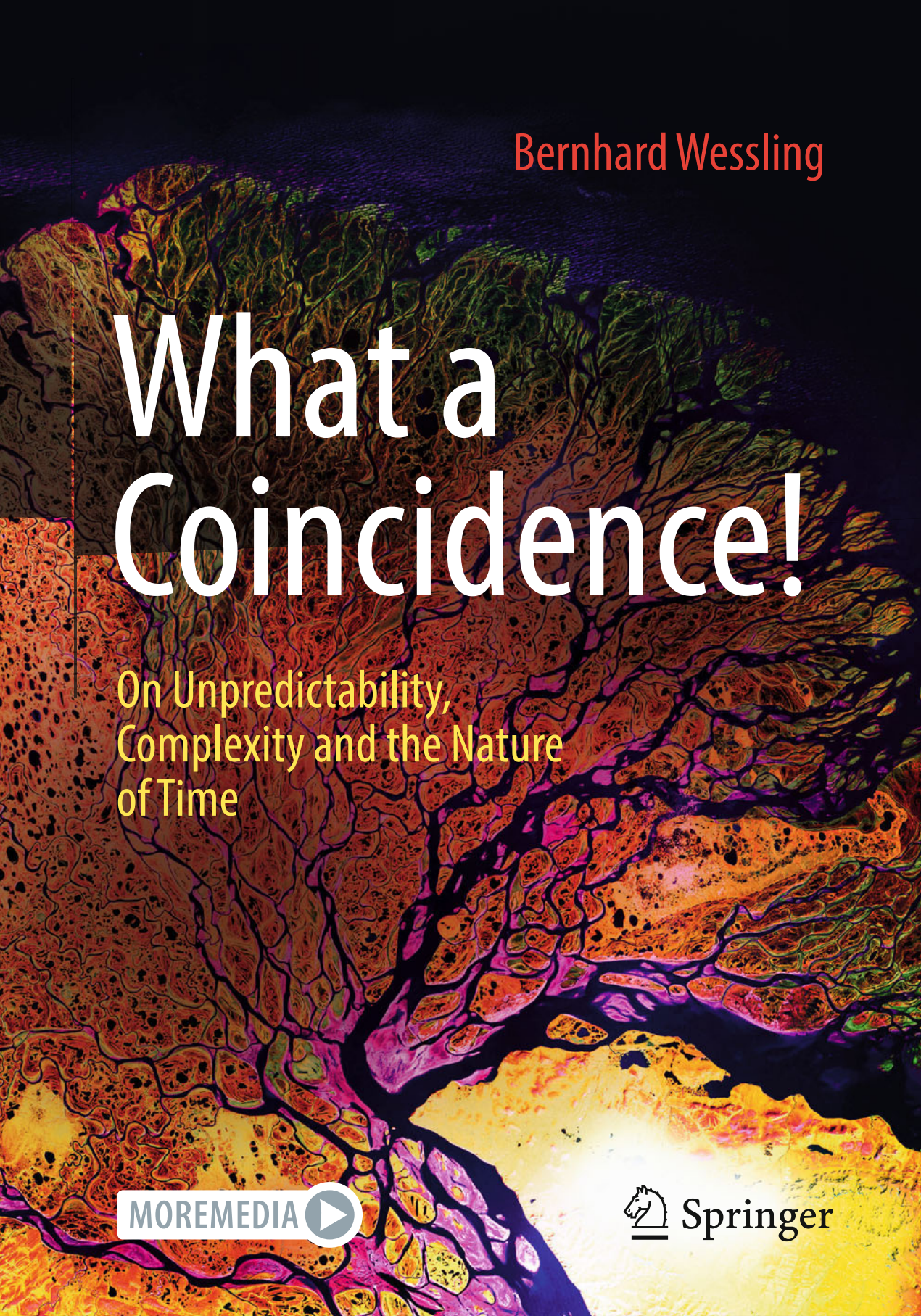
Bernhard Wessling
What a Coincidence!
On Unpredictability, Complexity and the Nature of Time
MOREMEDIA
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On Unpredictability, Complexity and the Nature of Time

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I dedicate this book to my grandchildren and those of my life partner, on behalf of all young people today. I hope it will help them in understanding our dynamic and sometimes chaotic world.

Preface

"How could this have happened again? That's impossible!" We've all uttered, heard, and read such exclamations many times. We consider unlikely events to be practically impossible. Experts calculate probabilities of disasters that we and, above all, the relevant politicians trust. There was theoretically nothing worse than a DBA (=design-basis accident) or "maximum credible accident" for nuclear power plants, but in practice, much more happened in Fukushima than was previously considered the worst case scenario. That was "coincidence" ("there were just too many unpredictable things coming together").

Successful people like to claim that they have planned everything, that they have stuck to their strategy. And yet, they forget how often they have met exactly the right people (whom they didn't previously know) by chance or appeared on the market in exactly the right market situation (which they could not influence at all) with a product (which was not intended for this exact market situation at all). Those who have worked just as hard but without success (if they are self-critical) accuse themselves of all kinds of mistakes, but often fail to notice that they have not met the right people by chance, or that they have appeared on the market too early (when the market situation was not yet suitable) with practically the same product, and therefore failed by accident.

August 2021 marked the thirtieth anniversary of the launch of the *World Wide Web*. Nobody could foresee, nobody could predict how much the WWW would turn the world upside down only a few years later. Not even its inventor Tim Berners-Lee, who only wanted to develop it for the easier exchange of scientific documents. Even the way to this start was a chain of coincidences and chances, as he has described.

Rather, we all experienced even more coincidences in 2020: Most likely, a new coronavirus jumped from animals to humans at a wild animal market in Wuhan (China) in December 2019. Perhaps this happened without anyone noticing it before, somewhere else, because according to current knowledge, the first infection occurred in Italy in November 2019, as was subsequently found out. In January 2020, the founder of the biotechnology company BioNTech learned of this virus. He decided to radically shift the focus of the company from cancer therapy research to the development of a vaccine against Covid-19. In December 2020, that is, after less than a year of work, the vaccine was approved. This research was only possible because the founding couple had come

across first indications from basic research more than twelve years earlier that *maybe* novel cancer therapies could be made possible using mRNA—we will go into this in more detail. Because, as oncologists, they had founded a company (BioNTech) for this purpose, happened to find two investors by chance—a pair of brothers—who were willing to take risks and be patient; and because they had developed the mRNA technology almost ready for use by the end of 2019, only still with no approved product. The vaccine was possible, even though the research was actually aimed at a completely different application area. But by chance they recognized this possibility of their technology platform and developed a vaccine in an incredibly short time.

We are at least annoyed by very many coincidences. There may be sudden rain, which was not forecast, and the picnic outside falls into the water. Some coincidences are dangerous, such as a car that suddenly takes us the right of way. Some are even life-threatening, such as the accidental spread of the coronavirus to humans. Other coincidences, however, are welcome: We are often happy about small ones. So the sudden reappearance of the sun, after we had packed the picnic quickly and could now unpack it again after all. We marvel smilingly at the bigger one, such as the coincidence that made it possible for me to get to know my life partner for the first time, with whom I live happily together. We shake our heads in joyful disbelief that our favorite soccer club was able to equalize in the very last second, and that only because an opposing defender's leg by chance sent the ball careening in the right direction. The development of stock prices is unpredictable, and this is by far not the only thing that is unpredictable in economic life. Inventions and discoveries are very often, if not predominantly, the result of chance, coincidence and accidents.

Other coincidences are even decisive for all of our lives: The extinction of the dinosaurs, which made the development of mammals possible. And even more decisive was the formation of the moon several billion years earlier, which stabilizes our Earth's axis and thus makes the world we live in possible. A world that we humans could not write about if, by chance, some decisive mutations had not occurred millions of years ago that shaped our brains the way we find them today.

If we're honest, more accidents and coincidence cases happen, more actually rather improbable events than those that we can plan, predict, forecast or influence. All kinds of things go wrong, although we haven't done anything wrong! And just as many events that please us or advance us happen unexpectedly, or at least at a time when we did not expect them. The newspapers and all other media are full of it.

So let's now assume that accidents, coincidences and chances are *normal*, i. e. nothing unusual, but rather completely typical phenomena with us on earth and thus throughout the entire universe; if that is the case—then we also want to know: Where does this come from, how does it come into our world, why is it normal? To answer this question, I will not argue with probability calculations, statistics or chaos theory, as mathematicians, philosophers or psychologists do. Nor will I work with philosophical considerations or psychological analyses that are to make us understand how we can enjoy, endure or cope with coincidence, chance and accidents. First of all—after a more detailed consideration

of coincidences and chances that surround us—, we will look at how it comes about that our world consists of nothing but complex structures. If all the substances in the universe were evenly distributed and nicely homogeneously distributed and mixed, there would be no us, with our complexly structured brain, the nervous and circulatory system, muscles, bones, our complex skin, the sense organs and all our fantastically finely built internal organs. How do such complex structures arise? How does complexity that we observe everywhere in the world, everywhere in the universe, arise?

If all substances in the universe were statistically evenly distributed and did not form highly complex structures, we could not admire the beauty of the cirrus nebula. Here is a new picture of the Hubble telescope.[1] *The nebula looks like a turbulent whirling smoke trail, but with a diameter of over one hundred light years. We will look at such and similar phenomena in the book and come to understand the reasons of their formation.*

To avoid making things too complicated, we will also turn to seemingly simpler structures and questions: Why is mayonnaise so stiff, even though the main ingredients—raw egg yolk, water and oil—are each nowhere near as viscous? Why do you have to follow certain steps when making mayonnaise or sauce Béarnaise and can't just pour all the ingredients together into a bowl and stir? Why isn't it easy at all using raw cocoa powder, as used for tiramisu, and milk to make a nice, rich brown cocoa, where cocoa clumps don't sink to the bottom of the cup after a few seconds? How do such complex and constantly changing structures arise as the mouth of a river delta, for example the Lena, as shown on the cover of this book?

[1]Cirrus nebula, latest picture of the Hubble telescope; source: https://esahubble.org/images/potw2113a/, Credit: ESA/Hubble & NASA, Z. Levay.

I will try to answer some of these questions based on my own research. For I discovered complex structures in material compositions that could not have existed according to generally accepted ideas. In my research as a chemist, I found a common denominator and therein the cause: All of these products are non-equilibrium systems. It was necessary for me to break away from the idea that I had developed as a chemistry student based on lectures and textbooks, just as all my fellow students had: For us, the world consisted of equilibrium systems, *non-equilibrium* was something rare and unwanted, and thus we described such systems only approximately again as equilibrium systems, ones that were *only somewhat* outside of equilibrium.

In my further research, I learned through the study of the work of many other researchers that non-equilibrium systems are structured. I started to wonder: Why is that so? Or, thinking the other way around: Why are complexly structured systems not in equilibrium? Professor Ilya Prigogine received the Nobel Prize for explaining this with a new theory of thermodynamics. It is simply and solely a matter of entropy, which is very decisive for what determines the course of the world. You may have already heard the word *entropy* before, but either didn't consider it important or possibly not understood it in the first place. I will try to make you understand it. Because anyone who wants to understand the world at least a little from the bottom up should have a reasonably accurate idea of entropy. But don't worry, I will explain it in a way that is really easy and practical to grasp.

Then we will also deal with fundamental questions: If everything was chaotic at the Big Bang, why can order arise in the universe, for example the diversely structured galaxies with countless sun/planet systems? And why can a glowing hot earth become a life-friendly blue planet? How did the Big Bang come about in the first place, wasn't that also a matter of chance or coincidence?

The phenomenon of *chance and coincidence* has always fascinated me. When I was working on non-equilibrium thermodynamics, I eventually came across a connection between chance/coincidence and non-equilibrium at some point. But how can that be? Well, that's exactly what this book is about, and I'll explain it step by step in the course of this book. Suffice it to say for now that both phenomena are inextricably linked to each other. And both phenomena are just as inextricably linked to entropy. My only surprise came, during even deeper research for this book, at the fact that apparently no one had come up with similar ideas before. Or, if someone had had similar thoughts, they had not been written down in a publicly (or at least easily) accessible way. In any case, all I kept reading and hearing was: It is the quanta, the unpredictably behaving elementary particles, that should cause chance, coincidental and accidental events in our macroscopic world. I will explain why this cannot be the case. Quite apart from the fact that there is no verifiable evidence to.

And *time*? We're not going to link entropy to *time* as well, are we? Yes, *we* are not going to link *time* to entropy and non-equilibrium, *we* don't have to and couldn't anyway. Because *time* is already linked with entropy.

But isn't time just an illusion, as Einstein said? And as some other very serious physicists and philosophers also think? But if it is not an illusion, what is the nature of time? We will approach the answer to this question, which has so far been clarified neither by philosophy nor the natural sciences, step by step, just as I have done in the course of my research.

And finally, the older ones among us may also expect an answer to the question (which the younger ones can put it aside for later): Why does time go by faster as we age? Is that really the case, or do we just feel that way? Why does time sometimes seem to go slow for the younger among us, like when we're waiting for something urgent, and sometimes seem to go fast, like when vacation is over sooner than we thought?

If you've ever asked yourself these or similar questions, I invite you on an expedition into landscapes of science that you have probably not visited before. We span wide arcs from simple mayonnaise to complex galaxy clusters, from mundane traffic jams on the highway to the fascinating subject of evolution, from the misunderstood Big Bang to the amazing self-organization of order out of chaos, from surprising goals in overtime to unimaginably oversized black holes. And we thus encompass the becoming and passing in our world, entropy, chance, coincidence and time.

We will also occasionally reflect on how our own thinking might work. How open are we to questioning widely accepted explanations, which we ourselves find pleasant and plausible, about the interconnections in our world? If we are all honest: Most of the time we are not very open. But we should try it more often. In the words of Nobel laureate Daniel Kahneman: "Our mind usually works so that we have intuitive feelings and opinions about almost everything we encounter. […] Regardless of whether we formulate them explicitly or not, we often have answers to questions that we do not fully understand, and we rely on clues that we can neither explain nor defend."[2] In this book you will encounter some thoughts that you may never have heard or read before. This will make you sceptical, because, as Daniel Kahneman explains in his profound book *Thinking, Fast and Slow* among many other aspects of our thinking, we hold statements that we have read or heard many times before as being far more likely to be true than those that we encounter for the first time. It then requires considerably more mental effort, and

[2]Daniel Kahneman (Nobel laureate 2002), "Schnelles Denken, langsames Denken", German edition Siedler-Verlag (Penguin Randomhouse) 2012, p. 127, retranslated from the German text by B. Wessling. (Original English edition: "Thinking, Fast and Slow", Penguin Books 2022). It is particularly interesting to consider his description of two different thinking systems and the experimental evidence for this: System 1 is fast and superficial, constantly trying to construct explanations from all sensory impressions that correspond to previous experiences; it is only, if this does not succeed, that System 2 becomes active, a system that represents our conscious (after-) thinking, but it is "lazy" because it uses a lot of energy. System 1 invents obvious explanations that we then accept. It is happy to answer questions that replace the actual questions, because they are much easier. Then, it seems to us as if the acute question has been answered, which is not the case.

thus more energy (!), to deal with new thoughts and phenomena than to read and hear things that we already know and have long considered to be correct.

With this book, I would like to motivate you to subject your previous world view to a critical examination in part: Is everything really *in equilibrium,* should the climate, the ecosystem, our economy really be *in equilibrium* at best? I do not expect you to change or even overturn your previous ideas; but I would like to encourage you to allow for some unusual thoughts and to think them through calmly. Because only in this way we will be able not only to answer the question of how chance, coincidence and accidents come into our world. We will understand the world as a whole a little better.

Jersbek Bernhard Wessling

For this English edition, readers should be aware the original German edition is using the German word “Zufall”. In English, there are several different words for what Germans are all calling “Zufall”: coincidence, chance, accident, randomness. I have tried to use the appropriate term in each given circumstance.

I Thank this World for its Non-Equilibria with the Coincidences and Chances

The origin of this book lies in my unbridled amazement at this world. And about what I found out in my research. I started writing in 2016, having, at the time, just been together with my new life partner for a year. How wonderfully unpredictable my life has been: A big thank you to non-equilibrium of the world I live in, and the coincidences and chances that brought me together with her! She viewed me indulgently when I hacked away at my laptop for hours at the table in our living room-kitchen in our first small flat together in Germany or at the sofa table in China. And not only there, but also on the plane to or during our trips within China. For two years. I am very grateful to her, above all for tolerating and supporting my work on this book—in parallel to my other books[3]. But even more than that: She had read the pre-pre-pre-version during its creation in 2016/17. But then stated: "I won't read the book again until it's really finished." So, she knew, even before I did, that it would take many years and many revisions and fundamental changes until the book was *really finished*, assuming it ever really was. It indeed got finished. She was surprised how much had changed when she read the original German edition.

Of course, not all the people to whom I am or should be grateful can be found here—the list would be too long for this book. But those not named can be sure of my gratitude! Nevertheless, I would like to mention a few key people.

Without Professor Ilya Prigogine and his scientific life's work, I would never have found the solution to the puzzles that troubled me so much for years, if not decades. Professors Werner Ebeling and Grégoire Nicolis specifically pushed me towards an essential question that I had to work on and could solve. The theoretical physicist Dr. Helmut Baumert let me lure him into a question that was initially uninteresting to him, until we were able to jointly develop a new theory of turbulence in non-Newtonian fluids. The non-equilibrium thermodynamicist Dr. Rainer Feistel,[4] the physicist Prof. Serdar Sariciftci

[3]"Der Sprung ins kalte Wasser", Verlagsgruppe Eulenspiegel 2023 sowie "Der Ruf der Kraniche", Goldmann 2020/"The Call of the Cranes", Springer Nature 2022.

[4]https://www.io-warnemuende.de/rainer-feistel.html

(Johannes Kepler Universität Linz, Austria)[5] as well as two other scientists read an earlier version of the manuscript and made a lot of critical comments. These have prompted me to do additional research and to think even more deeply, which is reflected in the book. My younger brother gave me numerous hints for passages that, despite my best efforts, had not been written in a manner that would be understandable to everyone. But, in particular, without the work of my many employees, especially in the laboratories of my company, there would have been nothing for me to discuss with these outstanding scientists. I have worked very closely with many of my employees, some for more than twenty to thirty years. The extremely intense thirteen years I spent in China also fill me with gratitude. I cultivated friendships there, that are still alive today. Our common active time was full to bursting coincidences, chances, accidents and exciting scientific discoveries …[6]

The freelance editors Obst & Ohlerich criticized an early version of this book to the ground in 2017, but they found the final version convincing. I learned a lot from the final round of editing carried out by Rouven Obst of the original German edition. Now, this English edition was reviewed by Marc Beschler (who already had reviewed the translation of my previous book about my sideline crane behaviour research, "The Call of the Cranes" (SpringerNature 2022), and I am again so grateful to him. The German poem in the Final Remarks (at the end of the book) was translated by Timothy Adès, a "rhyming translator-poet", whom I found "by chance" (sure! how else could it be!) and with whom I exchanged a few emails until the final version was approved by both of us, we both had fun. Let is be known that I am solely responsible or all remaining errors. In his editing of the original German edition, Eric Blaschke (editor at Springer Vieweg) pointed out numerous minor and major deficiencies, which prompted further research and improvements to the text. The publisher Springer Nature, here in particular the responsible editor Eric Blaschke and his boss Dr. Garbers, took the risk of publishing this book project, and now also this English edition—for this I am particularly grateful. Especially because Springer found my book project interesting and worth publishing, after I had already collected rejections from countless publishers and literature agencies before. Actually, I had already given up hope that a publisher would take it and want to bring it out. What a coincidence that I finally asked at the editorial team of Springer Vieweg!

But that is exactly how our world is, constantly things are happening that one cannot imagine, that cannot be foreseen, and for that I am grateful to the world for it! How boring my life would have been, if everything had been predictable and everything that I was to experience in my life had been documented in the appendix to my birth certificate. Fortunately for all of us, however, the world is made up of nothing but non-equilibrium systems—full of grace, beauty and surprises.

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[5] https://www.jku.at/en/institute-of-physical-chemistry-and-linz-institute-for-organic-solar-cells/team/sariciftci/

[6] https://www.researchgate.net/publication/260427241_Milestones_highlights_of_the_Organic_Metal_Polyaniline_Science_Technology, see Appendix 15.

Contents

Vita

Dr. Bernhard Wessling, born 1951, raised in Herne, studied chemistry in Bochum. From January 1978 to the end of 1980, he worked for an engineering company in Düsseldorf. After that, he moved with his then wife and two small children to Bargteheide and took over the management of the development laboratory of Zipperling Kessler & Co., a company with fewer than fifty employees, but a 170-year history. A few years later, he took over the management, and soon he became a shareholder of the company (with a very risky buy-out of a previous shareholder). It subsequently developed into a successful company with three hundred employees. At the end of 1995, Wessling founded the daughter company Ormecon, selling all of Zipperling's business to Clariant AG mid-1996. Wessling, having relocated in 2005 to China, sold Ormecon at the end of 2008, founded his one-man technology consulting company in ShenZhen and remained in China until the end of 2017. Throughout his career, despite holding such positions as managing director, he continued to be directly responsible for research and development. Thus, even as he fashioned himself as an author and entrepreneur, he remained committed to pursuing basic research.

Chance and Coincidence Take their Course

1

Abstract

The author describes numerous instances of chance and coincidence that opened his way into science, into basic research, in a small company that he has been responsible for as managing director and shareholder at a very early stage. These coincidences led him deeper and deeper into areas that have previously received little scientific attention and where surprising phenomena waited to be discovered.

About 30 years ago, on August 6, 1991, the world's first website went online.[1] The initial ignition of the *World Wide Web* was a product of the European research center CERN—created by accident and as the result of many coincidental events—, albeit initially only an internal one. Two years later, on April 30, 1993, the WWW was activated for the general public. Access was free of charge, but there was considerable cost around the technical requirements and the high telephone charges at that time. And still hardly anyone noticed it, certainly, no one predicted at that time that the WWW would have an impact on practically all areas of our lives. It was intended as a platform for the documentation and international exchange of documents within CERN, and even that came about unplanned.

Only two years later, on October 5, 1995, my company became the second chemical company in the world to go online, the next coincidence. I was and am anything but a

[1] Here is a copy of the original website: https://www.w3.org/History/19921103-hypertext/hypertext/WWW/TheProject.html; or here: http://info.cern.ch/hypertext/WWW/TheProject.html.

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computer nerd, yet I almost landed on pole position. Only the then-chemical giant Hoechst AG had beaten us by just a few days. But our site was much more informative: I had ensured that *all* our technical information and my scientific publications (together, over four hundred documents) were available, while Hoechst offered only the homepage.[2] In1995, in the Internet, which was intolerably slow from today's point of view, housed only 23,500 web addresses.[3] Today (as of Sep 12, 2022) there are two billion,[4] that is, over 80,000 times as many. As to our own site, I had no further ambition back then but to make our technical and scientific information more easily available to our international customers and research partners worldwide back then. There was no notion at all as to what the WWW would become in just a few years to come.

I was only reminded of the fact that the WWW would celebrate its 30th anniversary in 2021 or its actual anniversary as a public Internet in 2023 thanks to the article *How the Web Came Into the World?* at the end of 2020 from the weekly magazine DIE ZEIT.[5] And although the platform is therefore, strictly speaking, still very young, it seems to me as if the Internet has always existed. My memories of the telex, which I myself used actively for many years, as well as the fax machine that followed, strike even me now as being akin to stories from the time of early industrialization.

How many coincidences led to the existence of the WWW? Above all, there was never a plan to build something that even remotely resembles the Internet as we know and use it today. Tim Berners-Lee, who is considered the inventor of the WWW, once said that there was never *the one* decisive idea that initiated the Web: "I wrote the first programs. But many other people have contributed important ingredients, just as randomly as I did." Bernd Pollermann, who also worked on this chaotic team, said: "Why did I join in? So that my colleagues would no longer annoy me with their never-ending requests for internal telephone numbers." So, he just wanted to create a telephone directory that was accessible to everyone and could be edited easily, nothing more. Neither was the project an official project of CERN, where the developers were employed, nor was anything more planned than easier availability of scientific documents and telephone numbers of this huge European research institution; such information was previously almost impossible to find, even for insiders. The Englishman Berners-Lee had already completed an internship at CERN in 1980, after which worked for four years at

[2] In this web archive, you will find a copy of the websites from back then, not directly from October 1995, but from November 1996, because in 1995, there were also no web archivists: https://web.archive.org/web/19961125121325/http://www.zipperling.de/ZKC/About (with the hyperlinks that also work in this web archive, the reader can call up other websites from my company from that time); however, only the very few initial Hoechst websites from January 1998 can be found there.

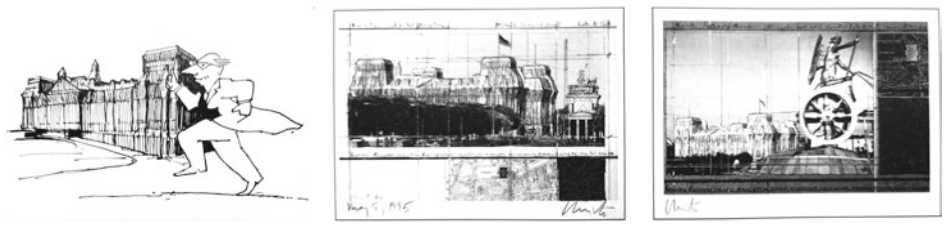
[3] "unique hostnames"

[4] http://bit.ly/3HXSli1 "How many Web Sites are there?" (Sep 2022)

[5] https://www.zeit.de/2021/01/word-wide-web-erfindung-internet-cern-genf-physiker-forschungszentrum.

a software company before applying and being accepted for a job at CERN in 1984. In 1989, he proposed a project that aimed to make research results easier to exchange and find. This was a self-imposed task for which he had most assuredly not been hired. His direct superior said: "Vague, but exciting." The project was run unofficially, because it would have taken far too long if a project application had been made. And it probably would have been talked down in the committees. When Berners-Lee wanted to present his concept at a hypertext conference at the end of 1991, he was not allowed to give a talk—even though the CERN-internal WWW already existed! He presented the state of his development in the foyer, where it hardly attracted any attention. When the Web was eventually opened up to the public in 1993, Berners-Lee was still only concerned with the exchange of information among researchers.

I too merely thought of providing technical information, albeit half already to customers, only the other half to my research partners and research competitors. A seemingly endless chain of chances, accidents and coincidences had led me to a point at which my advertising consultant and I began discussing, in the spring of 1995, how we wanted to present ourselves in the following autumn at the biannial plastics fair in Düsseldorf, the world's largest fair of its kind, which takes place every two years. As always before this event, we were looking for a funny or attention-grabbing action with which we could attract notice. One possibility was to advertise our active involvement in the Christo couple's wrapping of the Reichstag, the cover of the invitation to meet us at the fair is shown in the lower left-hand image. We had developed the flame retardant concentrate for the wrapping film and ropes to be used in Christo's project (see also Appendix 4).[6] But it was still unclear whether the project would go on as planned, because the wrapping was not due to begin until June and the approval was overdue. For the fair, it was still very uncertain whether we would get the two Christo lithographs (shown in the lower middle and right-hand images) that we had been promised for a raffle—a plan we developed for the show, which was a prerequisite for an effective advertising campaign.



And so, this other idea wafted around the room: Two years earlier, the *World Wide Web* had become generally available, and there had been first tentative attempts to use it for company information. I had already heard about this on the sidelines, while my consultant had read a lot more about it and had almost developed into an expert. At that time,

[6] https://web.archive.org/web/19970301045342/http://www.zipperling.de/News/Christo/reichsta

not a single chemical company in the world was online with a website, let alone one from the plastics industry, my company's particular market. I thought we could try to be the first. So, we got started. This endeavour turned out to be an obstacle course, with a dozen of my employees, my consultant and I putting in a lot of hard work. Ultimately, we managed to get everything ready a mere few hours before the fair's opening that our homepage went live. And so, we killed two birds with one stone: We made the relevant research results from our house available worldwide and, at the same time, created a stir.

Our company's booth at this world plastics fair, *K'95,* was constantly surrounded by a large crowd of people, especially since we were also raffling off our Christo lithographs. The visitors had, at best, heard or read about the WWW, but had never seen anything like it themselves; now they wanted to see it. Nobody had a computer at home with which they could have accessed the Internet with a beeping modem; only a few companies had something like that. But we had set up the then-modern Pentium computer with a large tube screen, connected it to the WWW by telephone line, and my employees and I took turns demonstrating the new websites and their content. The browser available at that time was *Netscape*, and if one wished to do a web search, one turned to *AltaVista.* We even printed out whatever website pages interested visitors desired on request. It was *the* talk of the day at the fair.

We were something like small pioneers on the WWW at that time. And at the same time, we were active with our insignificant company in what was then a *very hot* area of basic research and that would later shape my professional and business future. The road there was paved with an incredible number of chances, accidental events and coincidences, just like the road to the WWW and many other inventions, discoveries and important social changes. Above all, my scientific path showed me the deep cause of the perfectly normal occurrence of coincidences. But let's take a few steps back to the first accidental event without which I would not be alive, before we continue with the professional coincidences.

Many people probably tend to say that their birth and their conception before that were rather lucky coincidences. In principle, however, this applies to all people. Because only a fraction of the billions and billions of intimate encounters between two loving people of different sexes actually leads to inception. In my case, however, it was evident that my parents did not want to have a fifth child, at least not at *that* time, because their fourth one had just been born. But two months later, my mother was already pregnant again, namely, with me. I was born only eleven months after my next-older brother, and only six years after the end of the war. My father was still unemployed, our family was downright poor. A reasonable married couple could not want to have another child at that time. Either my parents were unreasonable at that time, or they simply had bad luck with contraception. But if you wanted to use contraception as a Catholic in those days and not be condemned to hell at the same time due to a mortal sin, you had to plan sexual

intercourse according to Knaus-Ogino[7] or, even better, with a thermometer, which often helped the Catholic Church and the German people to gain more members. On this occasion, by accident, that new member was me. (My mother has later confirmed this to me.)

As a child and teenager, I was curious, adventurous, and fond of exploring, and I took an interest early on in scientific questions; I loved biology class, where I learned about chromosomes and DNA. Watson and Crick, who had elucidated the structure of DNA,[8] became my idols. It wasn't long before a firm decision had formed in my head: I wanted to become a biochemist. Here, the next chain of coincidences began: I actually found myself very enthused with the idea of going to Tübingen (my oldest brother was a physics student there), the town's university was, next to Hanover, one of only two in Germany where you could study biochemistry. As a boy born in Herne in the middle of the Ruhr region, however, I also looked at the newly founded Bochum Ruhr University not far away, for cost reasons, and because I didn't want to be too far away from my first girlfriend. I went there to visit the chemistry department's biochemistry professor, who had come from the University of Tübingen. He advised me: "Don't study biochemistry. You would then be neither a biologist nor a chemist, without the ability to do either of them right. Study chemistry and also some biology on the side, then you can later decide which path in chemistry you want to take." That's what I did.

Unfortunately, the completion of my dissertation on a complicated synthesis question in natural product chemistry happened to coincide with a major economic crisis: The entire European chemical industry had imposed a hiring freeze. After a period coinciding with my high school years during which the industry had tried desperately to recruit chemists, I was now, after only seven years, a graduated chemist at a time when they weren't hiring anyone anymore. I decided to go to a small three-man engineering consulting firm, against the advice of everyone around me. I had seen a notice on the bulletin board of the chemistry department and applied.

My laboratory neighbors blatantly tapped their foreheads. "Are you crazy? You have to go either to a famous university or to one of the world's leading chemical companies and do research on big projects there. You're as active and efficient and goal-oriented here as no one else—and now you want to stop engaging in research?" But who said I wanted to stop researching? Maybe I could get something going on my own in the young engineering company? "That will never work," my best friends replied.

[7] Knaus and Ogino had been the ones who independently developed a calender-based contraception method which was recommended by the Catholic Church and usually referred to as "Knaus-Ogino method", cf. also https://en.wikipedia.org/wiki/Calendar-based_contraceptive_methods.

[8] J. Watson, F. Crick, Nature 171, 737–738 (1953), link to original paper: https://www.nature.com/scitable/content/Molecular-Structure-of-Nucleic-Acids-16331.

From Plow Horse to Racehorse

塞翁失马 (Sài Wēng shī mǎ),[9] very freely translated: "Who knows what will develop from it" or "You can never know". I only know this proverb since I lived, worked and also learned Chinese in China for thirteen years, from 2005 to the end of 2017, as a result of further accidents and coincidences. It is one of the infinitely many Chinese 成语, the *Cheng Yu.* These are proverbs that mostly consist of four characters, behind which lie stories that are thousands of years old. They contain valuable wisdom that Chinese students still learn today and—if you learn to understand them and really digest them—can be very helpful in coping with and understanding life.

塞翁失马 (sài wēng shī mǎ, "Sai Weng loses a horse") is the condensed, four-character[10] comprehensive headline of the following little story:[11]

> There was a man who lived on the northern border of China, whom the people called Sài Wēng (塞翁; old border dweller). One day, his horse broke loose and galloped into the barbarian territory beyond the Great Wall. The neighbors visited Sài Wēng to express their sympathy, but Sài Wēng surprised them by asking: "*Who knows if this is not a blessing?*"
>
> Months later, the horse returned with a mare, an incredibly beautiful and very fast horse. Sài Wēng's possessions had more than doubled overnight. Many came by to admire the new horse and congratulate him, but again Sài Wēng showed no great emotions. He said: "*Who says this can't be bad luck?*"
>
> Sài Wēng's son proudly rode the new horse around, but couldn't hold it well, fell and suffered a compound fracture of the leg. Again, sympathetic neighbors came, and again Sài Wēng said, as calm as ever: "*Who says that can't be some kind of blessing?*"
>
> A year later, the barbarians crossed the border. All young men fit for military service were drafted into the army to defend the country. There were heavy casualties on both sides.

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[9] The Chinese characters are made "readable" for foreigners by the official romanization "PinYin" with accents, which indicate the emphasis of the syllable that one has to use when communicating with Chinese people.

[10] In full, this proverb is: 塞翁失马, 焉知非福 (Sài Wēng shī mǎ, yān zhī fēi fú), thus consisting of two times four characters, literally translated as "Sài Weng loses a horse, how do we know not a blessing?" In German, this is often translated as "luck in misfortune". But the Chinese Cheng Yu only partly corresponds to our German saying, because what we mean by that is: When something unfortunate happens, for example, an accident in which one only sustained a superficial wound, despite the fact that it could have been a broken leg or even worse, one had luck in misfortune. The Chinese one goes much further, and means: Even if something bad happens, something good can develop from it (and vice versa). The accents on the syllables indicate the emphasis, which is decisive for communication in Chinese as a tonal language.

[11] I partly took the text from https://ostasieninstitut.com/enzyklopaedie/saios-pferd-%e5%a1%9e%e7%bf%81%e3%81%8c%e9%a6%ac-saio-ga-uma/, revised and translated into English. Reprint with kind permission of the institute.

> Nine out of ten men died. But Sài Wēng's son was not drafted because his leg was crippled. Therefore, he was spared the terrible fate and his family survived the war completely.

So, at that time, I had decided to set my sights low, very low. I had consciously decided *not to* pursue a university career as an alternative to big industrial chemistry. I considered myself incompatible with the research philosophy and bureaucracy of the universities. And apart from that the chemical industry had no openings at all, I was also not interested in applying for a position at any of the giant chemical companies where I was afraid I would be drowned in their hierarchy. So I started as a lone fighter and "chief" of a one-man "chemistry" department, handled consulting contracts for which some little chemical understanding was helpful, got new projects and actively sought opportunities to start solid development work without any realistic prospect of real research. By chance, I came into contact with an older engineer who had a strange idea: to "stretch" plastics, so to speak, by incorporating fillers, thus to dilute them and making them cheaper. I didn't have the slightest idea about plastics, but I set to work, practically alone.

鹰单飞，羊群集。 (Yīng dān fēi, yáng qún jí.), "Eagles fly alone, sheep flock together". Another interesting Cheng Yu, but at the time I didn't feel like an eagle at all, but rather like a lonely gray mouse.

So, by chance, I was led to a question in the field of plastic technology. Through a combination of incredibly improvised means, hours spent working on rented equipment in the halls of machine manufacturers and with advice from this senior engineer, I succeeded in developing a new process: Using vacuum in mixers and extruders, I worked a considerable amount of mineral filler into conventional plastics without significantly compromising the positive properties of these materials.

After my Ph.D., I had lost my horse—the prospect of an attractive job in chemical research—and unlike Sai Weng I had not found another particularly fast horse, but rather a lame donkey, namely, the position at the engineering consulting company. But I made a useful workhorse out of the lame donkey: I developed a new process, filed a patent,[12] won an investor, built a small factory and started my first combination of technical development with marketing and management. At the same time, the oil crisis developed worldwide—what a coincidence! Oil, and thus also plastic, were suddenly scarce and expensive. Without anyone—let alone me—having been able to foresee it: Our products were suddenly in demand!

In the meantime, a friend of mine, a laboratory neighbor from the time of my doctoral thesis, got in touch. He was doing postdoc research in France on electrically conductive complex salts. We were in contact by letter, and thus he knew that I was on my way to working on plastic technology. Now, he sent me an article that had just been published, in which three professors and two of their employees reported the discovery of

[12] https://patents.google.com/patent/WO1981003144A1/en.