all mysteries by rule and line, empty the haunted air, and gnomed mine – unweave a rainbow*. In the hands of scientists, the world allegedly becomes a disenchanted place with no room for imagination. All that is left are facts and numbers. Only the arts and humanities are said to be able to stand against the imperialistic aspirations of science and cultivate the appreciation of beauty, produced either by nature or man. They thereby rely on their own approaches and methodologies that distinguish them sharply from the sciences. However, the divide between science and the arts has been questioned and challenged by, among others, both CP Snow in his lecture on the *Two cultures* and, more recently, by Richard Dawkins in *Unweaving the rainbow*. They argue that science and the arts are two indispensible pillars of human culture that can and should interconnect. Science too depends on creativity and imagination and artists can find endless inspiration in the discoveries of science. Arts or science, there is much beauty to be found in both.

As Darwin himself experienced, evolution too is a wonderful phenomenon worthy of our attention and admiration. Think of the colours of flowers that lure insects to take part into the plant's reproductive process; of the lyrebird that is able to mimic all kinds of sounds from the environment to impress females, even when those sounds come from chainsaws

or an electronic photo camera; of the agility and strength of a white shark that allows this ferocious animal to jump high out of the water; and of the intelligence of humans and how they have modified the world. It is no wonder that Dawkins calls evolution *the greatest show on earth*. However, it is not merely the products of evolution that amaze us. In fact, people have mired in and glorified the beauty of nature long before the discovery of evolution. The amazement also, or perhaps primarily, lies in the realization that these wonderful things came to be by a slow and long process of random variation, the selective retention and accumulation of adaptive traits. We are at least as much impressed with the enormous explanatory power of Darwin's theory of evolution by natural selection as we are with evolution itself. We can find beauty and inspiration in the organization of an ant colony, but we can equally find it in William Hamilton's explanation of ants' behaviour in terms of inclusive fitness. Knowing and understanding the world from an evolutionary perspective do not go to the detriment of the aesthetic experience of nature, but, rather, expand and deepen it. Moreover, the beauty of evolution stretches way beyond the borders of the biological sciences, far into the realms of the humanities and the social sciences. Evolution is about all life, including humans. In philosophy, evolution touches on the traditional domains of metaphysics, morality, epistemology, and aesthetics. At the same time, evolution provides us with exciting opportunities to finally bridge the gap between the two cultures and to realize consilience, the integration and unification of *all* sciences.

Nevertheless, despite its explanatory richness and philosophical depth, evolution still has many enemies. Across the globe, fundamentalist religious groups oppose the teaching of evolution on the grounds that it degrades man and society. In the humanities and the social sciences, scholars reject evolutionary approaches because they assume that such approaches entail reductionism, scientism, genetic determinism, racism, sexism and conservatism. Such resistance against evolution will not subside overnight. However, by demonstrating how evolution explains and connects countless phenomena both in the biological and the cultural world, we can let ever more people experience the beauty of evolution. Let us explore where it can be found.

An evolutionary worldview

In order to fully appreciate the impact of evolution on modern thinking about the world and ourselves, we need to go back to the days before Darwin introduced his theory. The dominant worldview then was the great chain of being, the idea that God had created the universe in a hierarchical order from the lowest of minerals to the *Ens Perfectissimum*, God himself. The place of man was between the material and the spiritual world. His body put him firmly among the animals, but his mind allowed him to have a sense of the divine world above him. The divine order, in which each creature took its preordained place, was static, which meant that it had been more or less the same since creation and that it could not be changed in the future either, unless the universe disrupted. Within such a static view, variation is unimportant. Individuals are regarded only as imperfect reflections of a species-specific ideal type, an essence. As these essences were considered to be immutable, species could not change and therefore evolution was an absurd concept. The idea that the world was the creation of God had several implications. Foremost, it imbued the world with purpose. God did not make the world for fun, out of boredom, or just because he could, but intentionally, out of pure goodness. When God allocated each species to its intended place in the great chain of being, he also equipped them with the right properties and features by which each species could prosper within that place. For instance, God intended birds to fly, so he gave them wings, the intricacy of which bore witness to his divine power. Hence, humans could uncover God's intentions by simply looking at

the world. In the tradition of natural theology, instances of biological functional complexity, adaptations, in the language of evolutionary theory, were indeed explained as evidence of God's providence. In a classic example, William Paley, as did others before him, compares the complexity of the eye to that of a mechanical watch. The argument is that, if one finds a watch on the heath and looks at the way in which the cogs and springs are put together, one will immediately infer a watchmaker. Similarly, if one examines the composition of the eye, one will feel compelled to infer the existence of an eye-maker. That eye-maker, of course is God. It was also clear that humans were special. It was the only species with intelligence, language, and a soul. For that reason, God obviously had great plans with humans and he had created everything in order to realize them. In the end, human existence, how dreadful it was at times, served a higher purpose. Finally, the intentionally created world attested to God's infinite goodness. Maybe the world was not perfect, but it was at least the best of all possible worlds, as the philosopher Leibniz famously argued. All in all, God had taken pretty good care of his creation.

Then along came Darwin. Near the end of his five-year journey with the Beagle, Darwin started to question the creationist account of the origin of species that he had adhered to before. Two pieces of evidence in particular ignited this spark of doubt. The fossils he had found in the soils of South America were of giant sloths that were now extinct but that were quite similar to extant species of sloth. Secondly, he noticed that the Cape Verdean and the Galapagos Islands constituted relatively similar environments. Nonetheless, the former were home to species that resembled species on the African continent, whereas the latter were colonized by species that were clearly relatives to South American species. If God created life on earth, why then did he put different species in similar environments that looked remarkably the same as the ones on the nearest mainland? After a discussion in South Africa with John Herschel, who had described the origin of species as the *mystery of mysteries*, Darwin set sail for England where he would soon investigate the material he had collected on his journey. Less than one year later, in June 1837, Darwin drew a first impression of the tree of life – or rather the bush or the coral of life – that emerged as a result of common descent. By the end of September 1838, after having read Thomas Malthus' *Essay on the principle of populations*, he found the mechanism that drives evolution, natural selection. The world would never be the same.

Darwin's discovery of the theory of evolution by natural selection constituted a remarkably feat of human imagination. The facts do not point unambiguously at evolution, but require a brilliant mind such as Darwin's to regard them as such. Hence, we could dedicate an essay such as this one to Darwin's imaginative powers alone. Let us move on, however, to the impact that Darwin's novel theory had on the traditional worldview we sketched above. In a letter to his friend Joseph Dalton Hooker, Darwin famously described the discovery of his theory as the confession of a murder. He was specifically writing about the immutability of species, but that was far from the only part of the great chain of being that his ideas corroded. Perhaps the most radical idea was that the biological world had not sprung from God's mind, but from purely natural processes. Moreover, those processes turned out to work by wasting uncountable numbers of lives, an endless struggle in which only the best adapted survive and reproduce. Unsurprisingly, religious people were not happy with the materialistic undertones of Darwinian theory. Even the scientist John Herschel, whom Darwin deeply admired, condescendingly called natural selection the law of higgledy-piggledy. Moreover, it took another seventy years before the mechanism of natural selection became part of the scientific consensus. However, although, historically, natural selection did not receive the credit it deserved, and people still struggle to understand and accept it, the rupture it wrought

on the traditional worldview is abundantly clear. Darwinian evolution entails that the living world was not created by a benign, all-powerful being, but is the result of the interplay between chance and selection. There is no higher purpose to be had in nature. The biological design that natural theologians invoked as demonstrations of God's glory flaunted many imperfections and limitations, and was clearly the work of a tinkerer, modifying and adjusting the material already at hand, rather than of a divine engineer. Species were not immutable essences made up by God but dynamic populations of slightly varying individuals that could change dramatically over time. Moreover, nature was distressingly indifferent to pain and evil. Darwin himself famously referred to the Ichneumonidae, that lay their eggs in caterpillars or, more spectacularly, tarantulas. When the eggs hatch, the larvae eat their host in such a way that they leave the vital parts untouched so that the host remains alive and their food fresh. As Darwin realized such nastiness is difficult to explain when we assume the existence of a benign creator, but it makes sense when viewed in the light of evolution. Being nasty can be a very suitable strategy in a dog-eat-dog world.

Perhaps the most traumatizing part about Darwin's theory was the alleged degradation of man. In the Origin, Darwin had carefully omitted any reference to human evolution except for two sentences in which he prophesized: *Psychology will be based on a new foundation, that of the necessary requirement of each mental power and capacity by gradation. Light will be thrown on the origin of man and his history.* Nevertheless, the idea that humans were not created by God in his own image, but that they were closely affiliated with apes (and to all other life on earth), made an enormous impact. Unsurprisingly, religious people took great offence at the suggestion that humans too had a long evolutionary history and were, at least from a metaphysical perspective, no different from any other animal, plant or bacteria. At one meeting at the Museum of Natural History in Oxford, Bishop Samuel Wilberforce reportedly asked Thomas Huxley, also known as Darwin's bulldog, whether he thought to descend from monkeys through his grandfather or grandmother. Huxley wittily replied that he was not ashamed to descend from monkeys, but that he would be ashamed to be related to someone who used all in his power to obscure the truth. Not just the religious however had trouble with the idea of simian ancestry. Newspapers featured numerous cartoons that ridiculed Darwin and his *ape theory* and thereby expressed the general unease that people felt towards the idea that they were somehow related to animals. At the same time, however, the idea tickled the imagination and it became the subject of many projects, both in the sciences and the arts. The commercial success of the recent Planet of the Apes movies seems to indicate that the idea has not yet lost any of its appeal.

What beauty did we gain then by replacing the traditional with an evolutionary worldview? At first sight, it appears that we have only lost. We humans have knocked ourselves off our special status in a world that has become a cruel, uninviting place without God, purpose or objective morality. In fact, however, the beauty comes with a deeper understanding of the world, and of ourselves. We can venerate in wonderful biological phenomena such as the peacock's tail or a nightingale's song.These experiences become even more enriched with knowledge about why these phenomena exist and how much time it took for them to materialize. As to our place in nature, we can find beauty in and feel humbled by the idea that through common descent we are related to everything that lives on this planet. This has created a sense of connectedness that has made us critically evaluate and rethink our relations with animals and the environment at large. The idea that we can find no moral compass or purpose in nature can be quite perplexing. However, it also liberates us in the sense that only we decide what is valuable and desirable and only we can make a world

according to these values and desires. Finally, by looking at ourselves as a natural and not a semi-divine being, we have made it possible to investigate our capacities, our behaviour and culture through a scientific lens and learn much more about ourselves than ever before. That learning is still very much on its way, but let us look at the broad contours of what an evolutionary science of man can look like.

An evolutionary science of man

The evolution of the human body is relatively uncontroversial. Except for creationists, people generally have no problem with the idea that our body is the result of evolutionary processes. Most are familiar with at least some of the names of our ancestors, such as *Australopithecus afarensis* and *Homo erectus*. People also accept the idea that bodily parts have evolved in response to particular adaptive problems. Eyes have evolved, because they allow us to navigate in an environment rich with light, hands evolved because they enable us to manipulate things and our legs keep us on the move. The conceptions of how evolution works may be blurry or scientifically incorrect – we come back to that later –, but they do tend to accept this evolutionary scheme. Things change however when it comes to the human mind. In our daily personal experience, the mind is something completely different. Unlike the body, it appears to be immaterial, intangible and uniform. Religious people believe that it comes from a different, spiritual world, a special gift handed down to us by god or the gods. In science too, however, especially in the social sciences and the humanities, it is common to think that the mind is a blank slate, a general processing machine that can be filled with whatever cultural information one likes. Therefore, the human mind and culture are unsuitable subjects for a naturalistic and evolutionary study. The study of mind and culture requires a different approach altogether. Such assumptions continue to be widespread.

In recent decades, however, the cognitive sciences have overthrown this traditional picture completely and replaced it with a view of the human mind that consists of multiple specialized mechanisms, sometimes referred to as modules. The basic idea is quite simple. Just as we have ears for hearing and lungs to breath, so evolution has endowed us with multiple cognitive abilities that enable us to perform a plethora of different tasks. Some mechanisms deal with the processing of visual stimuli, whereas others facilitate our social life or help us to engage in finding a suitable mate. These mechanisms are inaccessible through conscious introspection, but can only be revealed through empirical studies, which explains why they remained undetected until recent. Darwin himself realized that human cognition would require an evolutionary approach, but it was not until the second half of the twentieth century that a naturalistic study of the human mind and behaviour started to materialize. The cognitive revolution was based on multiple empirical findings and theoretical developments. In artificial intelligence, researchers realized quite rapidly that the information processing devices they were constructing – computers – required built in reformation to perform even the easiest tasks. Studies on brain damage showed that people who lacked particular parts of the brain were unable to perform specific functions. In the 1940's, 50s and 60s ethologists such as Konrad Lorenz and Niko Tinbergen showed that animals depended for their survival on information about the world that they could not have learned through personal experience or from their parents or other conspecifics. Experiments in developmental psychology uncovered that babies hold specific expectations about the world, for instance that objects do not move by themselves or that only agents can create order. Studies in judgement and decision-making by Kahneman, Tversky and others discovered that, in general, people do not make choices based on a rational evaluation of the pros and cons but on fast and automatic rules of thumb, called heuristics. These developments

led to the development of evolutionary psychology. This inherently interdisciplinary study of human cognition takes very seriously the claim that the mind is the product of evolution and selection and assumes that the mind's evolutionary history continues to shape and constrain our cognitive, behavioural and cultural capacities. These principles have already generated wonderful contributions to the understanding of human thought and behaviour.

Take morality, for instance. According to the Bible, humans came to learn about good and evil after Adam and Eve, against God's will but seduced by the devilish snake, took a bite of the fruit from the tree of knowledge. As such, the story suggests that knowing about right and wrong is a divine privilege in which humans should not partake. The story is idiosyncratic to Christian cultures, but the phenomenon that morals and gods are somehow connected seems to be universal. The blank slate paradigm implies that norms and values are cultural artefacts and children can be raised in whatever moral system we like. As such, nurture alone determines whether they will become sociopaths or loving and caring altruists. This view has dropped the religious overtones, but both the religious and the blank slate view assume that morality is something special that is entirely out of reach for scientific investigations. The divine connotation of morality however is problematic, both theoretically and empirically. Theoretically, because, as the Greek philosopher Plato in *Euthyphro* argued, if a particular act is good because it is God's will, then we can hardly call this moral; and if God wishes it because it is good, then goodness exists independently from God. The facts confirm the latter point as secular societies clearly outrival religious ones when it comes to human kindness. Indeed, morality exists, and even thrives, in the absence of religion. The blank slate seems to make a more convincing case in the sense that the environment in which people grow up indeed deeply affects one's moral compass. Furthermore, at first sight, morality is truly problematic from an evolutionary perspective. If organisms are exclusively geared towards their own survival, how then can humans have evolved the potential of spending precious energy on the welfare of others? There seemed to be no worthy alternative to the idea that people adhere and behave according to the norms and values they grow up in.

Across cultures, however, moral systems display recurrent patterns that are inexplicable from a blank slate perspective. If morality is all about culture, then why do cultures independently converge on more or less the same structures? The answer is that these patterns emerge as the result of evolved cognitive mechanisms that are shared by all normal functioning human brains. Hence, morality is not merely a cultural product or a divine attribute, but a natural phenomenon that can be studied scientifically. Scientists can conduct experiments or perform large-scale and cross-cultural studies to lay bare the cognitive mechanisms that are involved with and impose patterns on morality. Moreover, although there is still much discussion about the details, the problem of how these moral mechanisms could have evolved has largely been solved. The basic answer is that not organisms but genes are the basic unit of selection. Hence, as Dawkins famously – or notoriously – put it, it is the genes that are selfish. This move is crucial for understanding the evolution and nature of morality, as it opens the door for altruism. Under certain circumstances, the best strategy for selfish genes might be to invest valuable resources in the survival of other organisms that share the same genes. This is for instance the case with family. With his notion of inclusive fitness or kin selection, William Hamilton showed that an organism could invest in the survival of its kin depending on the degree of relatedness. Hamilton's rule wonderfully explains the odd behaviour of neuter ants that invest all their time and energy in procuring for the female offspring of the queen mother, as they are more related to their sisters than they would be to their own offspring. Moreover,

inclusive fitness also explains why parents tend to take care of the offspring, both in humans and animals, because good parenting raises the odds that the genes that code for such behaviour will make it into the next generation. You can personally experience the evolutionary constraints of morality when you ask yourself who you would safe from a burning house: a relative or a complete stranger?

Naturally, kin selection can only be part of the answer as our moral feelings extend way beyond our relatives. One part of the answer is direct reciprocity, better known under the slogan: *I scratch your back, you scratch mine*. Organisms can work together if and only if the eventual payback of the cooperation is larger than the costs invested. The classic example is grooming apes. Each party invests little time and energy in removing parasites from the other party's fur, but both parties are much better of because of the cooperation, because grooming considerably lowers the risk of infection. Other examples are the vampire bats that share spendable portions of blood with non-related specifics and cleaning fish that eat the parasites of potential predators. Humans too are obsessed with reciprocity, both in the positive and the negative sense. Someone who systematically skips his turn to pay for a round will not likely receive drinks from his friends in the future. Punishment needs to be proportionate to the crime committed, we expect a fair reward or salary in return for our services or labour, and we hate being cheated, whether in an innocent game or in real life. Sometimes, however, the payback does not come from the beneficiary, but in terms of reputation, which raises the odds of future interactions with others. That indirect reciprocity played an important part in the evolution of morality explains why people tend to behave better when they have the feeling that they are being watched. It scales up their reputation.

Although we have only scratched the surface of the immense amount of evolutionary studies on morality, by now it has become clear that evolution enables us to shed new light on a subject that is traditionally regarded as belonging to the domain of philosophy. It helps us to comprehend better the patterns that underlie people's moral judgments and behaviour. Morality, however, is certainly not the only philosophical domain the understanding of which becomes enriched with an evolutionary approach. Art and art experience that traditionally belong to the philosophical discipline of aesthetics are now increasingly coming under the scrutiny of evolutionarily inspired research. Another domain is human knowledge. The fact that the cognitive mechanisms that acquire and process information about the outside world are the result of evolution has enormous consequences for how people think. Let us take a brief look at what these consequences are and how, once again, evolution helps us to get closer to a better understanding of human nature and culture.

The evolved mind and the temptation of anti-evolutionism

Over the last five hundred years, scientists have discovered wonderful things about the world, from the structure of the universe to the bizarre world of quantum mechanics, from evolutionary theory to plate tectonics. Although science is far from perfect, this has been a major human accomplishment, in particular because our mind has certainly not been wired to develop a scientific understanding of the world. Evolution is about making trade-offs and in the case of the human mind, evolution had to balance accuracy, speed and efficiency. On the one hand, the mind needs to construe sufficiently accurate representations of the world so that an organism is able to survive. An organism with a mind that mistakes a tiger for a rabbit will probably not have many descendants. On the other hand, a mind that renders a completely accurate and detailed representation of the world is not only very costly, it also leaves the mind perplexed by the enormous amount of data it needs to process. An organism that takes into account each and every detail of its surroundings, is unable to respond

adequately to particular challenges and will not survive for very long. The mind needs to focus on relevant data and disregard irrelevant types of information. Hence, evolution has endowed us with a mind that provides us with representations of the world that are accurate enough as to allow us to navigate efficiently through our daily lives, but that is not equipped to attain a scientific understanding of the world.

The mind is able to generate trustworthy representations because it relies upon intuitive expectations about particular aspects of the world. As we discussed above, even very young children have intuitions about the behaviour of objects. Similarly, we also have expectations about the living world. One dimension of this folk biology is psychological essentialism. Essentialism entails the belief that organisms hold an invisible and immutable core, an *essence*, that determines their development, behaviour and identity. This predisposition probably evolved because it enables us to quickly categorize organisms and react adequately in response to their presence. Another intuition is teleological thinking, i.e. the belief that natural phenomena exist or happen for a purpose. Unless taught otherwise, children intuitively assume that rain exist to water the plants, that lions are to go into the zoo or that rocks are pointy so that animals wouldn't sit on them. The predisposition arises from overextending our thinking about adaptations or artefacts. As a highly social species, we also tend to detect agents in nature and attribute mental states to completely natural phenomena. The attribution of mental states to other entities, which is part of our folk psychology, helps us to understand and manipulate the behaviour of other agents, specifically our conspecifics. However, we easily see faces in the clouds, interpret an unexpected sound in the house as the presence of a burglar, curse our car when it breaks down on our way to our holidays and smooth-talk our computer when it *refuses* to perform the function we would like it to.

We tend to think in essentialist, teleological, and intentional terms for good evolutionary reasons: they helped our ancestors to survive in a dog-eat-dog world by producing reliable representations of the external world. However, in modern times, when we want to gain a scientific understanding of the world, they can seriously mislead us and constitute formidable cognitive obstacles that require specially developed educational tools and strategies to overcome. Evolutionary theory holds that species do not reflect unchangeable essences but are dynamic gene pools that change with every generation, that the alleged biological design is only apparent and that nature knows no purposes or intentions. The theory is therefore highly counterintuitive which explains why even people who claim to understand it correctly and to accept it often transform it into more counter-intuitive types. The counter-intuitiveness of evolutionary theory also accounts for the fact why no human culture in history refers to the basic concepts of the theory in its creation story. According to Dan Sperber's cultural attraction theory, which is firmly anchored in an evolutionary view on the human mind, cultural representations will tend to converge, *ceteris paribus*, on types that are intuitively appealing. Hence, most creation stories include references to intentional acts by conscious beings that have created the world as it is for particular purposes. As these creationist representations tap into multiple intuitions, they become highly relevant: they grab the mind's attention, they are readily remembered and easy to process. As a result, such stories are more likely to be transmitted and become widespread, and thus cultural, within a particular population. It is also difficult to replace them with less intuitive representations, which accounts for the persistence of misconceptions of and resistance against evolutionary theory, even in many places outside the United States. Creationist activists even explicitly appeal to our intuitions, ensuring their audience to trust their intuition that the world is designed. In less traditionally religious surroundings, intuitions do not support creationist beliefs, but lead people to belief that nature is a

beneficent entity that procures good things for all living beings, especially us. However, such New Age beliefs are as unscientific as creationist stories. God the Father and Mother Nature are anchored in the same cognitive predispositions. Ironically, evolution has endowed us with a mind that finds it enormously difficult to properly comprehend and accept how evolution works. However, now that we have found ways to break through our cognitive blinds and, thanks to Charles Darwin, have seen the light of evolution, we comprehend how even understanding antievolutionism illustrates the explanatory power, and thus the beauty, of evolution.

Conclusions

Evolution has bereft us of many dreams. We can no longer regard ourselves as the pinnacle of an orderly and static world that God created solely for our good. Instead came a dynamic world dominated by randomness and an endless struggle for survival without a special place for the human species. However, how much beauty has Darwin bestowed upon us by his discovery of evolution by natural selection! Not only do we now understand the taxonomy of life, the origin of species and their features that continue to amaze us, we also gained much more insight into the history and nature of ourselves. Because humans have an evolved mind, they often fail to grasp the basic concepts of evolution or even actively oppose it. However, given evolution's impressive record as an explanation of the living world, including our social and cultural life, the beauty of evolution will become only more pronounced in the future.

Further reading

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