Stefan Klein

How We Change the World:

A Short History of the Human Mind

Bestselling author Stefan Klein takes us on a thrilling journey through the history of creative thinking. From the innovations of the Stone Age, such as painting, via the invention of writing to the achievements of the computers of tomorrow, Klein shows us vividly and in an entertaining way how the human mind has repeatedly reinvented the world.

Stefan Klein, who was born in Munich in 1965, is Germany's most successful science writer. His book *The Science of Happiness* (2002) topped all German bestseller lists for over a year and also brought the author international renown. This was followed by the much praised *All by Chance, The Secret Pulse of Time, Leonardo's Legacy: How Da Vinci Reimagined the World*, and *Survival of the Nicest*, Science Book of the Year 2011. His bestseller, *Träume: Eine Reise in unsere innere Wirklichkeit (Dreams: A Journey into our Inner Reality)*, received the Deutsche Lesepreis in 2016.

His most recently published book *Das All und das Nichts (How to love the Universe)* has been translated into nine languages.

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Table of Contents

Introduction: The Prometheus in Us

Part I Awakening

1 The Message of the Stones

2 An Explosion of Creativity

3 The Collective Brain

Part II The Age of Symbols

4 The Power of Signs

5 Seeing is Inventing

6 Flashes of Inspiration

Part III The Age of Networking

7 In Black and White

8 Traveling Through the Space of Possibility

9 How We Unhinge the World

Part IV The Future of Intelligence

10 Ada's Legacy

11 How We Change the World

Introduction: The Prometheus in Us

What is unimaginable today can become reality tomorrow. Usually we envision extraordinary human achievements as spectacular works like the Great Pyramids and the Eiffel Tower, Mozart's Symphonies and Leonardo da Vinci's Mona Lisa, Shakespeare's sonnets and the rockets that carried mankind to the moon. But creative thinking manifests itself as much, and perhaps even more, in small, seemingly everyday things. Our ability to take hot showers on cold winter days, for instance, is no less a triumph of human ingenuity than Einstein's Theory of General Relativity.

Anyone who has ever tried to start a campfire, especially with wet wood, knows what sort of challenges such elementary activities can present – and we today enjoy the advantage of matches to get the flames started. Our ancestors faced far greater obstacles. Striking pieces of flint together, as children sometimes do when pretending to be cavemen, barely creates the tiniest of sparks.

Before our early ancestors were able to make their first fire, they needed a whole serious of extremely unlikely ideas and connect various bits of inspiration. The solution was to strike flint against a softer stone like mica over easily flammable tinder. If you hit the mica at a steep angle with the flint, the friction caused glowing splinters. If they fell upon the tinder, they created a barely visible hotspot, whose heat could be transferred to a bundle of grass if blown on in carefully calibrated breaths.

The tinder commonly used consisted of tree-growing fungus called polypores, which required another set of amazing inspirations. Tinder fungus of this sort can be scraped from dying tree, but it isn't flammable. How did our ancestors know that they had to strip the fungus of its skin and then beat the flesh to produce amadou? And where did they gain the insight that the tinder would be more flammable if the flesh of the fungus was boiled in a mixture of water and ash and then left to sit for three weeks in human urine?

Knowledge of these techniques allowed our ancestors to survive winters much colder than those we know today. That is attested by a man who 5300 years ago crossed the Tyrolian Tisenjoch glacier, where he was murdered by an arrow. His frozen mummified remains are now exhibited a museum in Bolzano, Italy. The man is known as "Ötzi." In the pouch he wore around his waist, Ötzi carried some black matter researchers have identified as processed amadou. It contains shiny gold dust from mica.

The way we think is rooted deep in the past. Even Ötzi drew upon the experience of tens of thousands of generations. There is no doubt that the Neanderthals, and probably even earlier people, used tinder and mica to start fires. We don't know when our ancestors first succeeded making fire, but we do know that no event in human history was anything close to as influential as when they did. With the flames they now had under their control, human beings changed not only the world, but themselves as well. By cooking what they ate, they made their food more nutritious. Greater energy derived from food enabled the species to grow larger brains, whose dimensions were unparalleled in nature. Our path to computers and space travel began with the cooking pot. And it was thanks to human ingenuity that we were set off down this path.

Our ideas first made us who we are. Our imagination formed our nature. That's what distinguishes us from every other creature in nature. Animals have remarkable skills. The artistry with which termites, for example, construct massive, climate-conditioned structures for hundreds of thousands of fellow members of their species is no less of an achievement than anything human. The aerial architecture of capturing nets, dwelling chambers, canopies, adhesive strands, signal lines and bridging cords spiders weave from the silk when they produce their weds are the envy of any engineer. And the hunting strategies employed by crocodiles, which despite their tiny brains allow them to kill far more intelligent and mobile birds, seem hardly less refined than humankind's techniques for mastering fire.

Termites don't know they are building cities, however, and spiders have no idea how webs their webs work. They neither invented their artistry themselves nor learned it from others. They didn't have to. They came into the world as master builders. The plans and execution of the things they create are written into their genes. Crocodiles, too, only do what nature has programmed them to.

Humans are different animals altogether. Nature hasn't taught us how to start fires. Contemporary city-dwellers abandoned in a cold wilderness without a lighter and an insulated sleeping bag would quickly freeze to death. Even if they did succeed in finding a piece of flint, how many would realize that sparks from flint aren't hot enough to cause material to combust and that they also needed mica? Moreover, who knows any more that fungus can be made flammable?

Humble creatures like termites and spiders are able to build cities and weave enchanting fairy-tale castles relying on instinct alone. By contrast, human beings required a chain of inspirations before they were able to create a single flicker of flame.

So where do such inspirations come from? For a long time, it was believed that divine forces put ideas in the human mind. And since no invention was more crucial to human survival that taming fire, every culture has a myth about how a higher being brought it down to earth. In Greek mythology, Prometheus was punished for having stolen flames from the father of the gods, Zeus. In Antiquity, no one could imagine that human beings had gained control over fire thanks to their own ingenuity.

Today we are far less inclined to credit supernatural forces with our inspirations. Nonetheless, human creative thought is considered one of the greatest unsolved questions. Together with the mystery of consciousness, it demarcates "the boundary of out knowledge," to quote neuroscientist Eric Kandel, who won a Nobel prize in 2000 for discovering fundamental mechanisms of human learning.

Creative thought appears so mysterious because it's impossible to predict. Ideas, often to our dismay, run on their own schedules and take their own paths. If a problem requires new solutions and we're struggling to find inspiration, inspirations frequently refuse to come no matter how hard we try to summon them. Perhaps they don't come *because* we're trying so hard. Inspirations tend to arrive when we least expect them: when we're taking a shower, making a tricky turn on a busy street corner and even when we're dreaming. At those times, suddenly, our imaginations can be sparked.

Probably because human beings attributed inspiration to divine forces for so long, we have only had a name for our capacity to come up with and realize ideas for the past one-hundred-and-fifty years. Since precisely then, we have pondered what constitutes our ability to create new and valuable things.

Is it a gift reserved for humanity's greatest geniuses, the Mozarts, Picassos and Einsteins? It is early to understand why people revere genius. The final measures of the Jupiter Symphony are a miracle, the "Demoiselles d'Avignon" ushered in a new chapter in painting, and without doubt the Theory of General Relativity pulled back a curtain on aspects of our universe. It seems as logical for us today to consider the people who created such works chosen ones, just as it seemed reasonable to the mythic mindset of the past to describe fire as a gift from the gods. It was the only way for our distant ancestors to explain such gigantic creative achievements.

But just as Prometheus is a figure of fiction, not fact, the cult of genius has no basis in reality. The latest scientific research on the human brain shows that isn't a special ability, with which select individuals are blessed and the so-called average person is not. These pages will argue that creativity is something both deeper and more interesting. Creative thinking arises from elementary functions of reason common to all human beings.

What's more, the success or failure our mental labors depends less on individual personal qualities than on our ability to converse about our ideas with others. Creativity doesn't unfold primarily in the mind of one member of the species but in the productive exchange between people and their ideas. This is why creativity can be unleashed.

The genius coming up with a great idea on his own is a romantic conceit. The opposite is the case. Every form of creative thought originates in the interplay of multiple individuals. Ideas are often developed as answers to questions posed by others or by our environment. Without such external impetus, even the most powerful imagination is powerless. To find answers, pure reason depends mental tools and suitable material, just as even the best carpenter cannot build a house without wood and a saw. Together, these mental tools and the material from which the human imagination forms new inspirations are called culture.

In the history of humankind, our thinking has been through three revolutions, watersheds that shaped human intellect. We continue today to produce ideas with the tools and the material that arose during these periods of disruption. Moreover, right now, the world is being shaken to the core by a fourth revolution. What all of these upheavals have in common is that they were caused people developing new ways to use information.

The first revolution took place more than 3.3 million years ago, when our ancestors learned how to make carving implements of stone. Those tools gave them supernatural physical strength, allowing humankind to free itself from some of the bonds of nature. Chapter one to three of this book tell of how our earliest ancestors began to form their world. Because they were already dependent upon learning from one another, they needed a new means of communication. For that reason, it is likely that language arose during this first pivotal juncture.

As part of humanity's second intellectual revolution, human beings discovered symbolic thought. We don't know where and when this upheaval commenced, but it is clear that at least one hundred thousand years ago our ancestors began to understand the world in a novel way, realizing that they were free to interpret the things around them. Suddenly a mussel shell was no longer just a remnant of a marine creature. It could also be a piece of jewelry that granted its owner status. A curved line drawn on the wall of cliff with a charred stick could represent the back of an animal. A colored handprint could

recall the person who left it behind. For the first time in history, people could store information outside their own brains.

Symbols are tools of reason. As chapters four to six will show, they allowed people to live in larger groups and later to settle in fixed locations. Simple pictorial symbols gave rise to numbers and written language, which allowed for increasingly abstract ideas. By using symbols, human beings increased the potential power of their brains.

The third revolution took humanity into the age in which people's minds across the globe could connect. It's possible to date the beginning of mass communication to within a few months. Around 1450 AD, the goldsmith Johannes Gutenberg began operating a novel device in the German city of Mainz. His tin-lettered printing press allowed information to be disseminated quickly and in mass quantities. Within a few years, such presses were already printing millions of written pages. Chapters seven through nine will examine how, as a result, human beings increasingly oriented themselves around knowledge rather than faith. Science became a new force in the world, revealing previously concealed forces within nature and creating an unprecedented standard of living for billions of people.

The fourth revolution, the one we're currently undergoing, has disrupted established reality. Human beings have invented machines capable of taking over tasks from our own minds and of teaching themselves. In the shortest of times, humanity has become completely dependent on computers, with the pace of this transformation causing both surprise and alarm. Chapters ten and eleven will analyze the conundrum in which we live at present. On the one hand, machines are outstripping human intelligence and are making our decisions for us in ever more areas. On the other hand, so-called artificial intelligence is helping us better understand our own minds – helping us further improve the way we think.

In his book *The Origins of Knowledge and Imagination*, British mathematician and biologist Jacob Bronowski characterizes the rise of humanity as "a constant growth and expansion in human imagination." The

path by which the human species came to dominate the planet represents a triumph less of intelligence than of ingenuity.

The most astonishing ability of the human mind is its consistent ability to go itself one better. Conversely, every revolution that raised humanity up to the next level also brought a crisis shattering the old order. It is for this reason that we are so concerned with the questions posed by the mercurial rise of computers, the Internet and artificial intelligence. Perhaps examining the history of the human mind will help us find some sensible answers.