It is not uncommon for a scientist to hang up their lab coat and become a journalist. Martina Preiner did it the other way around. After a career as a science journalist, she switched sides again in her early thirties and returned to the laboratory. The reason for her change of heart was a fascination with the origin of life.

TEXT: CATARINA PIETSCHMANN

"You know what? Just come by." This rather casually expressed invitation marked a turning point in Martina Preiner's life. In 2011, biologist Bill Martin invited the freelance science journalist to his research laboratory in Düsseldorf, marking the start of her second career.

Seven years later, Martina Preiner headed the junior Geochemical Protoenzymes research group at the Max Planck Institute for Terrestrial Microbiology in Marburg. Behind the complicated term hides one of humanity's greatest questions: How did life originate on Earth? For science, more than 4 billion years ago, when life began, the early Earth was a very murky place: an inhospitable planet often depicted with bubbling volcanoes, with an atmosphere of water vapor, carbon dioxide, and other gases that was hostile to life by today's standards. "The conditions were completely different from those present today – that much is certain. But we don't know exactly what the Earth looked like back then. And that makes it difficult to go back to the beginning of life," says Martina Preiner.

Presumably, the first chemical reactions took place on rocks and in rock pores before the first functional cell saw the light of day many millions of years later. This cell is known as LUCA – the "last universal common ancestor" – the last common ancestor of bacteria and archaea and thus also of fungi, plants, and animals. Martina Preiner conducts research on the transition between geochemistry and biochemistry, the point at which the precursors of today's enzymes made more complex reactions possible. She studies reaction networks based on organic cofactors and other reaction products, and the question of whether porous rock could have acted as a precursor to cells.

Preiner's journey here was anything but straightforward. It started in 1985 in Burghausen, Upper Bavaria – her mother a medical-technical assistant, her father a chemist. "Influenced" in this way, she decided to study chemistry and biochemistry in Munich. It quickly became clear that this was a bit reckless, having only studied basic chemistry in 12th grade – but Preiner stuck with it. However, she also felt that she was always interested in more than "just" chemistry. When she finally had her master's degree in the bag, she had run out of steam. "I didn't really feel like a scientist at the time," she recalls. A doctorate and subsequent career in science or in the chemical industry seemed out of the question. But what to do instead?

During her studies, Preiner often listened to Munich student radio M94.5, where a school friend worked. She contacted her, became part of the editorial staff of the radio station and after a short time also the head of the science department. "I also had the supervisor of my master's thesis, physicist Don

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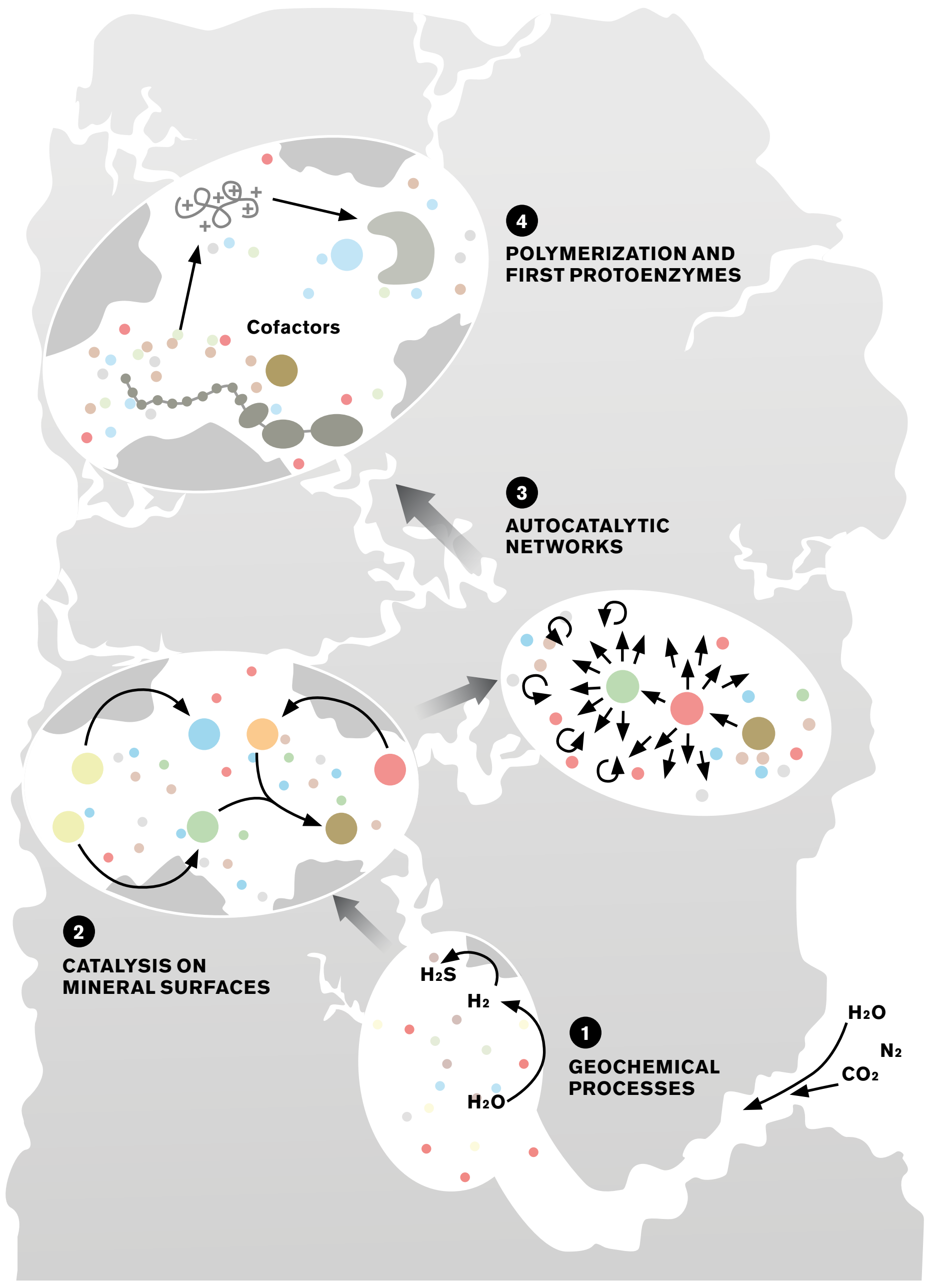
VISIT TO

MARTINA PREINER

PHOTO: KATRIN BINNER FOR MPG

A balancing act that extends beyond the stairwell: Martina Preiner brings together different disciplines in her research group.



The first life processes could have taken place in cavities in porous rocks. The pores may have provided a protected environment and catalyzed the formation of hydrogen (1) and more complex molecules (2) via minerals. This could have resulted in reaction networks that could sustain themselves without enzymes, but with the help of cofactors, minerals and salts (large circles) (3). The next step in this scenario would be the formation of polymers and thus the first enzyme precursors that can catalyze reactions in a more targeted manner (4).

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Lamb, to thank for this. He gave me one day off during the week, which I was able make up for by working on Saturdays in the lab." It was exactly the view from outside the box that she needed. The next step was not long in coming. Through a tip-off, she became aware of the mentoring program of the Robert Bosch Foundation's Science Journalism Initiative.

After a journalistic crash course in Cologne, she completed internships at Deutschlandfunk and WDR, gaining experience in radio and, for example, on the scientific TV show Quarks. That was in the spring of 2011. "It was shortly after the Fukushima reactor disaster, and science journalism was suddenly the focus of a lot of media coverage." Martina Preiner helped the editors working around Ranga Yogeshwar, the Quarks presenter at the time, to gather facts and deal with false information. She soon made her own contributions to the program.

Life as a freelance journalist was great and never felt boring. She produced radio reports for Deutschlandfunk and WDR about anxiety disorders, radioactive radiation, adhesives, and the human voice. For Deutschlandfunk Nova, she joined a mushroom expert to collect boletuses and agarics in a Cologne cemetery, investigated science scandals, and interviewed one of the first commercial astronauts. From neurobiology to the VW scandal to climate research, everything was covered.

She had enough work; things were often quite tight financially. "I was restless at the time. If I had money left over, I traveled to India for a month or to South America for three months, usually I gathered journalistic material during these travels to finance them." However, permanent positions were few and far between. And when she secured a job as a researcher at a Munich production company, it quickly became apparent that this "wasn't right at all!"

life in the future. "Half joking, I said: 'I could do that.'" However, Martina Preiner had been out of academia for six years. Was there even a way back? And then came the all-important sentence quoted at the beginning of the article: "You know what? Just come by."

The thought of perhaps obtaining a doctorate had occurred to Preiner a few times. "But I wouldn't have gone back to university for any topic other than the origin of life, I think." In 2016, Preiner moved to Düsseldorf and set up a chemistry department in Martin's laboratory, which focused purely on microbiological research, and began to investigate potential parallels between biological and geochemical binding of carbon. "I allowed carbon dioxide and hydrogen to react with minerals such as magnetite

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So she returned to self-employment. An article for the science magazine *Spektrum der Wissenschaft* would change all that. It dealt with the hypotheses of how life might have originated on Earth. According to the "RNA-first" theory, a kind of "primordial soup" simmered in ponds on the surface of the Earth, in which small nucleic acid building blocks were formed, which then combined to form larger molecules. The "metabolism-first" theory, on the other hand, postulates, among other things, that the first metabolic processes developed at hydrothermal vents in the deep sea.

Martina Preiner was mesmerized by the topic, the research of which involved very different disciplines, from geology and geochemistry to biology, biochemistry, chemistry, and physics. In the course of her research for the article, she also conducted an interview with the biologist Bill Martin from the University of Düsseldorf, a proponent of the metabolism-first theory. At the end of the conversation, the scientist mentioned that he would also like to explore the chemical processes behind the origin of

or the iron-nickel alloy awaruite, which can be found at hydrothermal vents, and analyzed whether these can enable the conversion of carbon dioxide." In the aqueous solutions she found four small organic molecules: methanol, formic acid, acetic acid, and pyruvic acid. In other words, exactly the substances that are still at the beginning of the metabolism of many carbon dioxide-fixing microorganisms! This was proof that these first reaction steps can also be carried out on minerals.

However, Preiner could not leave journalism entirely alone. Alongside her work in the lab, she hosted a podcast. Together with her friend, science journalist and astrophysicist Franziska Konitzer, she had already applied for a science podcast on Amazon's audiobook offshoot Audible before starting her doctorate. "For Undoder zum Quadrat (And/or square), we talked about gold, nitrogen, nuclear power, love, and death, among other things. It was great!"

In the laboratory too, Preiner soon found a like-minded person – postdoctoral researcher and biotechnolo-

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gist Joana Xavier, a free spirit like her. Irritated by some representatives of the various theories on the origin of life and their stereotypical thinking, Preiner and Xavier organized an interdisciplinary conference in 2018 just for doctoral researchers and postdocs studying the origin of life. Thanks to their request to refrain from using technical language as much as possible, the participants were able to communicate across disciplinary boundaries. “There was a totally relaxed atmosphere, everyone was very open about the pros and cons of the different theories of how life might have come about. They dared to do more because there was not the usual polarization you see at conferences.” In a joint publication, the researchers then presented how they see the future of their research area.

had already happened to her several times before. Initial overload, because she was the only generalist among the specialists and knew less about the basics than everyone else; then a steep learning curve, and in the end the rewarding feeling of having acquired a lot of new knowledge, this time about geochemistry.

She was in Utrecht with her young family for just six months when a colleague forwarded her an invitation to tender from the Max Planck Institute for Terrestrial Microbiology. They were building the leadership team for a junior research group within the new Microcosm Earth Center. As a chemist who deals with metabolic processes, going into microbiology, such an opportunity was too good to be true!

“If you focus too much on a single theory, you lose your openness and objectivity.”

Two years later, the next conference followed, now organized by people who had participated in the first one. Finally, the Origin of Life Early-career Network (OoLEN) was formed out of these meetings, today counting over 200 members worldwide. “Hypotheses are of course indispensable. But if you focus too much on a particular hypothesis, you lose your openness and objectivity. I think the network has also advanced our field of research because it facilitates cooperation among researchers.”

Shortly after obtaining her doctorate in 2020, like so many others, Peiner suddenly had to contend with the complications brought by Covid-19. In addition, Preiner was also pregnant with her daughter. She initially stayed in Düsseldorf as a postdoctoral researcher before starting a job in Utrecht and on the Dutch island of Texel, “finally getting a chance to get out of the laboratory.” Aboard the research vessel Pelagia, as a scientific co-director with geoscientists, ecologists, and biologists, she sailed to the Mid-Atlantic Ridge and took samples of nanoparticles around hydrothermal vents on the seabed. What she experienced during her postdoc period

On the advice of friends and family, she applied despite her doubts. When she received the invitation to the selection process, she couldn’t believe it at first. But she got the job. And as it would soon turn out that, with her focus on the beginnings of metabolism, she was an excellent fit for the team. In her office, she sits opposite biologist Julia Kurth, who is researching methanogenic archaea – ancient single-celled organisms that bind carbon dioxide and convert it into methane. One door down works Judith Klatt, the third member of the team. The biogeochemist is a specialist in ecosystems in primeval oceans. And not far away, researchers are investigating what the first proteins could have looked like. “We are now thinking about whether we could reconstruct them and release them into an artificial geochemical environment,” says Martina Preiner. “Had we not all come together here, such ideas would not have come about.”

As is the case for many millennials, her career was full of unforeseen twists and turns. School, studies, doctorate, then permanent employment until retirement – these were relics of the past. Nothing is set in

Hot springs in the deep sea, known as "white smokers," are a possible birthplace of life. Martina Preiner is now also researching other chemical environments in which the first life processes may have taken place. Carbon dioxide always plays a central role – albeit not in the form of dry ice as shown in this picture.

PHOTO: KATRIN BINNER FOR MPG

stone anymore. "That's why I sometimes advise students to do something besides academic research for a while to get their bearings. Because not everyone is or will be happy in academia and it is good to know what other options are out there." The fact that she repeatedly jumped into cold water and also swam against the current is perhaps no coincidence. In her youth she was a competitive swimmer and started diving at the age of 14. From the cool Attersee in Austria to tropical coral reefs, she has been to the bottom of many bodies of water. This year she will get her fins and diving mask out of the closet again after a long time and accompany her father on his final dives in Indonesia.

Martina Preiner has arrived at Max-Planck in Marburg for the time being. Reflecting on her career, it is clear that Preiner has consistently seized opportunities for further development instead of simply treading water. "That's probably my motto for life," she says, laughing. And it is likely a trait she has in common with the origin of life on Earth.