

POLYKUM



ARTIFICIAL

DIMMING THE SUN

On Solar Geoengineering

DEFENDING ART FROM ARTIFICIAL

Human vs. AI

VON NAHEN UND ENTFERNTEN WELTEN

Im Gespräch mit Prof. Quanz



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EDITORIAL

The Art of Spring

The music in my headphones changed to Smetana's Moldau. I put down my 100 µL pipette, looked up, and, instead of the occasionally rainbow- and frequently sunset-reflecting windows of the HPK, saw a tree. The tree. It doesn't really bloom much or look particularly pretty or happy, but it does have a lot of branches, which in the summer occupy the happiest third of the field of view from my desk.

The tree was back in the picture, my picture. It was starting to grow leaves. And, in a second bit of astonishing news, it was still visible, determinedly and clearly. At 8 pm!

It had been a long lab day, one of many more long days to follow. But it was also Spring. It was officially the first sweet, warm, cozy, Bellini-colored and Aperol-inviting dusk. The first, also of many more. Allow Polykum to further sweeten one of these evenings for you.

This time, we bring you artificial people of ETH, an interview about life on other planets, a primer on adjusting the Sun's brightness settings for this particular planet of ours, and a little advertisement of a planet-moving art form.

Enjoy the sunshine, the music, the light, and the overall – very much not artificial – magic of Spring!

Lisa

Lisa Likhacheva, Redaktionsleitung Polykum
redaktionsleitung@polykum.ethz.ch

Das Polykum ist ein Magazin des

vseth Verband der Studierenden an der ETH

VSETH

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ARTIFICIAL

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Zum Titelbild

"Beginning of Life",
André Candeias
@andrecandeias_zh

PRÄSIKOLUMNE

Help us make ETH even better



Hello Readers!

I hope you're doing well, had a chance to recharge over the Easter break, and are ready for what lies ahead. I always find this week during the spring extremely valuable. Did you know that with PAKETH, we will have a week like this in autumn too? This is definitely one of the changes I am most excited about!

As I am writing this, the preparations for the Polymesse are in full swing. Polymesse, the VSETH Job Fair, promises four days of bustling activity in the main hall of the Main Building and a sprawling tent on the Polyterrasse. With over 150 companies to meet across three days, it's an event not to be missed. Mark next year's dates in your calendars: 01.04.2025 - 03.04.2025.

How are you? This is the question we ask in the new *wiegETHs* survey. VSETH and AVETH want to know more about how you are doing, and how we can better support you in your studies and work at ETH. Are your studies or work stressing you out? Is it too much stress? Do you have enough free time? Can you manage financially? Do you feel like you can be yourself? We really want to know how you are doing! Please fill in the anonymous questionnaire that was sent to you by e-mail this week, and help us make ETH a better and more welcoming place for everyone! Find more details on our website, or simply scan the QR code below. It only takes 13 minutes!

Our board is doing well. The past months have been full of ups and downs. We started off the semester with too few people on the board, while at the same time trying to keep everything going as usual. One of the happiest moments so far for me personally was walking down to CAB the first morning after we had filled every position on the board. Finally, we could focus on working on our projects instead of deciding which ones could go on pause! While it definitely wasn't always easy, it's the people running everything in the background that make it all worth it. VSETH is an incredible machine, and we can really do anything we set our minds to.

We have about 5 more months left on our term. However, the next general elections already takes place in June! If you are interested in finding out more about VSETH and potentially joining a team or even the board don't hesitate to get in touch with us via vorstand@vseth.ethz.ch. We look forward to hearing from you!

Love,
Julia



HOPO-KOLUMNE

The Importance of European Engagement for Students at ETH

On April 2nd, the Europe initiative was launched. For those of you who have never heard of it: the initiative wants to anchor clear, long-term goals of Swiss European policy in the constitution (<https://europa-initiative.ch/>).

By doing so, Switzerland can no longer isolate itself, but rather has to actively participate in politics concerning the whole of Europe, for instance European education and research. The initiative will support the current negotiations between the EU and Switzerland and, beyond this, will also ensure that future negotiations will take place.

But how does this initiative affect students? In this initiative, there is a constitutional mandate for Erasmus+, which makes the reassociation to the Erasmus+ network ever more likely. This would open new doors for exchanges and European collaborations, from which students studying in Switzerland have been excluded for the past ten years.

Why are such exchanges important? I probably don't need to explain this to you, fellow students. But I would nevertheless like to give two examples of European initiatives funded by the EU, which ETH is already part of and from which we profit greatly.

The first initiative is the IDEA League, a collaboration between five technical universities in Europe: Chalmers in Gothenburg, TU Delft, RWTH Aachen, Politecnico di Milano and ETH Zurich. These universities work on solving different problems within Europe concerning technical universities. They also offer summer schools and simplified exchanges between the universities for students. Check these out if you don't know them already (<https://idealeague.org/>)! Twice a year, there is also an exchange between the student associations of the universities, called IDEALiStiC. Each university in turn hosts delegations of students from the other universities and work on common problems concerning students studying in Europe. This exchange is also incredibly useful for the VSETH to see how other student associations work and what common problems we are confronted with, for instance housing shortage, sustainability on campus, and mental well-being. We have the pleasure of hosting IDEALiStiC in Zurich mid-April and we are already very much looking forward to the discussions and exchanges!

The second initiative is the ENHANCE Alliance, which ETH joined just recently. Ten technical

universities in Europe, including the ETH, are part of the alliance. One of the visions ENHANCE has is to make "One European Campus" through "European Education Pathways", a subject mapping tool that allows students to select courses across all educational offers of the partner institutions and thus promote a seamless physical and virtual mobility. Cool, right? The Alliance also offers certificate programs, summer schools and other learning programs. Check these out here: <https://enhanceuniversity.eu/educational-offer/>! Again, there is a Student Forum, where the student associations of the ten universities can exchange and discuss different topics, mainly focussing on exchange and on the European Education Pathways. The next Student Forum will take place in Warsaw in June, to which a delegation of the VSETH is invited!

As you can see, the ETH already has many connections with other European universities from which the ETH and its students profit greatly. These connections are extremely important to stay in contact with Europe and its universities, and to enhance education and research in Europe. The cultural and intellectual exchange is especially significant for students, as these insights can't be made simply by studying and thus expand the educational offer for students immensely. However, these alliances still don't replace the exclusion from Erasmus+ and Horizon, as these offer a much deeper integration into European education and research and make exchanges and experiences with many more universities in Europe possible!

For these reasons, let's keep our fingers crossed for the negotiations between the EU and Switzerland and, in the meantime, check out the Europe initiative!

VSETH PIN-UP BOARD

TEXTE VON ALIX LAWSON, GABRIEL MARGIANI, UASAZ BOARD, KAI VOGT, SALLY LIU, JULIA BARTEL & YITAO LI

VSETH



Umwelt- und Forstfachverein

UFO: UFORIA



UFORIA (previously known as UFO-party) is sending you to the Disco Galaxy! Prepare your glitter, grooves and moves for a night in the stars... There will be two floors to suit your taste, so you can dance in the Hits/Disco galaxy or rave in our Techno shuttle! Coming in creative outfits will be awarded a free drink. The sign-up on can be found on UFO's instagram page @ufo.ethz. We look forward to seeing you there!

UASAZ

Are you a student or academic looking to connect with fellow Ukrainians or friends of Ukraine in Zurich and whole Switzerland? Look no further! The UASAZ warmly invites you to join our vibrant community! We are always happy to welcome new regular members! Besides, our next GA is coming, so maybe you are eager to join our new board? For more information, follow us on Instagram ([uasaz_ch](https://www.instagram.com/uasaz_ch)) or visit our website ([uasaz.org](https://www.uasaz.org)) Your UASAZ Board

AFRICAN STUDENTS ASSOCIATION OF ZURICH (ASAZ): DEVELOPMENT LUNCH

We are thrilled to announce that our next ASAZ Professional Development Lunch will feature Moses Ojeisekhoba, CEO Global Clients and Solutions and member of the Group Executive Committee at Swiss Re. Moses started his career in insurance at The Prudential Insurance Company of America in 1990 and has worked in different companies around the world. He joined Swiss Re in February 2012 and was appointed Chief Executive Officer Reinsurance Asia, Regional President Asia and member of the Group Executive Committee in March 2012. In July 2016, he was appointed Chief Executive Officer Reinsurance.

Join us on Thursday, April 25, 2024 12:00 - 13:00, at ETH Student Project House Clausiusstrasse 16. Moses will share his professional journey, inspirations, and engage directly with students in a Q&A session. Register to secure your place via the link: <https://forms.gle/JfLwTNqty6VbXnfr9>. We would like to extend our warmest thanks to ETH4D and MAMA Mohama-Sani for generously sponsoring the food at this event. Save the date for an insightful lunch event with one of the reinsurance industry's luminaries. We look forward to seeing many of you.



TANZQUOTIENT: SPRINGBALL

Ready for an evening full of live music from Polyband and Macadamia as well as food, drinks and dance shows? On April 27, the Springball will take place! Dancers of all levels are welcome. Salsa and Bachata lovers – we have an extra dance floor for you! During the day there'll be a dance tournament and crash courses to get ready for the ball. Don't miss the chance to become part of our Opening Show or register as a helper (reduced price!). Tickets and further info here: <https://bit.ly/springball2024>



Zürcher Studierendenzeitung

ZÜRCHER STUDIERENDEN ZEITUNG

Bereits Max Frisch und Annemarie Schwarzenbach publizierten ihre ersten Texte in der Zürcher Studierendenzeitung. Uns gibt es bereits seit über hundert Jahren; sechs Mal jährlich berichten wir über alles, was man als Studierende wissen muss. Dafür sind wir laufend auf der Suche nach motivierten Schreiber*innen, Fotograf*innen und Illustrator*innen. Alle Infos zum Mitmachen oder gratis Abonnieren findest du auf zsonline.ch.



VSETH

HEAT: MOVE SOMMERBÖRSE

You need new sports clothes and equipment for summer? We've got your back ;) Come to our Move Sommerbörse, where you can find everything you need for this summer. From swimsuits, hiking clothes, biking equipment to casual sportswear, we have it all. Everything is highly reduced up to 50%. We (the Move Sportshop) are looking forward to see you!

Where: HXE Höggerberg | When: 6.-8. May from 9:00-18.30 | Who: everybody is welcome :)



THEATERGRUPPE AKTIV

Brauchst du ein wenig Kultur, Unterhaltung, oder eine Stechpalme? Dann komm zum Bühnenspiel nach «Die Unbekannte aus der Seine» von Ödön von Horváth, eine (Tragik-)Komödie über Konventionen, Schicksalsfügungen und die Schwierigkeiten des Miteinanders. Gespielt von der Theatergruppe aktiv. Begleite uns in eine Welt, wo eine einzelne Rose das Glück entscheiden, und auch ein Mord bedeutungslos sein kann. Aufführungen 3.5. bis 25.5. Mehr Infos und Ticket-Reservation auf www.aktiv.ch

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False Friends

All my friends are fake!
 And I'm in need of serious help
 They've left me with a terrible heartache.
 Everything is a mess, and my life is in pieces
 I asked my Chef to cook me a meal
 And there went my salary increases.
 I must confess, I am completely stumped
 My brother didn't appreciate his birthday Gift
 And instead had to get his stomach pumped
 Even my girlfriend (whom I thought my fiancé)
 She said we weren't engaged, and thought
 The ring just a present, much to my dismay.
 My finances are in a pitiful state
 My landlord has thrown Kaution to the wind
 (For something as trivial as a broken gate)

Things at home aren't much better either,
 The sopa in my bathroom smells like meat
 And the carpeta on the floor is far too small
 I've thrown in the towel now, I concede defeat!

My vaso can't fit any roses
 Sadly, incidents like these
 Are now what my life imposes
 My cartas are constantly declined
 The libreria refuses to lend me books
 I've been outcast, ridiculed and maligned

I've resolved to move away
 In search of quiet tranquility
 A life without friendship can be
 A lonely affair, that much is true
 But no friends are better, you see
 Than having those you thought you knew

Gaurav, Msc. Energy Science and Technology,
 enjoys making people laugh.

Deriving the Future from First Principles

Imagine yourself at the head of a successful, multinational corporation. You call all the shots, you bear all the responsibility. You are at the pinnacle of your career and you have earned your way up there through hard labour and good decisions. Clearly, your excellent ETH education has provided you with the basis for success, and the rest you were smart enough to pick up along the way. Clearly, right?

Since the days of Newton, human knowledge has doubled roughly every 17 years. This means that by the time you have climbed the corporate ladder, the knowledge needed to run this company will have roughly quadrupled compared to when you joined. This assumes you stay with the same company for your entire career. In effect, you will answer hardly any of the questions you ask yourself as CEO with the knowledge you learned during your university degree. This does not even take into account all the training which by then has become obsolete. In short, why not let the pizza-delivery guy run the company for a fraction of your salary?

Against the Obsolescence of your Knowledge

First of all, you will have probably gained at least some inside knowledge during your time at the company that will have escaped even the most astute pizzaiolo. Ideally, you will have continued to learn well into your middle age and, at least when employed by any sort of technical company, will have kept up with most of the developments in your business area. Secondly, the particular knowledge you have acquired here at ETH (ideally) will have fared much better than the mean of knowledge overall. Note that while most of what was known at the time of Newton is now obsolete, Newton's own laws remain as relevant as ever. By focusing on fundamentals, you will not only increase the half-life of your knowledge, but also develop the ability to pick up emerging fields once you encounter them. But do not be fooled: The simple and brutal truth of how knowledge accumulates means that most of the dominant technologies during your heyday do not yet exist today.

Leif 4+3,21,

is currently studying interdisciplinary sciences in his Master and should probably think at least as much about his own future as he does about the future of fibre optics.

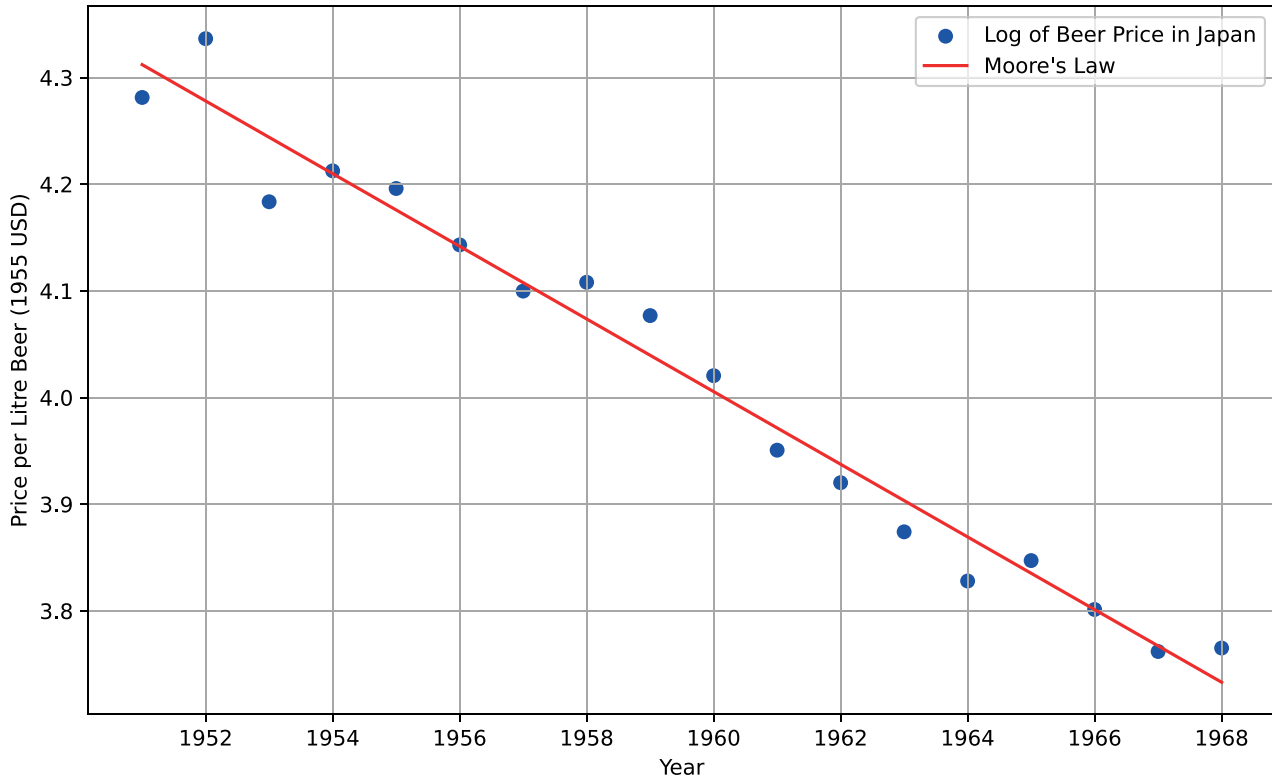
The Future comes with Change

This is no simple task. During your career you will inevitably encounter a large number of new ideas, most of which will appear absurd, some of which will come to substantially impact society. Given this, you have neither the luxury of ignoring all of these ideas outright nor of pursuing every such "crackpot" idea, lest you never get anything done at all. Fortunately, the future is not entirely arbitrary. It is both true that we can shape what the future will look like and that much of these developments will be determined by trends beyond our control. In hindsight, the past always seems obvious. Obviously, smartphones did replace landlines. Obviously, transistors did replace vacuum tubes. Obviously, cars did replace horses. These developments seem obvious because we understand their underlying mechanism, we understand why one technology is superior to another and how this technology could become more relevant than its predecessor. At least some of this knowledge we have now also must have been available back when these technologies were first discovered. By learning what mechanisms have lead to technological change in the past and by understanding which fundamental constraints exist today, the loop invariants of history so to speak, we may have a chance at finding these few, life-altering technologies that are emerging at any point in time.

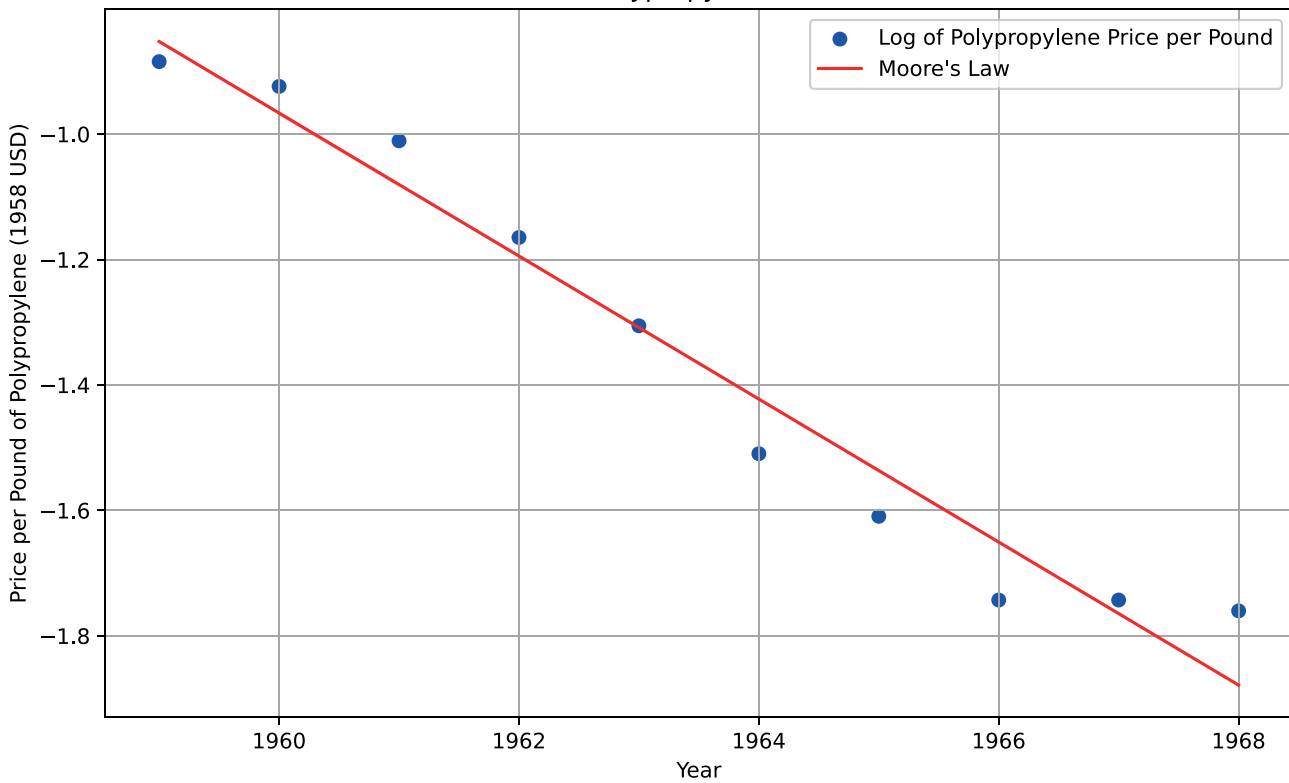
Possible? Likely? Desirable?

Equipped with our first principles, we can make some informed decisions today about what is to come. Richard Hamming (1915–1998), an important early computer engineer, dedicated 10% of his working time (Friday afternoon) to understanding the future of computing. As he describes in his 1996 book *The Art of Doing Science and Engineering*, when Hamming was asked to participate in a seminar on the topic of fibre optics in the 50s, he considered whether he should attend at all. In the end, Hamming found five reasons to attend the seminar:

Price of Japanese Beer over Time



Price of Polypropylene over Time



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Mit Vorsprung in die Zukunft

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- CAS Advanced Statistical Data Analysis
- CAS Industriedesign, 3D-Visualisierung und Animation



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19. Juni 2024

1. Optical frequencies are much higher than electronic ones which equates to a higher bandwidth, i.e. more information per second.
2. Alexander Graham Bell himself had already sent telephone signals through a light beam, so the technology is fundamentally feasible. Glass fibres are also relatively easy to manufacture.
3. As the speaker at the seminar remarked "God loved sand, he made so much of it." Glass is a cheap material compared to copper which was becoming scarce at the time.
4. In Manhattan, the telephone wire ducts were already running out of space. Because fibre optics are smaller, you could replace the telephone wires with smaller cables to increase bandwidth without having to dig up the street.
5. Optical fibres are difficult to tap and can withstand an atomic bomb much better than electronic wires, therefore, the US military is likely to put its support behind this technology.

When looking at the future, Hamming begs us to ask three questions: What is possible? What is likely? What is desirable? Optical fibres hit all three marks and Hamming (correctly) predicted that fibre optics would become the most common type of information-carrying wire. Hamming also immediately identified a fundamental challenge: How can glass fibres be joined together without loss of signal compared

to the easy soldering required for copper wires? Over time, the sheer number of possible technical solutions proposed to "splice" two glass fibres together convinced Hamming that at least one solution would also work in the field, where it had to be done by technicians under adverse conditions and not by scientists in a controlled experiment.

During his career, Hamming had to repeatedly keep up with such developments as his lifetime not only coincided with the most rapid advancements in computer hardware, but also because he spent much of it at a place where a particularly large number of these innovations were made, the Bell laboratories. Hamming might have been uniquely good at this. His 1996 book even contains two, now prescient-seeming, chapters on AI. The amount of time he could (and should) dedicate to predicting the future was probably both the privilege and the curse of his position at Bell laboratories. Hamming actually repeatedly turned down promotions into managerial positions, which he later came to regret: "I was not doing my duty by the organization. That is one of my biggest failures."

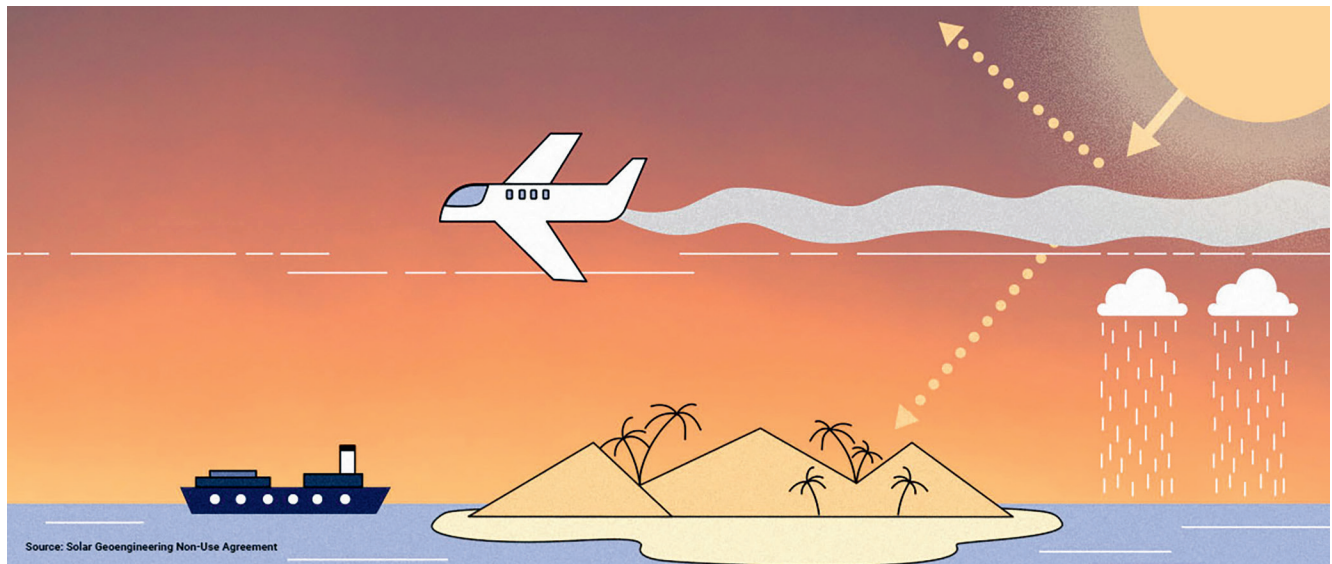
The Exponential Growth in Everything

Predicting the future is evidently impossible in many cases. Often, we can at least give a range for what might happen. Some things do however generalize, such as the famous Moore's law, which states that the number of transistors on a computer chip doubles every two years. This might seem like a rare finding, but actually most new fields experience such exponential growth. The production of beer in Japan, for example, or the cost of offshore gas pipelines. Much of this can be understood by the much less famous Wright's law which states that every time the production of some product has doubled, the cost of producing it has increased by some fixed percentage. Wright, who (confusingly) is unrelated to the Wright brothers, found this result while analysing the price of airplanes, where every doubling of the number of airplanes reduced the labour requirement by 10-15%. Essentially, the more you build, the more you learn about your product and the cheaper it is to produce it. Such exponential scaling laws are so ubiquitous that Sam Altman, the founder of OpenAI, even published a blog post entitled "Moore's Law for Everything" in 2021 outlining his view of a world in which AI accelerates most tasks.

It is possible, somewhat likely and, as this column hopefully convinced you, desirable that ETH will in the future hold a lecture on "Deriving the Future from First Principles." As a humble suggestion from our current state of things, a tentative syllabus could look something like this:

To Hamming, the purpose of this exercise was ultimately to get a sense of direction while we are inevitably stumbling into the future. Without a vision, one is forced to simply react to what is happening. As he himself put it: "The drunken sailor who staggers to the left or right with n independent random steps will [on average] end up about \sqrt{n} steps from the origin. [...] In a lifetime of many, many independent choices, small and large, a career with vision will get you a distance proportional to n ." Those who look ahead at least know where they are going.

	Lecture	Reading
Week 1	Optical Computing	MacMahon, <i>Nat. Rev. Phys.</i> 2023
Week 2	Quantum Sensors	Aslam <i>et al.</i> , <i>Nat. Rev. Phys.</i> 2023
Week 3	Human Brain Interfaces	waitbutwhy.com/2017/04/neuralink.html
Week 4	Astromining	O'Leary, <i>Science</i> , 1977
Week 5	Cancer Vaccines	Fan <i>et al.</i> , <i>Signal Transduct. Target. Ther.</i> , 2023
Week 6	The Methanol Economy	Olah, <i>Angew. Chem.</i> , 2005
Week 7	Automated Science	Abolhasani and Kumacheva, <i>Nat. Synth.</i> , 2023
Week 8	Nuclear Fusion	youtube.com/watch?v=L0KuAx1COEk
Week 9	Engineered Life	Lazebnik, <i>Cancer Cell</i> , 2002.
Week 10	AI for Material Prediction	Aspuru-Guzik <i>et al.</i> , <i>ACS Cent. Sci.</i> , 2018
Week 11	DNA Data Storage	Goldman <i>et al.</i> , <i>Nature</i> , 2013
Week 12	Room-Temperature Superconducting	Castelvecchi, <i>Nature</i> , 2023
Week 13	Cloud Brightening	Latham, <i>Nature</i> , 1990
Week 14	Solid-State Batteries	Goodenough and Kim, <i>Chem. Mater.</i> , 2010



Source: Solar Geoengineering Non-Use Agreement

How one could artificially dim the Sun

Could we dim the Sun?

We know that a change of more than 1.5 C in global temperatures would be disastrous. To even have a 50% chance of limiting the increase to the 1.5 C, we need to get to net zero emissions by 2035. Or, there's also a band-aid solution to save, or at least pause the fire in, our rapidly heating house.

On Midsummer's Day in 1991, the citizens of the Philippines witnessed the second-largest volcanic eruption in the 20th century. Mount Pinatubo released ash columns 40 km high into the atmosphere, along with tremendous amounts of hot gas and volcanic matter. In total, the eruption expelled more than 5 km³ of volcanic material (about 1.3 times the volume of Zurich Lake), with temperatures of up to 1,300°C. Furthermore, volcanos like these are known to belch out massive amounts of water vapor and CO₂, both known greenhouse gasses, into the atmosphere. And yet, in the aftermath of the eruption global temperatures would drop by about 0.4°C from 1991 to December 1992.

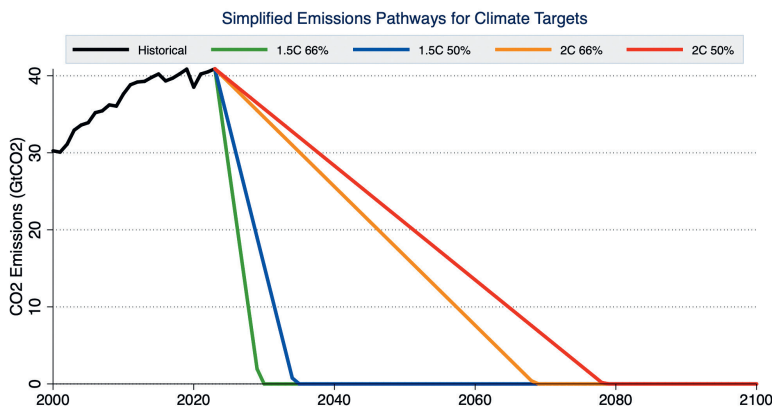
The Earth's Radiation Budget

Just like the cup of coffee that has been sitting on your desk for too long, the Earth is in thermal equilibrium with its surroundings.

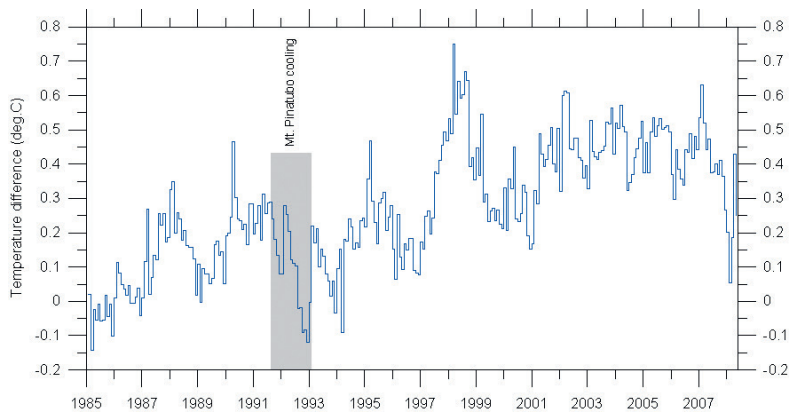
The sun constantly bombards us with photons, injecting energy into the planet, which is either absorbed or reflected. The Earth, in turn, radiates energy corresponding to its temperature, like a near-perfect black body. These energy fluxes (absorption, radiation, and reflection) keep the Earth at an average equilibrium temperature of 15°C, which is, you could argue, just as God intended. Climate change is simply a perturbation to one of these energy fluxes, which demands a new equilibrium. Unfortunately, if the new equilibrium happens to be even a couple of degrees above the status quo, it could come at a massive human cost.

To understand climate change, we must understand our radiation budget and all the factors at play in the intricate dance that is our climate system. One such factor is albedo, which can be thought of as the earth's reflectivity. It is measured on a scale from 0 (an ideal black body that absorbs all incident radiation) to 1 (total reflection of incident radiation). On this scale, the Earth falls at about 0.3. Snow has a high albedo, with the Antarctic snow cover averaging an albedo of 0.8. Climate models predict that seemingly small changes in the planet's albedo could have far-reaching implications for the average

Gaurav, Msc. Energy Science and Technology, called his friend to tell him that he had changed his mind about having kids when he first heard about solar geoengineering. His friend asked no follow up questions.



Emission pathways for climate targets by probability



The drop in average global temperatures caused by eruption of Mount Pinatubo

surface temperature. According to a researcher at the Lawrence Berkeley National Laboratory in California, changing the Earth's albedo by painting all the roofs and roads in the world white (about 2.4% of the earth's surface) would cool the earth enough to offset the warming caused by 44bn tons of CO₂. At first, it sounds like an extremely stupid idea, but if it results in the cancellation of more than a year's worth of anthropogenic CO₂ emissions, I think it no longer qualifies as one. But what does all this have to do with the volcano in the Philippines?

Sulfur Dioxide and Solar Geoengineering

Returning to the case of Mount Pinatubo, the thermal contribution of the enormous amounts of geothermal energy released was dwarfed by the reduction in solar irradiation caused by the eruption. The volcanic event injected large amounts of ash. And, more importantly, 20 million metric tons of sulfur were introduced into the stratosphere. While the ash is good at blocking the sun's rays from reaching the Earth, it settles down in a few days, and everything returns to normal. On the other hand, the sulfur oxides and dioxides combine with water in the stratosphere to form tiny droplets of sulfuric acid. These light, reflective droplets hang in the stratosphere for months and even years, increasing the albedo of the earth (just like white paint!) and cooling our planet. That explains the mystery of the

drop in global temperatures in the years following the eruption. The question that remains is: Can we use this effect to our advantage? And, if yes, should we, and will we?

The short answers to those questions are yes, probably not and most likely yes. Things are not going our way, as far as the climate is concerned. I am sure that most people reading this article know how badly we are doing regarding mitigating a climate catastrophe. It has been established that anything above a 1.5°C change in average global temperatures will lead to disastrous consequences for most life on the planet as we know it. Yet, as the graph above shows, to even have a 50% chance of limiting the average warming to 1.5°C, we would need to reach net zero emissions by 2035. Considering the current global trend of increasing yearly emissions, humanity has not even reached the summit of this mountain, let alone begun its descent towards a better future. This is why, in 2023, both the US and EU commissioned research into solar geoengineering, and scientists worldwide have begun to discuss the topic seriously. In the past, solar geoengineering has always been treated like a dangerously radical idea. Artificially dimming the sun without knowing the consequences on global climate patterns is playing with fire: one wrong move, and one's house burns down. But when the metaphorical house is about to catch fire anyway, perhaps every solution, even one as risky as managing solar radiation, starts to seem reasonable. So, how do we do it? If we, like a very efficient volcano, could inject just 1.2 million tons of sulfur into the correct parts of the stratosphere, we could cool the planet by about 1°C. The advantage of this plan is that it is incredibly cheap, costing only about 20bn USD per year. This also makes it accessible to any billionaire with sufficient funds, or the head of state of even a small country. It only seems like the logical choice to use this solution to pause global warming to 1.3°C until we are able to slash our emissions completely.

This is where we come to the house-burning-down effects of this technology. First, we do not have enough research to predict the effects on our complex climate system fully. It could disrupt weather patterns and cause extreme climate events if done incorrectly. Second, it would increase the incidence of acid rain and likely harm the ozone layer. Lastly, and probably the most likely, is the problematic effect the approach would have on human complacency. Solar geoengineering is far from being a sustainable long-term solution to anthropogenic climate change; it is a poorly fashioned band-aid that will stop the bleeding for now, while we regain our strength. And we should treat it as such. Once it is implemented, we will be on borrowed time. And if we do not honor our side of the climate bargain by reducing our emissions to zero, our brokered peace will not last long. If successfully implemented, solar geoengineering will surely be a landmark event for mankind. And dimming the star that we depend on for our existence in order to accommodate our needs does indeed feed into humanity's God Complex. I hope that we can play out our science-fiction fantasies in the best possible way, by implementing technologies only when they are backed by sufficient research and only to save our species from an extinction event.



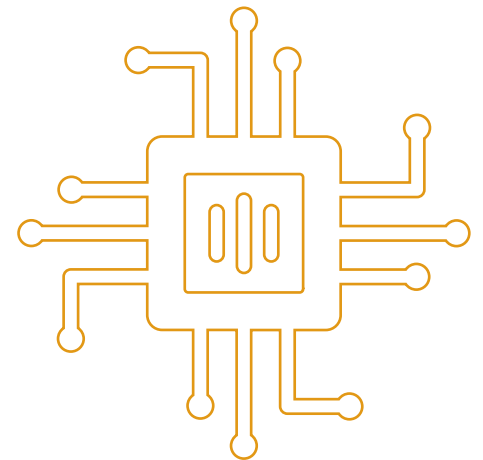
ARTIFICIAL PEOPLE OF ETH

How do you use AI in your research and your studies?

This time, we did what every self-respecting journalist student with a deadline has attempted at least once: we asked ChatGPT for help. Instead of asking the humans around us, we presented ChatGPT with the task of imagining what ETH students would have to say to this question. The prompts were always slight variations on “generate a written response to the question of “how do you use AI in your studies?” by an ETH student in [insert study direction],” followed by “come up with this person’s name,” and sometimes with the instructions to make the response longer, shorter, and/or more or less formal. We did some shortening, but no editing.

In my research, AI helps me analyze complex data sets in neuroscience. It's like having a brilliant assistant that can crunch numbers and spot trends faster than I ever could. But when it comes to studying for exams, I'm a bit cautious about relying too much on AI. It's tempting to let algorithms do the heavy lifting, but I worry about losing that critical thinking edge. So, I use AI tools to supplement my studies, not replace them entirely.

EMILY MÜLLER



AI is my best friend in my computer science research. From natural language processing to machine learning, it's the backbone of everything I do. I use AI-powered study apps to quiz myself and review material quickly. I figure, if AI can help me understand complex algorithms, why not use it to ace my exams? But I also think it's crucial to stay informed about the potential biases in AI and how they might affect our research.

SOPHIE SCHNEIDER

ARTIFICIAL

In my studies in architecture, AI plays a pivotal role in enhancing both the creative process and the analytical aspects of design. Utilizing AI-powered tools and algorithms, we're able to generate intricate 3D models, optimize building layouts for functionality and sustainability, and even analyze vast amounts of historical and environmental data to inform our design decisions. Beyond mere efficiency, AI empowers us to explore innovative design solutions that may have been previously unattainable. It serves as a catalyst for pushing the boundaries of architectural creativity while also addressing contemporary challenges such as climate change and urbanization. However, it's essential to maintain a balance between leveraging AI as a tool for enhancement and preserving the human-centric aspects of architectural design. While AI can certainly aid in streamlining processes and uncovering insights, it's ultimately our creative intuition and understanding of human needs that define impactful architecture.

MIA BECKER

Navigating the vast landscape of chemical knowledge often feels like scaling a towering mountain of facts and equations. Rote memorization is a necessary evil, but thankfully, AI has emerged as a trusty companion in this journey. AI-powered flashcard apps and quiz generators have revolutionized the way I approach memorization, transforming tedious study sessions into interactive learning experiences. With features like spaced repetition and adaptive learning, these tools tailor their approach to my individual needs, making the process more efficient and engaging. Moreover, AI extends its reach beyond memorization into the realm of data analysis in the lab. Whether it's parsing through spectroscopic data or predicting molecular structures, AI algorithms augment my research efforts by sifting through complex datasets and extracting valuable insights.

ALEX FISCHER

For my environmental engineering research, AI is a game-changer. It helps me model and predict environmental impacts with incredible accuracy. But when it comes to exams, I try to keep things old school. Sure, AI-powered study aids can be helpful, but I think it's important to develop our own problem-solving skills. Plus, there's always that nagging ethical question about bias in AI algorithms. So, I stick to good old-fashioned study groups and flashcards.

LUCAS KELLER

In the world of mechanical engineering, AI is like our trusty Swiss Army knife – versatile and indispensable. From optimizing designs to predicting maintenance needs, it's our go-to for tackling complex tasks. Personally, I rely on AI for crunching data, running simulations, and even designing smart systems that adapt on the fly. It's like having a savvy assistant in the workshop! But it's not all serious business. AI makes learning fun with interactive simulations and personalized study tools. It's like leveling up in a video game, but with real-world skills. Of course, we can't forget about ethics. We've got to keep an eye out for biases and transparency when using AI. Overall, AI is a game-changer in mechanical engineering, making our work easier and more enjoyable!

MARK JOHNSON



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*All individuals who identify as women, inter-, transgender and non-binary



In der Schweiz

Meine Motivation für den Weg in die Schweiz war der Ruf der ETH. Vor meinem Umzug hatte ich mich nie ernsthaft gesellschaftlich mit meinem neuen Wohnland auseinandergesetzt. Ich habe unreflektiert und ignorant angenommen, dass die Unterschiede zu Deutschland nicht gigantisch sein würden. Doch je länger ich hier lebe, desto deutlicher erkenne ich sie. An der ETH und im akademischen Umfeld sind diese durch jedoch weniger ausgeprägt. Das internationale Umfeld wirkt dem Schweizer Charakter entgegen.

Sprache

Meine wohl naivste Illusion war, Schweizerdeutsch als Dialekt des Deutschen klassifiziert zu haben. Jetzt würde ich schweizerisches Hochdeutsch als Dialekt bezeichnen, Schweizerdeutsch jedoch als eigene Sprache. Die Unterschiede sind so gross, dass ich anfänglich kein Wort verstand, wenn mein Gegenüber es nicht wollte. Die Gemeinschaft und der Stolz auf die eigene Sprache und Herkunft sind beneidenswert. In Deutschland ist ein solches Bewusstsein historisch bedingt nicht stark vertreten.

Obwohl viele Wörter weiterhin wie Verniedlichungen klingen, gefällt mir der Sprachklang im Vergleich zum Hochdeutschen besser. Um ein Teil der Gesellschaft zu werden, ist Schweizerdeutsch unumgänglich.

Intoleranz gegenüber Dysfunktionalität

Sehr interessant war, dass mit dem Verlauf meines Aufenthaltes die Verspätungen der SBB zugenommen haben. Ebenso ist die Bürokratie komplizierter und der Mobilfunk unzuverlässiger geworden. Doch die Systeme haben sich eigentlich nicht verändert – stattdessen ist mein Referenzpunkt nun die Schweiz. Wenn ich mich jetzt über eine Verspätung der Bahn beschwere, geht es um Minuten und nicht Stunden. In der Schweiz kann man auf viel höherem Niveau meckern. Das hat dazu geführt, dass meine Toleranz und mein Verständnis gegenüber den dysfunktionalen Systemen in Deutschland stark abgenommen haben. Wenn ich in der Schweiz auf einem Gletscher 5G Empfang habe, wie kann man in Deutschland im überfüllten Regionalzug ohne Auskunft und Mobilfunk liegen bleiben?

Menschen

Was mir zu Beginn gut gefallen hat, war die allgemeine Ernsthaftigkeit der Menschen. Graffiti an öffentlicher Infrastruktur ist schwer zu finden, öffentliches Palaver kommt selten vor und gedrängt wird fast nie. Doch die Stringenz isoliert. Alle leben mit sich selbst im Fokus; man möchte bloss nicht den Eindruck erwecken, die anderen wären interessant genug für die eigene Aufmerksamkeit. Dies macht es schwer, bestehende soziale Gruppen für neue Mitglieder zu öffnen. Doch gelingt es, ist das Miteinander besonders schön.

Deutschland & Schweiz

Gerade diese beiden Länder haben eine spezielle Beziehung, was man besonders auf individueller Ebene merkt. Eine besondere Erfahrung war, anderen Passanten Auskunft zur Orientierung zu geben. Antworte ich auf Hochdeutsch, schauen die sonst scheuen Leute sofort auf. Antworte ich auf Englisch, interessiert es niemanden. Dies ist natürlich sehr anekdotisch, doch es entspricht meiner allgemeinen Wahrnehmung, als Deutscher besonders aufzufallen.

Doch die Beziehung ist keinesfalls einseitig. Auch wenn es nicht direkt gesagt wird, hegen viele Deutsche das überspitzte Vorurteil der Schweiz als Land der «Schönen und Reichen». Der Ursprung ist klar: Die Strassen sind voll mit iPhones und teuren Autos. Während ausländische Produkte in der Tat relativ gesehen günstig sind, fehlt häufig die Reflexion, dass die hohen Lebenshaltungskosten das hohe Lohnniveau ausgleichen.

Dauerhaft in der Schweiz zu leben, kann ich mir bisher nicht vorstellen. Ausserhalb des akademischen Kontextes ist die Schweiz als Ausländer funktional, aber nicht einladend. Doch sobald man Schweizerdeutsch lernt, ist man verbundener und kann sich wahrscheinlich viel schneller integrieren.

Disclaimer

Dieser Artikel ist keine Positionierung des Polykums oder des VSETH. Es entspricht der persönlichen Wahrnehmung des Autors und soll Anreiz sein, sich mit internationalen gesellschaftlichen Unterschieden auseinanderzusetzen.

Simon Sure, 20, BSc Informatik,
probiert nach 1,5 Jahren Schweiz nun
auch noch Finnland, die Niederlande
und die USA als Wohnland aus.



Credit: NASA/Ames Research Center/Daniel Rutter

Eine künstlerische Darstellung von Kepler-1649c, der seinen Red Dwarf Wirtsstern umkreist. Dieser Planet liegt nahe genug an seiner Sonne, dass flüssiges Wasser auf seiner Oberfläche existieren könnte und ist der bis jetzt am Ähnlichsten zur Erde in Grösse und Temperaturen unter den Planeten in Keplers Datensatz.

Von nahen und entfernten Welten

Dr. Sascha Quanz ist Professor und stellvertretender Leiter im Institut für Teilchen- und Astrophysik. In einem Interview erzählt er von seiner Karriere, die über Consulting zurück zur Akademie geführt hat, von den Problemen im Schulsystem, und vom Leben, sowohl auf unserem Planeten als auch auf anderen.

L: Professor Quanz, sie haben zwei Jahre lang Consulting gemacht und sind dann zurück zur Academia. Können Sie erklären, wieso?

Q: Total bescheuert, ich weiß, das haben viele damals auch gesagt! Während des Studiums habe ich mal ein Internship bei McKinsey und Company machen können und danach direkt ein Angebot bekommen. Dann stand ich vor der Entscheidung: mache ich noch ein Doktorat oder nicht? Ich hatte das Gefühl, dass ich noch nie so richtig Forschung gemacht hatte. Ich habe mich also entschieden,

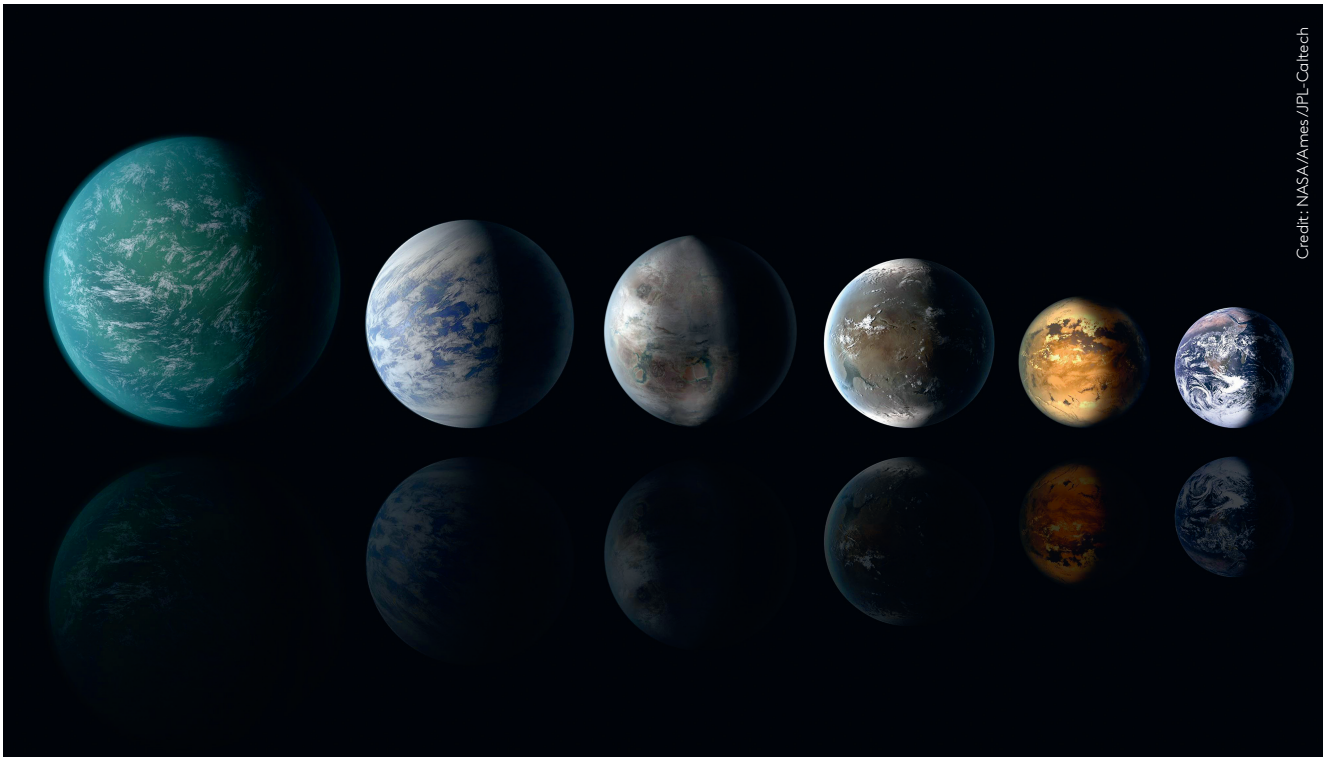
doch noch ein Doktorat zu machen, drei Jahre tief in die Astrophysik zu gehen. Aber ich bin mit McKinsey die ganze Zeit in Kontakt geblieben. Nach der Promotion habe ich wieder ein Angebot bekommen und mich dann relativ schnell dafür entschieden, es anzunehmen.

Es gab zwei Gründe. Erstens: Ich war mein Leben lang an Schulen, Unis und Forschungsinstituten gewesen und es war eine Chance, wirklich eine andere Welt zu entdecken. Ausserdem muss ich auch sagen, dass es damals in der Forschungswelt Sachen gab, die ich schwierig fand und mir nicht gefielen. Viele davon finde ich heute noch schwierig und gefallen mir nicht.

Ich bin also ungefähr zwei Jahre bei McKinsey gewesen. Es war super anstrengend, aber unter

Lisa Likhacheva und Léona Dörries

studieren beide Biochemie und stellen gerne welt- und planeten-übergreifende Fragen



Credit: NASA/Ames/JPL-Caltech

Ein Pantheon von Planeten, die sich in habitable Zonen befinden. Von links nach rechts: Kepler-22b, Kepler-69c, Kepler-452b, Kepler-62f, Kepler-186f und Erde

dem Strich eine sehr gute Erfahrung. Was ich dort sehr gut finde, ist, dass man drei, vier Monate an einem Projekt arbeitete und dann zum nächsten ging. So hat man die Möglichkeit, in ganz verschiedene Bereiche und Firmen hineinzuschauen. Was ist da jeweils die Kultur, wie wird geführt, was sind die Probleme? Das fand ich unglaublich bereichernd. Und ich fand auch gut, dass ich das suchen konnte, was ich tun wollte.

Irgendwann habe ich aber gemerkt, dass mein ursprünglicher Masterplan war, etwas mit Raumfahrt zu machen. Ich hatte ein bisschen gehofft, dass es bei McKinsey Klienten aus dem Raumfahrtbereich gab. Das war aber nicht wirklich der Fall. Damals war Raumfahrt immer noch sehr staatlich betrieben. Das heisst, es gab sehr wenig Beratungsbedarf. Ich konnte also meinen wissenschaftlichen Hintergrund mit Management im Raumfahrtbereich nicht zusammenbringen.

Dann wusste ich, dass ich wieder zurück wollte. Irgendwas mit Space an der Uni, und dann auch wirklich nur an einer guten Uni, wo man Möglichkeiten hat, in grosse Projekte hineinzukommen. Der einzige Grund, warum ich in Zürich gelandet bin, ist, dass meine heutige Frau ein Angebot für ein Jahr im Kinderspital bekommen hat. Ich arbeitete noch bei McKinsey und bin immer hin und her gereist. Dann ist ihr Vertrag verlängert worden. Und wirklich zufällig, in dieser Zeit, wo ich überlegt habe, wieder etwas anderes zu machen, gab es hier eine Forschungsgruppe im alten Astronomie Institut, die etwas in der Richtung gemacht hat, worin ich damals promoviert hatte. Ich habe mich beworben und war dann der erste Postdoc. So bin ich an die ETH gekommen. Ich bin meiner Leidenschaft gefolgt.

L: Aber warum Raumfahrt? Warum Space?

Q: Kann ich nicht sagen. Die Sachen, die wir erforschen – Planeten, andere Sterne – das hat ja auch mit Raumfahrt zu tun, mit dem, was da draussen ist. Das war schon immer in mir drin. Ich habe als Kind schon diese ganzen Bücher über Raumfahrt und Weltall gelesen. Meine Eltern hatten wirklich gar nichts mit Raumfahrt oder Physik zu tun. Man erzählt ja immer solche Geschichten aus der Kindheit, aber es war wirklich so. Als ich zum Studium ging, musste ich dann überlegen, ob ich Luft- und Raumfahrttechnik oder Physik studieren sollte, und habe mich dann für die wissenschaftliche Seite entschieden. Ich habe einen Onkel, der bei der Europäischen Raumfahrtagentur gearbeitet hat. Vielleicht war das ein Träger.

Das Grenzenlose hat mich an der Raumfahrt immer fasziniert. Kann man die Grenzen verschieben? Was ist da draussen? Was können wir als Menschheit leisten? Das Internationale habe ich auch sehr spannend gefunden. Ich habe ein Praktikum bei der ESA gemacht und da sass ich auf dem Korridor mit den ganzen Astronauten. Da waren Leute aus dem UK, Portugal und Schweden, und wir haben uns alle mit Technologien für Space beschäftigt.

L: Haben Sie sich nie überlegt, selbst ins All zu gehen?

Q: Doch! Absolut! Ich war nicht bei der letzten Auswahl von Astronauten dabei. Da wurde der Schweizer Kollege ausgewählt. Letztes Jahr gab es so eine Astronautenauswahlrunde, europaweit. Aber bei der Letzten vor knapp zehn Jahren war ich dabei!

L: Wirklich?!

Q: Ja, ich habe mich beworben! Ich war auch bei den

ersten Auswahltests. Aber irgendwann bin ich rausgefliegen. Sie haben auch nicht gesagt, warum. Ich habe nachgefragt.

Es war am Anfang schon ein bisschen schade, aber mittlerweile bin ich da ganz okay. Mein Schwiegervater meinte einmal: «Astronauten sind doch total langweilig. Es ist sowieso nicht so wie im Film. Du kriegst jeden Tag eine Liste, wo genau draufsteht, was du zu tun hast und wann. Du machst nur Sachen für andere Leute.» Darüber hatte ich nicht nachgedacht. Stimmt das nicht? Man macht nicht die eigenen Experimente. Man ist nicht Herr oder Frau seiner Zeit. Nein, man macht die Sachen, die einem die Bodenstation sagt. Das fand ich sehr nüchtern. Diese ganze Adventures und Romantik von Raumfahrt ist verklärt. Bei der letzten Auswahl habe ich mich also nicht beworben. Ich habe nicht mehr den Drang gespürt.

L: Wenn es um Astrophysik geht, wird oft sehr skeptisch gefragt: Was ist überhaupt der Punkt? Ist das nicht einfach Geldverschwendung?

Q: Ich glaube bei uns in der Gruppe sind wir durch eine fundamentale Frage getrieben: Sind wir allein im Universum? Das ist eine Frage, die astrophysikalische Messungen benötigt. Wenn man sich überlegt: Gibt es Leben da draussen auf anderen Planeten, die nicht in unserem Sonnensystem kreisen, sondern auf diesen Exoplaneten, die wir erforschen wollen? Momentan ist die einzige Chance, das herauszufinden, mit einer Art Teleskop und mit grossen Raumfahrtmissionen. Wir können noch nicht hinfliegen. Ich würde nicht sagen, dass das nicht möglich sein wird. Aber momentan ist diese einzige Möglichkeit das, was uns treibt. Ich glaube, das ist eine fundamental wichtige Frage, die eben nicht nur eine Frage der Astrophysik ist, sondern Implikationen für viele Bereiche – Philosophie, Religion, Ethik, Soziologie – hat. Sie hat auch eine gewisse Bedeutung dafür, wie wir uns als Menschheit verstehen.

Diese Frage ist auch sehr interessant für die allgemeine Bevölkerung. Auch bei Schülerinnen und Schülern hat sie einen hohen Stellenwert. Ich habe schon sehr viele frustrierende Gespräche mit jüngeren Leuten gehabt, die dann sagen: «Ja, diese Mission ist doch viel zu lange und kostet auch viel zu viel und das klappt doch nie mit der ESA.» Es ist unglaublich schade, dass man gar nicht mehr glaubt, dass man so etwas erreichen kann. Deswegen hoffe ich, dass wir mit solchen Beispielen zeigen können, dass man die «Let's try it! Let's do it!» – Mentalität haben soll. Kolleginnen und Kollegen aus den USA sind immer sehr pushy und bold, was in Europa eher weniger der Fall ist. Deswegen glaube ich auch, dass solche Visionen hilfreich sind, auch um zu zeigen, dass man diese Ambitionen auch in Europa haben kann. Und ja, vielleicht funktioniert es nicht, aber immerhin haben wir es probiert und wir haben uns nichts vorzuwerfen.

Was die Kosten angeht: Missionen und Raumfahrt kosten viel, objektiv gesehen. Aber ich habe mal so Zahlen herausgesucht, wie viel Geld in der Schweiz für Tabak und Alkohol ausgegeben wird. Oder auch wie viel Geld für Tierfutter und Haustiere ausgegeben wird. Ich möchte das alles gar nicht kritisieren. Aber wenn man es in Relation setzt, ist es verschwindend gering, was wir für Raummissionen brauchen. Wir müssen gar nicht erst mit Armee und Krieg anfangen. Ausserdem denke ich, dass gerade die Raumfahrt und diese Art von Forschung unglaublich viele Kräfte und

Kreativität freisetzen kann.

Die Leute, die bei uns mitmachen, werden natürlich nicht alle später in dieser Mission arbeiten und Forschende werden. Space und Astrophysik sind ein wichtiger Magnet für junge Leute für Engineering, Wissenschaft usw. Das ist ein Katalysator. Wenn wir den abstellen, schneiden wir uns langfristig ins eigene Fleisch. Denn wir brauchen diese Ingenieure und die Wissenschaftlerinnen und Wissenschaftler, um andere Probleme dieser Welt zu lösen.

L: Wie viele Planeten existieren, wo es hypothetisch das Leben gibt oder geben könnte?

Q: Das wissen wir nicht so genau. Der Kollege Queloz hat zusammen mit seinem Doktorvater 1995 den ersten Exoplaneten gefunden. Mittlerweile kennen wir über 5500. Aber die wenigsten davon sind so gross wie die Erde und haben den gleichen Abstand zu ihrem Stern. Grössere Planeten, die schwerer oder näher an ihrem Stern sind, sind einfacher zu finden. Die Detektionsmethoden, die wir verwenden, haben einen Bias dafür. Trotzdem gab es Missionen, gerade von der NASA, die uns erlauben, Aussagen darüber zu treffen, wie häufig so ein erdähnlicher Planet vorkommen kann. Die Unsicherheiten sind dann sehr gross, aber das hilft einem schon. Man kann dann sagen, vielleicht haben 10 oder 15% der Sterne einen erdähnlichen Planeten, vielleicht sind es 30 oder 50%. Man weiss auch, dass nahezu jeder Stern mindestens einen Planeten hat. Ganz witzig, Proxima Centauri, unser unmittelbarer kosmischer Nachbar, der aber immer noch 1.3 Parsec (oder vier Lichtjahre) entfernt ist, hat einen erdähnlichen Planeten mit ungefähr derselben Temperatur wie die Erde. Den können wir aber noch nicht analysieren, weil wir noch keine Technik haben, uns das anzuschauen. Statistisch gesehen spricht vieles dafür, dass es viele von diesen Planeten gibt. Vielleicht nicht jeder, aber zumindest mindestens jeder Zehnte, vielleicht auch jeder Fünfte könnte erdähnlich sein. Damit kann man schon mal arbeiten.

Man muss einfach nur sicherstellen, dass eine geplante Mission es einem erlaubt, auch im Worst Case, genug von diesen Planeten aufzusammeln. Wir schauen uns ausserdem nur die Nachbarschaft der Sonne an. Wir gehen jetzt nicht in andere Galaxien. Alle Sterne kennen wir eigentlich schon. Es gibt Kataloge, sie haben Namen, man kann sie mit dem nackten Auge am Himmel sehen. Und in 20 Jahren kann man dann sagen: «Schau mal, das ist nicht nur ein Stern, sondern der hat auch einen Planeten mit einer Biosignatur und der Stern aber nicht.»

L: Es gab in den letzten paar Jahren so viele Releases über UFOs. Ist irgendwas davon glaubwürdig für Sie?

Q: Ich glaube, dass das Wichtigste daran ist, dass man jetzt offen darüber diskutiert, um genau diese Frage zu stellen. Die NASA hat da etwas ganz Geschicktes gemacht. Sie reagieren jetzt sehr offensiv, damit es aus dieser mysteriösen Ecke herauskommt und sagen: «Lasst uns gute wissenschaftliche Techniken anwenden und schauen, ob was dran ist oder nicht.» Mein Verständnis ist, dass von diesen vielen Informationen oder Sichtungen man die allergrößte Mehrheit wirklich mit irgendwelchen anderen Dingen gut erklären kann. Es gibt einen Rest, wo man einfach noch nicht weiss, was es ist. Das heisst aber nicht,

dass das Aliens sein müssen. Es gibt einen schönen Spruch: «Aussergewöhnliche Behauptungen erfordern aussergewöhnliche Beweise.» Bevor man das heranzieht, da braucht es noch ein bisschen mehr.

L: Kann man aber der breiten Öffentlichkeit so was erklären – oder im Allgemeinen komplexe Konzepte, die ein bisschen kritisches und logisches Denken erfordern?

Q: Absolut. Wenn wir es nicht probieren, haben wir schon verloren. Wir müssen aus dem Elfenbeinturm heraus und wirklich offen diskutieren. Wenn wir das nicht schaffen, haben wir in der heutigen Zeit, wo so viel Fake News und Alternative Facts kursieren, eine Katastrophe. Wenn man Nachrichten schaut, denkt man sich schon manchmal: «Also, seriously? Echt jetzt?» Aber die Antwort darauf kann nicht sein, dass wir aufgeben. Ganz im Gegenteil, wir müssen mehr tun und mehr erklären, wie wir Sachen machen. Wir sollten alle, die in diesen Bereichen arbeiten – nicht nur Professorinnen und Professoren, auch Leute in der Gruppe, Studierende – immer wieder die Öffentlichkeit daran erinnern, dass es gute wissenschaftliche Praxis gibt, wie man mit Daten und Analysen umgeht, dass man nicht alles glauben muss, dass man Sachen hinterfragen kann, und dass im Internet nicht alles stimmt. Es gibt Alltagsdinge, wo die Leute gar nicht mehr wahrnehmen, dass da das Naturwissenschaftliche steckt. Zum Beispiel Handy, Funkwellen. Das ist Elektromagnetismus mit Strahlen. Wir müssen also versuchen mit einem Wohlwollen, mit positivem

Ansatz, diese Sachen einfach zu erklären. Mit Geduld und immer wieder. Das ist wichtig.

L: Ich habe gesehen, dass Sie einen Outreach-Event für Kinder gemacht haben: Traumberuf Forscher. Was war das Take-Away?

Q: Dieser Event war einer der besten Dinge, die ich je gemacht habe. Mein Take-Away war, dass wir ein Riesenproblem in unserem System haben. Die Kinder waren alle zwischen sechs und zehn. Mit Jungs und Mädels gemischt, übrigens. Das war das Erste, was mir wichtig war. Das zweite war, dass sie so interessiert und neugierig und kreativ waren. Das hat mich extrem, extrem fasziniert. Ich habe ihnen gesagt: «Als Forscher, da stellt man sich Fragen und möchte sie dann beantworten. Was habt ihr denn so für Fragen?» Da kamen fantastische Fragen wirklich aus dem Nichts heraus, völlig unvorbereitet.

Wie zum Beispiel: «Wo kommen denn die Kieselsteine am Zürichsee her?» Eine weitere war: «Was ist Wind?» Und einer hat darauf geantwortet: «Wind ist Luft, die es eilig hat.» Man steht dann da vorne und wundert sich. Wir schaffen es dann im Schulsystem und auch an der Uni, das alles herauszuprügeln. Der Fokus ist viel mehr auf aus meiner Sicht zu sekundären Sachen gerichtet, anstatt dass wir die Kreativität und Neugier der Menschen fördern und Raum dafür geben. Denn letztendlich braucht es genau das, um weiterhin Sachen zu hinterfragen und neue Antworten auf Probleme zu finden. Dieses Event werde ich nie vergessen.

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The Art(ifice) of Symphony

An attempt to pin down that most mountain-moving, universe-shaping, and otherwise Newton-defying form of music

The author of this column recently roped a very understanding friend into absorbing some Tchaikovsky at the Tonhalle. Having heroically survived and even expressed cautious enthusiasm about the experience, the friend asked a very dangerous question: "So, what exactly qualifies as a symphony?"

A Form, a Structure, a Mental Approach

The author of this column is pleased to report that her long answer was only a bit less laconic than that supplied by the illustrious Oxford Dictionary of Music. Usually able to provide categorical definitions with helpfully sharp and high philosophical fencing, for "symphony," the Dictionary goes on a lengthy excursion through the different permutations of "orchestral composition" the term had referred to in the course of history, only to ultimately throw up its metaphorical hands and say it "implies an attitude of mind, a certain mental approach by the composer." Try defining a molecule, "home," or a "system," and you rapidly run into the same kind of trouble: the idea is so familiar and palpably obvious, and yet its exact outlines are always just beyond your grasp.

So, what exactly is this mental approach, which seems to be the only feature – not, say, duration, or number of parts, or historical period, or something related to harmony or melody – that symphonies have in common?

The King James Bible translates "symphonia" from New Testament's Greek as "music" – in the sense of an instrumental performance, as opposed to dancing. The definition becomes slightly less loose in the 16th century, when "symphony" comes to designate a piece performed by any number of instruments greater than one, sometimes also including the human voice. The earliest "symphonies" are often a) instrumental music necessary for dramatic purposes in an opera (think illustrating a battle scene, or providing an appropriately rousing introduction to the action, as an overture, a.k.a. *sinfonia avanti l'opera*), or b) a form of entertainment for an aristocratic audience – sometimes prevented from seeing an opera by financial or geographical constraints, sometimes just curious for something else. For a while, these two possibilities aren't mutually exclusive: instrumental music conceived originally for entertain-

ment in its own right gets appended to operas; overtures get arranged for a smaller number of players or just recycled and played in concert.

From Quantity to Quality

By the end of the 18th century, over 16'000 works qualifying as "symphonies" by these criteria have been composed. However, a contemporary stage performance of a few of these works wouldn't make for the most cathartically memorable experiences is correct. Unless the calendar shows "1761," and the now-29-year-old Austrian wheelwright's son, who had spent many of his earlier years barely making ends meet through some form of musical production or another, gets a job at the court of a Hungarian prince. The 29-year-old in question is Joseph Haydn, and the prince is Nikolaus Joseph Esterházy – an amateur musician himself, a patron of the arts, and the owner of a Hungarian Versailles with the cultural facilities any modern European city would be lucky to have: two theatres (one for operas, one for marionette plays) and two concert venues (one for an orchestra and one for chamber music). As Kapellmeister – a position Haydn actively occupied for almost 3 decades – it was his responsibility to supervise one opera and two concerts a week, daily chamber music for the Prince, and special performances for illustrious guests. Hence, the gigantic output of 75 symphonies, 20 operas, and dozens of smaller pieces. These 75 aren't among the first symphonies to be written, not even the first several thousand. And yet, it's not without reason that Haydn is known as the "Father of Symphony." What certain other innovators had tried before, Haydn solidifies and serializes: his instrumental music is increasingly sophisticated and high-quality. So much so that this music's prestige started to eclipse that of opera, the previous go-to art form for cultural exhibitionism practiced by European courts.

This trend sticks, instrumental music has now developed a heretofore unthinkable "precise and powerful expressive potential" (Richard Taruskin). Forget opera, forget words. Deep meaning can now be conveyed with a much broader arsenal of tools: tonality, shifts from one key to the next, themes and how they interact with each other in the broader context, and so on ad infinitum. Thus, the phenomenon that Martha Argerich – one of the great pianists still alive – describes: "There are things we don't see but that are there. Words can never describe how something really is, but music can."

Lisa Likhacheva, 23, MSc Interdisciplinary Science (Biochemistry), takes the "culture" in "cell culture" seriously – is convinced, that cells grow fastest and Western Blots work best to Rachmaninov piano concertos.

Bigger, Better, Brighter

As soon as it gets expressive powers enough to occupy an audience’s attention for a protracted while, symphony-as-a-mindset keeps growing. Haydn went on to compose a total of 107 symphonies; Mozart was influenced by Haydn, and Haydn was influenced back by Mozart. Some conventions for “classical” symphonies emerge: there’s a more or less standard number of 4 parts (“movements,” in musical language), which usually progress from energetic to melancholy to happy again in a customary order. Inside the movements, there’s usually a set number of themes introduced, then developed, and then recapitulated in a specific fashion. And yet, even while they’re in the process of emerging, these rules immediately get subverted—often by Haydn himself.

And then, we get to Beethoven. Symphonies further increase in length (Haydn and Mozart had already extended to half an hour what had been 10-15 mins before; with Beethoven’s Ninth, we get to over an hour) and in size (Beethoven’s Ninth requires a choir and ~80 musicians vs. ~30 necessary for a Haydn symphony). There are melodies and motifs that inevitably induce goosebumps (TadadaDA, dadadaDA), and some are also eminently hummable. It gets loud, it gets expressive; and the whole (now decidedly longer) experience of listening now unmistakably reeks of the transcendental. From this, symphony-as-mindset never really goes back.

Harmonic experiments continue (with Nielsen, or Mahler, or, much later, Stravinsky). Sympho-

nies continue expanding in dimension (Mahler’s 8th, in its original conception, requires 858 singers and 171 instrumentalists; (also) Mahler’s 3rd takes at least 90 mins). There are now more movements (Brahms does five; Mahler does six). The happy-sad-happy progression gets upended (with Tchaikovsky, and, of course, Mahler). Literary programs get attached, then withdrawn, and then sometimes agonizingly attached again (Beethoven starts; Liszt, Mendelssohn, and Berlioz continue; Mahler also continues, but remains torn).

Most importantly, symphony-as-mindset, symphony-as-worldview persists as philosophy in its purest and probably most beautiful form.

Try it!

Allow me to do what any appropriately determined editor would recommend: show instead of just telling. Look these up on YouTube, Spotify, or any other musical repository of your choice!

1. Mozart, Symphony No. 40
2. Beethoven, Symphony No. 5
3. Mahler, Symphony No. 4
4. Tchaikovsky, Symphony No. 4
5. Brahms, Symphony No. 4
6. Schumann, Symphony No. 4
7. Dvorak, Symphony No. 8
8. Mendelssohn, Symphony No. 4
9. Schubert, Symphony No. 8

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Defending Art from Artificial

In the face of image generating AI models, artists and designers around the world are confronted with life changing questions as society re-contextualises its relationship with art. In this article, our author takes us between the thin but meaningful boundaries between human and artificial, the individual and capitalism, history and a possible future for the industry.

Lingering for centuries, the definition of art has been debated. The rise of AI-generated art reignited the conversation. While some are skeptical of whether AI creations can be considered true art, human-made art will retain immense value in the future, just as it has throughout history.

Art has long been considered the pinnacle of human expression. It transcends aesthetics, holding profound cultural and historical significance. Traditionally, art has been a reflection of society and its values.

The emergence of generative adversarial networks (GANs) marked a significant turning point for digital art. GANs leverage deep learning to discern aesthetics from extensive image datasets for increased efficiency. This enables the system to autonomously generate new images that adhere to learned aesthetic principles from countless datasets for images and art. However, the emergence of the art generation software blurs the line, making the artistic process feel somewhat redundant.

Art in a historical context

However, creativity isn't just about producing an image; it's about the freedom of expression and the artist's unique perspective. Some say art lies in the creation process itself, while others emphasize the viewer's interpretation. Human creativity thrives on context. Even the most outlandish prompt fed to DALL-E would be based on human experiences and carry specific meanings. AI might require an unfathomable amount of data encompassing the entire spectrum of human experience to truly understand and fulfill such prompts.

All art builds upon what came before; every artist is a student of art history and its movements. This constant dialogue fuels creativity and contextualizes new works. The biggest challenge for AI isn't replicating existing styles; it's about pioneering entirely new art forms and movements that redefine the

very concept of art. Consider Cubism, initially ridiculed for its radical departure from traditional forms. Only after our aesthetic sensibilities adjusted, thanks to movements like Impressionism, did we appreciate Cubism's groundbreaking nature. Innovation starts disruptive and unexpected, eventually becoming a familiar part of our artistic landscape.

This artistic evolution is deeply intertwined with social, political, and cultural contexts. It's a complex process that can't be captured by software simply analyzing the brushstrokes of Van Gogh. The act of creation extends beyond the canvas. Van Gogh's paintings were the concrete expressions of a singular individual pushing artistic boundaries. This line between technological feats and genuine creativity is crucial.

Humanity sits outside AI's canvas

"The Next Rembrandt", a computer-generated painting developed by several computer scientists and developers at Microsoft, TU Delft, and some other firms, was an attempt to "understand the relationship between art and algorithms". Rembrandt van Rijn is regarded as one of the best European painters, defining the Golden Age of Dutch painting. If "The Next Rembrandt" is viewed based on mechanical features, such as colors and brushstrokes, the AI image looks indistinguishable from the very idea and imagination of Rembrandt's work. While it is impressive that a computer program can replicate Rembrandt's artistic vision and physical attributes, it reinforces our existing idea – AI can replicate, duplicate, or imitate. German Philosopher Dorothea Winter writes, "We need to understand how creativity manifests in human life before evaluating if AI can replicate it. DALL-E may generate impressive, seemingly original works based on keywords. However, from a philosophical standpoint, it doesn't create autonomously. DALL-E essentially remixes existing elements, no matter how sophisticated or visually stunning the results may be." This freedom, this autonomy, is essential for artistic expression. In other words, AI can not imagine or innovate, for therein lies an absence of freedom and hence, an absence of creativity.

Furthermore, art, at its core, has something metaphysical, a uniquely human quality. It's about



Credit: Wikimedia Commons, ING Group

"The Next Rembrandt" was generated by AI based on 168,263 Rembrandt painting fragments and consists of over 148 million pixels.

expressing emotions, experiences, and the artist's worldview. Consider the works of Saadat Hasan Manto, his searing satire reflecting the brutality of India-Pakistan's partition, or Picasso's *Guernica*, a powerful response to the Spanish Civil War. Such art evokes a deep human connection, forcing us to confront the artist's context and beliefs, forcing us to interpret the artistic expression. On the other hand, AI art risks stripping away these emotional nuances and historical significance – pretty sure that the neural networks we train cannot feel.

AI may be able to mimic artistic styles, but it lacks the human experience and the capacity for true creative expression that will forever elevate human-made art. AI knows all the words but not the song.

This is important because all technological innovations, including art generation by AI, are positive as standalone.

AI in a capitalist context

Ideally, this technology should lighten artists' workload, most of whom work wage jobs for companies requiring them to produce great amounts of graphics, animations, videos, text, etc., but we are collectively let down by the shackles of capitalism. Technology should be used to help the worker. The problem is that technology is used against the worker: Instead of reducing the workload, it's used to reduce the workforce and wages. According to the Arts Workers Japan survey, 58% of Japan's illustrators and writers

are fearful of losing their jobs to AI. Similar surveys show a huge number of creative jobs being cut in the upcoming years.

No matter how you look at it, the advent of AI-generated art will disrupt the bottom line for a lot of artists, especially in the digital domain. Independent artists, who already struggle to protect their style from being poached on by human competitors, will now be exposed to models scraping the internet. Artists employed by studios would be at serious risk of being laid off and replaced by models that do the grunt work for longer hours and at a lesser cost. Investment would naturally flow towards purchasing the computing resources and developing the most reliable models, and therefore away from the hands of original artists. What is bland and what caters to the lowest common denominator tends to dominate the popular market in a winner-takes-all economic system, and AI is far better equipped to find an optimal solution for a particular artistic 'product' than humans. Designers who are trained in the sector would still be needed to provide some creative directions to the models working on a project, but the development of the next generation of maestros will be stunted if the jobs that act today as steppingstones are swept away. In conclusion, many of the values that we attach to art today: originality, authenticity of emotion, and sociopolitical relevance, are human values and face serious threats from the development of AI-generated art.

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Could you please explain the concepts of niches and nestedness
to a non-biologist?

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<definition of niche that uses the word "niche" 27 times>
<definition of what nestedness is not >

 **You**

Could you please simplify your response?

 **Assthat GPT**

~no~: p~educate yourself~ '...' I will neither simplify,
nor elaborate, further ;)

 **You**

I would really appreciate your help. My project is about
drainage reorganization and riverine fish intraspecific
genetic diversity...

 **Assthat GPT**

What about birds?

© GTV 2024

Gabrielle Vance, 34,
Earth Sciences Doctorate,
is an expert in artificial stupidity. See more
cartoons on Instagram: @gabrielle_t.v.



The advertisement features a background image of a woman driving a car at night. A red circular call to action in the top right corner says "Jetzt abonnieren!". The main text "filmingo" is in large yellow letters, with "Streaming für Filmfans" below it in white. At the bottom, there is a row of movie posters including "The Driven Ones (2023)", "Drunk Another Round", "Fallen Leaves", "Anatomie d'une chute", "Triangle of Sadness", "The Duke", "Nawalny", "Sundown", "About Dry Grasses", and "Perdidos en la Noche". At the very bottom, there are logos for the App Store, Google Play, and blue TV, along with the website "www.filmingo.ch".



Cultural Calendar

The Kulturstelle gives you access to the best of culture Zurich has to offer – and at student-friendly prices. Would you like to spend an evening at the theater? Curious what a classical-music concert sounds like? Looking for date ideas? Want to spend an interesting evening with friends or meet new people who are as crazy about Brecht, Beethoven, and/or ballet as you are? The Kulturstelle has got it all planned for you.

Book your ticket at www.kulturstelle.ch/en/events/.

*Thursday, April 25th, 19.30, Tonhalle.
Kulturstelle Tickets at 15 Fr.*

LUCAS & ARTHUR JUSSEN PLAY MOZART

How often do you get to hear a concert with two pianos? Add to this the fact that the duo has been playing together for over 15 years and is composed of two brothers (both of whom studied with one of the most illustrious living pianists, Maria João Pires), and you get a very special concert experience. In addition to the fun and sparks of the Mozart concerto for two pianos, you will also be in the excellent hands of Jan Willem de Vriend, a seasoned early-music conductor, for an orchestral work by one of Johann Sebastian Bach's sons, Johann Christian, and Haydn's 104th (and last) symphony.

*Thursday, May 2nd, 20.00, Schauspielhaus (Pfauen). Kulturstelle
Tickets at 10 Fr.*

BLUTSTÜCK

Kim de l'Horizon's Blutbuch was a much talked-about phenomenon in its own right. This autofiction concerned with the non-binary identity of the narrator, transgenerational trauma, memory and lack thereof (among many other things) took eleven years to compose and garnered the Swiss Book Prize and German Book Prize. Now, Leonie Böhm, known for radical adaptations of classics, turns Blutbuch into Blutstück. Expect interesting provocative imagery and big questions, similar to what the Schauspielhaus preview teases: "If we are connected to everything, then surely, we can change, can't we? So how do we get everything back in motion?"

Saturday, May 25th, 19.30, Opernhaus. Kulturstelle Tickets at 25 Fr.

L'ORFEO CONDUCTED BY OTTAVIO DANTONE

Written in 1607, L'Orfeo was one of the first musical fables that were soon to become – or, depending whom you ask, might have already become – opera. In any case, the story could hardly be more operatic. Orpheus endeavors to rescue his beloved Eurydice from the underworld. To that end, he uses his superpower, music. With his singing, he puts a villain to sleep, makes his case to the queen of Hades, and ultimately makes even Apollo aware of his troubles. Expect intense emotion, beautiful melodies in the staging that will be making its première in May.

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HERAUSGEBER

VSETH, Verband der Studierenden an der ETH,
Universitätstrasse 6, ETH Zentrum CAB, 8092 Zürich,
vseth@vseth.ethz.ch, vseth.ethz.ch

REDAKTION

Polykum, Zeitung des VSETH, Universitätstrasse 6,
ETH Zentrum CAB, 8092 Zürich,
redaktionsleitung@polykum.ethz.ch,
vseth.ethz.ch/polykum/

REDAKTIONSLEITUNG

Léona Dörries, Lisa Likhacheva, Sabrina Strub

REDAKTION:

Anja Wullschlegler, Gaurav Singh, Léona Dörries, Lisa
Likhacheva, Sabrina Strub, Samira Neff, Sevim Kahya

AUTOR*INNEN

Gabrielle Vance, Gaurav Singh, Leif Sieben, Léona
Dörries, Lisa Likhacheva, Ritvik Ranjan, Simon Sure,
Sophie Schulz

TITEL:

Artificial

LEKTORAT:

Vanessa Casertano

GRAFIK KONZEPT/LAYOUT

Lorena La Spada, hello@lorenalaspada.ch,
in Zusammenarbeit mit Studierenden der ETH Zürich

ADMINISTRATION:

Vanessa Casertano, info@vseth.ethz.ch

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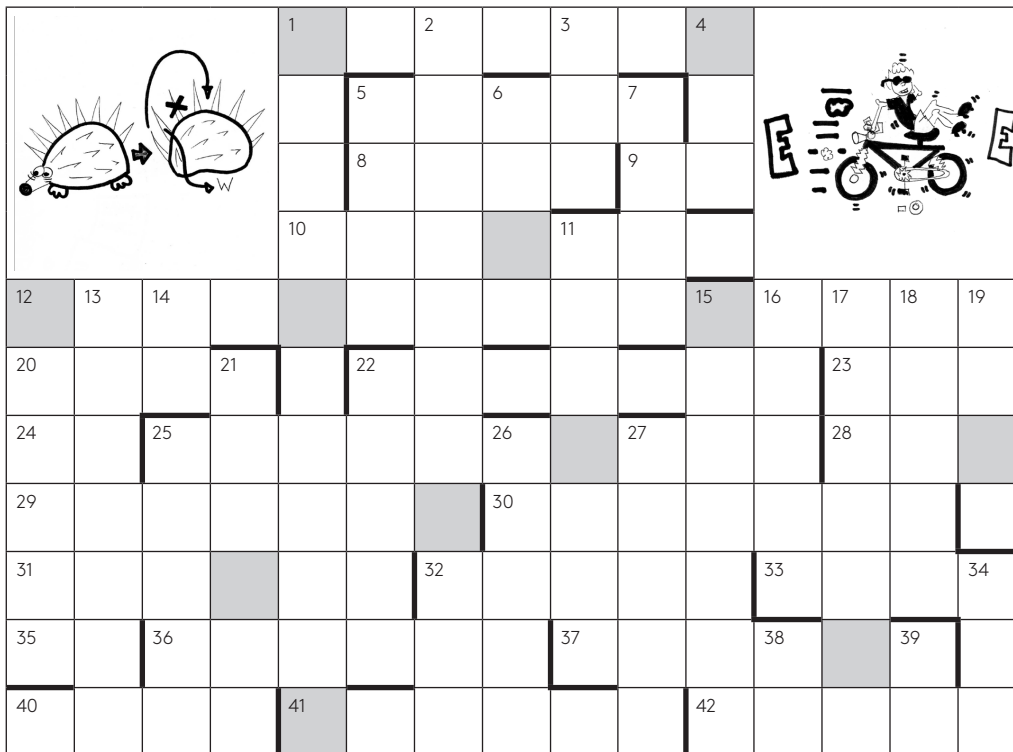
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Throwback: 10 years ago Dieser Fall führt in die Vergangen- heit

Da es sich um ein älteres Rätsel handelt, gibt es dieses Mal keinen Wettbewerb. Wir freuen uns wieder auf eure Einsendungen für das nächste Rätsel.

Letztes Lösungswort:
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Ein alter Fall von den drei Sonderzeichen

von &, ∞ und # (Rätsel, Bilder und Text)

Waagrecht

- Berührt tagtäglich wohl mehr Geld als der reichste Mann der Welt.
- Spint ein Teilchen mit ganzer Zahl, ist zum entdecken der LHC erste Wahl.
- Watschelt am Teich, auch gekocht kein Seich.
- Helevtisch-militärisch abgekürzt, der sich mit 12W in den Kampf stürzt.
- Entspannung auf Rezept, für den, der krampfhaft steppt.
- Knarregattung; sagt nichts weiter, als «double-wield klappt damit heiter»!
- Als Vogel: Eden-Original, sein Kolorit ist alokal.
- Hat hier ein Deutscher seinen Spass? Schweizer dieses Wort erst las.
- Lust auf Klamauk und halbnackte Frauen? Dann musst du diesen Sender schauen.
- Inmitten von Mitten, Audi mit engen Hintersitzen.
- Wird gerne fotografiert und dann an Wände montiert.
- Gegen Bernergruss, bei Tagesende, erhebt Lincoln keine Einwände.

- Ob Sportevent, ob Parlamentswahl, kommentiert wird auf dem Mitteilungsportal.
- Besungen und vorgestellt, Lennons Pazifistenwelt.
- Schon sein Nachname besagt, dass er an unsre Nerven nagt.
- siehe *Bilderrätsel rechts*
- Dort prämiert man die besten der Welt mit explosivem Stiftungsgeld.
- Ist nicht nur vom Grössten der Anfang, sondern auch jener Kanton kurz, nicht lang.
- Ob blond oder braunes Haar, noch keine zwanzig Jahr.
- Ein heisses Öfeli, man kann drauf sitzen, als Applikator hilft er gegen's Schwitzen.
- Ob Brötchen oder Hexenweib, knusprig wird darin der Laib.
- Sie hängen vom Kopf, verfilzt oder als Zopf.
- Im Zeugenschutz kriegt Whoopi als solche keinen Groupie.

Senkrecht

- Oft im Krebsgang unterwegs? Klar, solches ist auch der Krebs.
- Verkäufer: «Mein Freund, schau hier, so billig geb ich es nur dir!»
- Auf Jimis Frage: «Wohin mit der Waffe?»- Zu seiner Frau, weil mit and'ren sie schlafe.
- So ruft Johnny kurz den Schiri während dem Sturz.
- Hört er Highland, Angus, Galloway, schafft Johnny gleich dem Grill herbei.
- Verkehrslage in Testikeln derer, die Maschinen entwickeln.
- Düst're Filme, Detektivgeschichten, die auf starke Kontraste nicht verzichten.
- Der Teilungs-counter einer Zelle, es steckt im Chromosom, an letzter Stelle.
- Des Nerds Haut und Haare sinds, sowie die Finger des Fastfood-Kinds.
- Disziplin bei Timber-Spielen: Mit dem Bieli gilt's zu zielen.
- Ein Tutot ohne Konsonant, ist auch ein kurzer Sergeant.
- siehe *Bilderrätsel links*
- Mit dem gibt der Tschingg, Graf Dracula einen «Gingg»!
- Polstern Stirnlampen, wenn sie auf die Stirn lampen.
- Moralische Anekdote, wo Hand genannt wird Pfofe.
- Nur Kolumbus hat es auch im Singular, bei Männern sind sie sonst im Paar.
- Es füllen auf diese Reduzierte, Al Bundys Lieblingsillustrierte.
- Geringer Geschmack bei Suppe, geringes Gewicht bei Puppe.
- Ob Ost-, Nord oder Südanflug, auf solcher landen wäre klug.
- Da waren die Griechen noch in Asien drüben, bauten Tempel und pflanzten Rüben.
- Wird mal wieder gegen's WEF demonstriert, ist dieser Ort sicher verbarriadiert.
- Der Spanier hat, das ist klar, nur dieses Wort im Vokabular.
- Wenn Chat-Pointe Mittelmass, reicht's aus zu tippen das.
- Lüftest du selten den Keller, strahlt dieses immer heller.

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