ALMA MATER EUROPAEA
ECM

DOCTORIS HONORIS CAUSA

KLAUS MAINZER

IT'S ABOUT PEOPLE 2024: *IN SERVICE OF SUSTAINABILITY AND DIGNITY*

The 12th Annual Conference of Europe's Sciences and Arts Leaders and Scholars

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Gaudeamus igitur,
iuvenes dum sumus,
Gaudeamus igitur,
iuvenes dum sumus.
Post iucundam iuventutem
Post molestam senectutem,
Nos habebit humus,
Nos habebit humus.

Vivat academia!
Vivant profesores!
Vivat academia!
Vivant profesores,
Vivant membrum quodlibet,
Vivat membra quaelibet,
Semper sint in flore,
Semper sint in flore.

PROGRAMME

Gaudeamus Igitur

WELCOME ADDRESS

Dr Ludvik Toplak
President of the Alma Mater Europaea - ECM

NOMINATOR

Dr Željko Knez
Member Slovene Academy of Sciences and Arts and EASA

LAUDEATOR

Dr Felix Unger
Honorary President of the European Academy of Sciences And Arts

LAUDEATOR

Dr Marko Robnik
Member EASA Founder and Director CAMTP

LAUDEATOR

Dr Lenart Škof
Dean Alma Mater Europaea Institutum Studiorum Humanitatis

Music Break

Tim Ribič, *tenor*

Špela Pokeržnik, *soprano*

HONORARY DOCTORATE CEREMONY

Dr Klaus Mainzer,
President of the European Academy of Sciences and Arts,
President of the Scientific Committee of the It's About People Conference

Professor Dr Ludvik Toplak

PRESIDENT OF THE ALMA MATER EUROPAEA - ECM

Over the past fifteen years, Alma Mater Europaea – ECM has developed academic programs at all levels and academic disciplines, in line with the mission of the European Academy of Sciences and Arts (EASA). We thank you for your trust, and for the moral and academic support shown throughout this period by the honorary president of EASA, Professor Dr Felix Unger, and the current president, Professor Dr Klaus Mainzer.

The 12th Annual Conference of Europe's Sciences and Arts Leaders and Scholars, 'It's About People 2024: In Service of Sustainability and Dignity,' co-organized with the European Academy of Sciences and Arts, takes place in one of the most turbulent periods of the last hundred years.

The fundamental values of the thousand-year-old European identity and the assumptions of the equality of all people, regardless of gender, religion, race, or other personal circumstances, are under threat. These values are based on the Judeo-Christian tradition, Greek philosophy, Roman law, European humanism, and the development of socio-economic rights in recent centuries. This includes the equality of languages and the political equality of people, established by the declaration of the United Nations on human rights, and by further acts of the institutions of the United Nations and the European Union.

The task of science is to provide answers to new challenges, and thus prevent threatening contradictions and develop values and technologies in the education system to ensure peace and well-being in society.

These are questions to which Professor Dr Mainzer has devoted himself in his work for several decades. Alma Mater Europaea – ECM expresses its gratitude to him for his outstanding contributions to science and philosophy in the vision of a new Renaissance and awards him the title of honorary doctorate.

Professor Dr Ludvik Toplak

Distinguished Excellencies, Ladies and Gentlemen,

First, I welcome you on behalf of the Slovenian Academy of Sciences and Arts and its President, Academician Professor Dr Peter Štih.

I would now like to say that it is a great honor and privilege for me to be the promoter of an outstanding scientist, the President of the European Academy of Sciences and Arts, and, if I may say so, a man who was among the first to realize that Europe needed a Renaissance, Professor Dr Klaus Mainzer.

Professor Dr Klaus Mainzer was born in 1947. He is a German philosopher and scientist.

Mainzer graduated from the Landrat-Lucas-Gymnasium in Opladen and studied mathematics, physics, and philosophy. In 1973, he obtained a doctorate in philosophy and mathematics fundamentals ("Mathematical Constructivism"). In 1979, Mainzer got his habilitation in philosophy with a thesis on "Space, Geometry and Continuum" at the University of Münster. In 1980, he received a Heisenberg grant. He was a professor of the foundations and history of exact sciences at the University of Konstanz from 1981 to 1988. He was the Vice-Rector of the University of Konstanz between 1985 and 1988.

From 1988 to 2008, Klaus Mainzer was a professor of the philosophy of science and director of the Institute for Philosophy. Since 1998, he has been the founding director of the Interdisciplinary Institute for Computer Science at the University of Augsburg. Between 2008 and 2016, he held the chair for philosophy and philosophy of science at the Technical University of Munich. Mainzer was appointed director of the Carl von Linde Academy. He was the Munich Center for Technology in Society founding director at the Technical University of Munich. Since 2016, Mainzer has been "TUM Emeritus of Excellence." Since 2019, Mainzer has been a Senior Professor at the Carl Friedrich von Weizsäcker Center at the Eberhard Karls University of Tübingen. He is also a co-founder of this institute.

He was a member of the Advisory Board of the TUM Institute for Advanced Study, Principal Investigator of the TUM Cluster of Excellence Cognition in Technical Systems, and a member of the Editorial Board of the International Journal of Bifurcation and Chaos in Applied Sciences and Engineering. He is a member of the Research Center for Education and Information (Beijing University), the Academia Europaea (London), the European Academy of Sciences and Arts (Salzburg), and their Dean of the Class for Natural Sciences 2018–2019, member of the German Academy of Science and Engineering. Mainzer was a member of the Board of Trustees of the Daimler and Benz Foundation and the Institute for Advanced Studies at TUM. Since 2020, he has been Deputy Chairman of the Board of Trustees of the Udo Keller Foundation Forum Humanum (Hamburg).

Professor Dr Željko Knez

ACADEMIC;
MEMBER SASA AND EASA

He gave guest lectures or carried out visiting professorships in Brazil, China, India, Japan, Poland, South Korea, the US, and Russia. He was a visiting scientist at the Euler International Mathematical Institute (St. Petersburg), the Hausdorff Research Institute for Mathematics (Bonn), and the Leibniz Center for Informatics at Schloss Dagstuhl.

Klaus Mainzer initially published on the concept of a number, the foundations of geometry, space, time, symmetry, and quantum mechanics. He became known as a fundamental theorist of complex systems and artificial intelligence, who considers their social consequences in the age of digitization. He elaborated mathematical models of complex systems that organize themselves in nature - from molecular and cellular systems to organisms and brains.

Professor Dr Klaus Mainzer is the editor and author of several books translated into several languages. Besides the huge number of books, he is the author of the widely translated, cited, and reviewed book *Thinking in Complexity*.

Professor Dr Klaus Mainzer is the recipient of numerous awards and prizes. I will mention only the most prestigious ones:

- Heisenberg-Grant
- TUM Emeritus of Excellence
- Senior Professor University of Tübingen
- Merkatzer Philosophy Prize for outstanding overall and lifetime achievement in the field of philosophy
- Golden Medal of the International Center of Education for lifetime achievements in the fields of mathematics and complex systems science with outstanding performance as president of the European Academy of Sciences and Arts
- Patron of the EU Science Festival on the occasion of the appointment of Katowice (Poland) as Science City 2024

Besides this, he is a member of Academic Societies:

- European Academy of Sciences and Arts / Salzburg. In November 2020, the European Academy of Sciences and Arts elected Mainzer as its new president. He succeeded Felix Unger, who had served as president for three decades.
- Academia Europaea/London,
- National Academy of Science and Engineering Berlin/ Munich.

Dear Rector of the Alma Mater Europea, Professor Dr Ludvik Toplak, I propose that, based on all that has been presented, you promote Prof. Dr. Klaus Mainzer to the honorary title of Doctor Honoris Causa.

Professor Dr Željko Knez

Klaus Mainzer (born 1947) is a German philosopher and scientist. Mainzer is the president of the European Academy of Sciences and Arts. He is the author of the widely translated, cited, and reviewed book *Thinking in Complexity*.

Academic career

Mainzer graduated from the Landrat-Lucas-Gymnasium in Opladen and studied mathematics, physics and philosophy. In 1973, he obtained a doctorate in philosophy and mathematics fundamentals („Mathematical Constructivism"). In 1979, Mainzer got his habilitation in philosophy with a thesis on „Space, Geometry and Continuum" at the University of Münster. In 1980, he received a Heisenberg grant. He was a professor for the foundations and history of exact sciences at the University of Konstanz from 1981 to 1988. He was the Vice-Rector of the University of Konstanz between 1985 and 1988.

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He was a member of the Advisory Board of the TUM Institute for Advanced Study (IAS) (2009-2016), Principal Investigator (PI) of the TUM Cluster of Excellence Cognition in Technical Systems (CoTeSys) (2009-2014) and a member of the Editorial Board of the International Journal of Bifurcation and Chaos in Applied Sciences and Engineering (2005-2015). He is a member of the Research Center for Education and Information (Beijing University), the Academia Europaea (London), the European Academy of Sciences and Arts (Salzburg) and there Dean of the Class for Natural Sciences 2018–2019, member of the German Academy of Science and Engineering (acatech), there spokesman for the Academy's position paper „Responsibility" 2018–2019 and since 2018 spokesman for the working group „Basic Questions." Mainzer was a member of the Board of Trustees of the Daimler and Benz Foundation (Ladenburg) (1998–2008) and the Institute for Advanced Studies (IAS) at TUM. Since 2020, he is Deputy Chairman of the Board of Trustees of the Udo Keller Foundation Forum Humanum (Hamburg).

Professor Dr Klaus Mainzer

PRESIDENT OF THE EUROPEAN ACADEMY OF SCIENCES AND ARTS

He gave guest lectures or carried out visiting professorships in Brazil, China, India, Japan, Poland, South Korea, US and Russia. He was a visiting scientist at the Euler International Mathematical Institute (St. Petersburg), the Hausdorff Research Institute for Mathematics (Bonn) and the Leibniz Center for Informatics at Schloss Dagstuhl.

Klaus Mainzer initially published on the concept of a number, the foundations of geometry, space, time, symmetry and quantum mechanics. He became known as a fundamental theorist of complex systems and artificial intelligence (AI), who considers their social consequences in the age of digitization. He elaborated mathematical models of complex systems (e.g., cellular automatons and neural networks) that organize themselves in nature - from molecular and cellular systems to organisms and brains. With Leon O. Chua of University of California, Berkeley, he pointed out that non-linearity and instability are insufficient to explain new structures (emergence). The prerequisite is the principle of local activity, which mathematically explains the emergence of complex structures at the edge of chaos.

In foundational mathematical research, he began studying constructive mathematics against the background of Kant's philosophy. Based on degrees of predictability and constructiveness, he researched the extent to which mathematical proofs - and thus human thinking - can be reduced to algorithms and computers. The world's calculation leads again to complex systems and the question of the degree to which they can be digitized (e.g., as quantum information systems).

In the technical sciences, Mainzer advocates increased basic research into verification programs to overcome the blind spots of statistical learning algorithms (machine learning) in AI. Complex Systems in the Internet of Things (e.g., Smart Mobility, Industry 4.0) lead to a data explosion (Big Data), which raises security and responsibility issues. In addition to program verification, Mainzer demands technology design that takes social, ecological, ethical and legal aspects into account in the innovation from the outset. In the global competition of world systems, he calls for the European innovation area to reflect on its legacy of individual human rights and to develop artificial intelligence as a service system further.

In November 2020, the European Academy of Sciences and Arts elected Mainzer as its new president. He succeeded Felix Unger, who had served as president for three decades.

Publication

Author of books, e.g.: History of Geometry (German: B.I. Wissenschaftsverlag 1980); *Numbers* (with H.-D. Ebbinghaus, H. Hermes, F. Hirzebruch et al., German: 1983, 3rd edition 1992, English 1990, Japanese 1992, French 1999); *Symmetries of Nature* (English: De Gruyter 1996, German: 1988); *Thinking in Complexity. The Computational Dynamics of Matter, Mind, and Mankind* (English: Springer 1994, 5th enlarged edition 2007, Japanese 1997, Chinese 1999, Polish 2007; Russian 2009); *Computer – New Wings of the Mind?* (German: De Gruyter 1994, 2nd edition 1995); *The Little Book of Time* (English: Copernicus Books 2002, German: C.H. Beck 1995, 5th edition 2005, Chinese 2003, Korean 2005); *Matter. From Its Origin to Life* (German: C.H. Beck 1996, Chinese 2000); *Brain, Computer, and Complexity* (German: Springer 1997); *Computational Networks and Virtual Reality. Living in Knowledge Societies* (German: Springer 1999); *Hawking. Master Thinker of Cosmology* (German: Herder 2000); *AI – Artificial Intelligence. Foundations of Intelligent Systems* (German: Wissenschaftliche Buchgesellschaft 2003); Computational Philosophy (German: Junius Verlag 2003, Polish 2007); *Symmetry and Complexity. The Spirit and Beauty of Nonlinear Science* (English: World Scientific Singapore 2005); *The Creative Chance. How Novelty comes into the World* (German: C.H. Beck 2007, Japanese 2010); *Complexity* (German: UTB-Profile 2008); *Life as Machine? From Systems Biology to Robotics and Artificial Intelligence* (German: Mentis 2010, Japanese 2013); *The Universe as Automaton. From Simplicity and Symmetry to Complexity* (with L.O. Chua, English: Springer 2011); *Local Activity Principle. The Cause of Complexity and Symmetry Breaking* (with L.O. Chua: English: Imperial College Press: London 2013); *Die Berechnung der Welt. Von der Weltformel zu Big Data* (C.H. Beck: München 2014); *Information: Algorithmus-Wahrscheinlichkeit-Komplexität-Quantenwelt-Leben-Gehirn-Gesellschaft*, Berlin University Press 2016; *Wie berechenbar ist unsere Welt? Herausforderungen für Mathematik, Informatik und Philosophie im Zeitalter der Digitalisierung*, Springer: Berlin 2018; *The Digital and the Real World. Computational Foundations of Mathematics, Science, Technology, and Philosophy* (World Scientific Singapore 2018); *Artificial Intelligence. When do machines take over?* (2n German edition Springer: Berlin 2019, English translation Springer: Berlin 2019; Chinese translation: Tsinghua University Press 2022); *Leben als Maschine: Wie entschlüsseln wir den Corona-Kode?* Brill-Mentis: Paderborn 2020; *Quantencomputer. Von der der Quantenwelt zur Künstlichen Intelligenz*, Springer: Berlin 2020; Limitation of AI – theoretical, practical, ethical (with R. Kahle), Springer 2022; Temporal Logic. From Philosophy and Proof Theory to Artificial Intelligence and Quantum Computing (with S. Centrone), World Sciemtific Singapore 2023; Future through Sustainable Innovation, Springer-Gabler 2023 [German].

Editor of books, e.g.: *Philosophy and Physics of Space-Time* (with J. Audretsch, German 1988, 2nd edition 1994); *Origin of the World* (with J. Audretsch, German 1989, 2nd edition 1990); *How Many Lives has Schrödinger's Cat? Philosophy and Physics of Quantum Mechanics* (with J. Audretsch, German: 1990, 2nd edition 1996); *Natural Science and Humanities* (German 1990); *The Question for Life* (with E.P. Fischer, German 1990); *Economy and Ecology* (1993); *Quantum, Chaos and Demons* (with W. Schirmacher, German 1994); *From Simplicity to Complexity: Information, Interaction, and Emergence* (with A. Müller and W.G. Saltzer, 1998); *Complex Systems and Nonlinear Dynamics in Nature and Society. Complex Systems Research in Germany on the Way to the Next Century* (1999); *Information- and Communication Technology as Interdisciplinary Task* (2000); *Complexity* (The Academy of Europe, European Review: Cambridge University Press 2009); *Causality* (The Academy of Europe, European Review: Cambridge University Press 2010); *Natural Law* (The Academy of Europe, European Review: Cambridge University Press 2014); *Proof and Computation. Digitization in Mathematics, Computer Science, and Philosophy* (with P. Schuster and H. Schwichtenberg), World Scientific Singapore 2018; *Proof and Computation II. From Proof Theory and Univalent Mathematics to Program Extraction and Verification* (with P. Schuster and H. Schwichtenberg), World Scientific Singapore 2021.

Awards

Heisenberg-Grant (1979); Membership of Academic Societies: Academia Europaea /London, European Academy of Sciences and Arts / Salzburg, National Academy of Science and Engineering Berlin/Munich; TUM Emeritus of Excellence (2016); Senior Professor University of Tübingen (2019); Merkatzer Philosophy Prize for outstanding overall and lifetime achievement in the field of philosophy (2022); Golden Medal of the International Center of Education (INTERCEDU) for lifetime achievements in the fields of mathematics and complex systems science with outstanding performance as president of the European Academy of Sciences and Arts (2023); Patron of the EU Science Festival at the occasion of the appointment of Katowice (Poland) as Science city 2024; honorable invitations for numerous festive speeches at international universities, research centers, and companies since decades.

Professor Dr Felix Unger

HONORARY PRESIDENT OF THE EUROPEAN ACADEMY OF SCIENCES AND ARTS

On behalf of the European Academy of Sciences and Arts, I have the great honour to congratulate Professor Dr Klaus Mainzer to the Honorary Doctorate for his outstanding scientific achievements.

Professor Mainzer is one of the well-known German philosophers. Beyond artificial intelligence, his main areas of expertise are complex systems, philosophy of science, foundations of mathematics, history of science and philosophy of nature. In addition to his numerous activities especially as Emeritus of Excellence at the Technical University of Munich and Senior Professor at the Carl Friedrich von Weizsäcker Centre at the Eberhard Karls University of Tübingen and German National Academy of Science and Engineering (acatech), Prof. Mainzer is currently President of the European Academy of Sciences and Arts.

In the European Academy of Sciences and Arts, to which I belong as Honorary President and founding member, Professor Dr Mainzer continues the interdisciplinary work in the spirit of the Academy's principles with the aim of building bridges in science and society in a changed, tense and conflict-ridden world. In doing so, Professor Dr Mainzer is pursuing the idea of rediscovering Europe as an innovative and cultural area in the sense of a new Renaissance.

His interdisciplinary commitment has had a wide impact on the leadership of numerous universities, scientific societies and organisations. Professor Dr Mainzer was Dean and Vice-Rector at the University of Konstanz, Director of the Institute of Philosophy, Founding Director of the Institute for Interdisciplinary Computer Science and Dean at the University of Augsburg; Director of the Carl von Linde Academy, and Founding Director of the Munich Center for Technology in Society (MCTS), as well as Emeritus of Excellence at the Technical University of Munich (TUM) and co-founder of the Carl Friedrich von Weizsäcker Center and Senior Professor at the University of Tübingen, to name but a few. Professor Dr Mainzer is also spokesman for the working group "Fundamental Issues in Engineering Sciences" of the German National Academy of Science and Engineering (acatech), as well as a member of the Academia Europaea (London), a member of the Daimler-Benz Foundation (Ladenburg), a member of the scientific advisory board of the Institute for Advanced Studies (IAS) at the Technical University of Munich and chairman of the scientific advisory board of the Forum Humanum Foundation in Hamburg.

Professor Dr Mainzer's philosophical work shows an impressive breadth, he deals with the challenges of quantum physics as well as with the possibility of mathematical knowledge, which he has expressed in his numerous publications, seminars and lectures, he has written books on symmetries in nature as well as on time, and he has investigated in an interdisciplinary way how new things arise in the world.

In the European Academy of Sciences and Arts, Professor Dr Mainzer was particularly committed to the introduction of new working groups on the topics of "Digitalisation, AI and Society", "Energy, Climate, Environment", "Innovation, Training and Education". The certification of corresponding position papers ("white papers"), the introduction of the Academy's scientific journal PEASA and the coordination and moderation of numerous Academy events since 2020 are his ongoing and future projects.

The European Academy of Sciences and Arts is honoured having Professor Dr Mainzer as Honorary Doctor Maribor and I am sure, that he as important member of the Academy will enrich our goals.

Professor Dr Felix Unger

Professor Dr Marko Robnik

MEMBER EASA FOUNDER
AND DIRECTOR CAMTP

Honorable Guests, Respected Colleagues,
Ladies and Gentlemen,

following the kind invitation of Professor Ludvik Toplak, it is my great honor and pleasure to briefly describe the scientific work of Professor Klaus Mainzer, President of the European Academy of Sciences and Arts, in continuation of Professor Knez's promotional speech.

Professor Mainzer is not only an outstanding philosopher, especially a philosopher of science, but also a mathematician, physicist, and theoretical computer scientist. His scientific work spans the impressively broad domain of various scientific disciplines. This includes foundations of mathematics, where he studied constructive mathematics, pursued the questions of predictability, and researched how mathematical proofs can be reduced to algorithms and computers.

He has been addressing the fundamental concepts in physics, like space, time, symmetry, and quantum mechanics. Perhaps his most crucial work contributed to the entirely general theory of complexity in a variety of systems, applicable in physics, encompassing microscopic and macroscopic systems, chemistry, and biology, from the single cells to organs, organisms, and ecological systems, but also in technology, social and economic sciences, as well as in neurosciences and computer sciences. He has been contributing to the foundations and applications of artificial intelligence and is advocating necessary increased research on aspects of machine learning away from the blind statistical learning algorithms in artificial intelligence. He is deeply concerned with the utilities, applications, and possible abuses of artificial intelligence. In addition, he is one of the main promotors of quantum computers.

In the technical sciences, Mainzer is concerned with the complex systems in the Internet of Things, which lead to a data explosion (big data) and raise security and responsibility issues. He also demands technology design to take into account the social, ecological, ethical, and legal aspects. He calls for the European innovation policy to make sure that these developments respect general individual human rights and that artificial intelligence serves society at all levels.

Let me say a few more words about his fundamental contributions to the development of the complexity theory. With Leon Chua of the University of California at Berkeley, he developed a mathematically formulated theory of how ordered complex structures can emerge from a disordered structure. The classical physics of the 19th and 20th centuries provided the foundations of the statistical theory of many-body systems, which, when isolated, tend toward complete disorder, based on the second law of thermodynamics. A fundamental discovery of the late 20th century, widely further developed in the 21st century, is that ordered structures can emerge from homogeneous, dis-

ordered structures. In a sense, order is created from chaos. It is the universal condition that such systems must be open systems, which gain energy from the environment, and to be stable must be dissipative in such a way that the energy losses, on average, are compensated by the energy gain. Quite generally: order costs energy! To create order from chaos, one certainly needs the nonlinearity of the underlying system. The emergence and existence of spontaneously ordered structures in such open systems, e.g., reaction-diffusion systems and biological systems, does not contradict the second law of thermodynamics.

Mainzer and Chua build on the ideas of Schrödinger, Turing, Haken, and Prigogine and show that nonlinearity and instability are not enough to create order. They maintain and show that *the principle of local activity is the missing concept to explain the emergence of complex patterns in a homogeneous medium*. This is also the title of their original book published in 2013 by the Imperial College Press.

Understanding the emergence of complex systems is the beginning. The effort to describe and understand the properties and functioning of a complex system requires new methods, from mathematical approaches to the computer-based analysis of big data, also using artificial intelligence and machine learning. Professor Mainzer has contributed significantly to these research issues and their societal impacts over the past decades. When it comes to organizing our modern society, also at the most global level, the key word is cooperation. In constructive cooperation, with maximal intelligence, nobody is harmed, and all parties involved are winners, and that was, on the time average, the main driving force of progress and prosperity in humanity.

The modest attitude of Professor Mainzer teaches us that this is the most appropriate approach based on tolerance and intelligence. Therefore, I support his and Chua's words: *Act locally and think globally with responsibility to the whole Earth system*.

Apart from his plentiful academic and scientific activities worldwide, I should mention that Professor Mainzer is, since 2019, every year one of the most prominent invited speakers at the annual Christmas symposia of physicists at CAMTP of the University of Maribor, which I am organizing since 2002. Also, we have been co-organizing several EASA workshops taking place in Salzburg. Thus, his scientific ties with Slovenia are also significant.

In the end, please allow me to congratulate Professor Mainzer for the promotion to Dr. h. c., thanking him in the most general sense for his outstanding contributions to science, the academic world, and human society.

Dear Klaus, sincere congratulations!

Professor Dr Marko Robnik

Professor Dr Lenart Škof

DEAN ALMA MATER EUROPAEA INSTITUTUM STUDIORUM HUMANITATIS

Dear distinguished guests,

it is my honor as a philosopher and Dean of Institutum Studiorum Humanitatis to be in the role of one of the laudators on the occasion of awarding the President of the European Academy of Sciences and Arts, Professor Klaus Mainzer the doctor honoris causa at Alma Mater Europaea.

Klaus Mainzer is a renowned German philosopher and scientist and the author of numerous books and publications on the philosophy of science, among them the widely translated, cited, and reviewed book Thinking in Complexity, published by Springer in 1994.

Professor Mainzer's career in philosophy started after obtaining a doctorate in philosophy and mathematics in 1973. A few years later, in 1979, Mainzer got his habilitation in philosophy with a thesis on "Space, Geometry and Continuum" at the University of Münster. Later, he continued his philosophical work at the Universities of Konstanz and Augsburg. Between 2008 and 2016, he held the chair for philosophy and philosophy of science at the Technical University of Munich.

Broadly, his philosophical works focus on some of the fundamental concepts in philosophy ever since Plato: the concepts of number, space, time, and symmetry, but also key modern topics such as quantum mechanics. As a thinker, he became internationally known as a fundamental theorist of complex systems, and, more recently, artificial intelligence theories. This work closely relates to the Complex Systems theory, demonstrating that equilibrium in systems is not the answer, but that productive and robust systems must exist on the edge of chaos. As Prigogine & Stengers have been arguing in their works, by applying this lens to physics, biology, chemistry, philosophy, cybernetics, robotics, and other fields, resilience can be rebuilt and sustained. The key components of the Complex Systems theory and its new ontology and epistemology are in the integrative, diverse, mutually activating, co-evolving, dynamic, sub-optimal, self-organizing, connective, emergent and non-linear systems, making truly a paradigm shift in interdisciplinary humanities and philosophy of science today.

The contributions of Professor Mainzer in this view are enormous: with his already mentioned book *Thinking in Complexity*, as early as 1994, Mainzer was already able to predict some of the most dangerous threats of the world we are living in: he argued for an ethically and socially responsible science, economics, and politics, thus directly influencing not only our social lives but also our new ways towards relationality with nature. He states, »We should neither overact nor retire, because overreaction as well as retirement can push the system from one chaotic state to another. We should be both cautious and courageous, ac-

cording to the conditions of nonlinearity and complexity in evolution«. Yes, to be cautious and courageous means to be both humble and bold, to be responsible towards everything that exists, but also to be audacious towards our common future. In his words: »We have to protect the Greatest Good in an ongoing evolution with increasing complexity«. These words undoubtedly testify to a truly strong presence of humanistic impulses and values in Professor Mainzer's works and scientific worldviews.

Among his key works, let me mention *Symmetrien der Natur* (De Gruyter, 1988), *Thinking in Complexity: The Computational Dynamics of Matter, Mind, and Mankind* (Springer, 1994, with new editions), *The Little Book of Time* (Copernicus, 2002), *The Universe as Automaton* (Springer, 2011) and *Die Berechenbarkeit der Welt: Von der Weltformel zu Big Data* (Beck, 2014). His book from 2019 is titled *Artificial Intelligence: When do machines take over?* (Springer) – in this book, Mainzer strongly argues that AI must prove itself as a service in society.

It is clear that today, apart from achieving peace in Ukraine, Israel, and Palestine, and elsewhere in the world, humanity will need to resolve many crucial issues – from environmental (such as global warming), to issues related to the ethical and also socio-political consequences of the advanced AI. In all these issues, Professor Mainzer's philosophical work was not only highly topical and influential but also contributed to the paradigm shifts in the areas of studies of complexity, dynamics, and, more recently, digitalization and advanced AI.

On behalf of the Alma Mater Europaea – Institutum Studiorum Humanitatis faculty, it is my greatest pleasure to express our praise for Professor Mainzer as a recipient of the Doctor Honoris Causa award from Alma Mater Europaea University and wish to congratulate him sincerely for the award.

Professor Dr Lenart Škof

Professor Dr Klaus Mainzer

PRESIDENT OF THE EUROPEAN ACADEMY OF SCIENCES AND ARTS

Distinguished Excellencies, Ladies and Gentlemen,

Thank you all very much for coming to this honorable assembly. I would especially like to thank Prof. Zejko Knez from the Slovenian Academy of Sciences as nominator and rapporteur, as laudators Prof. Marco Robnik from the Centre for Applied Mathematics and Theoretical Physics and Prof. Lenart Skof as philosopher for their honourable words. Last but not least I want to thank Prof. Ludvic Toplak as spiritus rector of the Alma Mater Europaea in Maribor.

The laudators highlighted my interdisciplinary work, which began with my studies of mathematics, physics and philosophy. Prof. Robnik mentioned my work on complex systems, which actually combines my interdisciplinary interests. Although this is a mathematical formalism, it can be used to understand the emergence and decay of orders in nature and society. I would therefore like to briefly discuss this in order to better understand today's conference topic of demography, the current political and economic situation in Europe and the task of the European Academy.

What are complex and chaotic systems ?

Systems are called complex when they consist of many elements. For example, a complex molecule can consist of many atoms. A cell consists of many molecules, an organ of many cells, an organism of many organs, a population of many organisms and an ecological system of many populations. In physical terms, these are open systems that are constantly exchanging materials, energy and information with their environment. This exchange is measured using control parameters. At critical control values, the interactions between the elements of a system change and lead to the formation of new orders and structures.

We speak of phase transitions, in which stable orders are initially in equilibrium, but when the critical values change, they initially fluctuate and oscillate and can ultimately become chaotic. In chaotic situations, the system is highly sensitive to smallest local changes, which can build up to a global collapse of the entire system.

Examples in the physical sciences: The flow of a river, for example, is a complex system of molecules whose dynamics depend on the flow velocity. Initially, the flow is in equilibrium with a smooth surface. As the flow velocity increases, small eddies form behind an obstacle, which eventually turn into turbulent and chaotic vortices. An ecological system can become unstable, when environmental conditions become critical. The climate is a complex system that can change into a chaotic and uncontrollable state at critical control values of human pollution.

Examples in the life sciences: In medicine, we are familiar with multi-organ failure, in which the interaction of all organs becomes chaotic. The brain is a complex system of active („firing") neurons whose interactions generate cognitive states. These dynamics of neuronal networks nowadays serve as a model for artificial intelligence.

Examples in the social sciences: Social systems can also be understood as complex systems with many interacting agents. One example is traffic flows: Traffic can flow evenly. If traffic density becomes critical, the traffic becomes fluctuating (stop-and-go). If traffic density is very high, traffic becomes sensitive to the smallest disruptions, which can build up into a traffic jam out of nowhere. In demography, we are experiencing migration flows worldwide that can be orderly, stable and controlled, but can also turn chaotic.

Examples in economics: Markets are also complex systems of many interacting agents that can become stable, fluctuating and chaotic depending on control parameters. According to the great Austrian-American economist Joseph Schumpeter, it is new inventions that entrepreneurs turn into innovations and thus initiate new phases of development in the economy and society: Examples include the invention of the steam engine, which triggered the first phase of industrialisation at the beginning of the 19th century, the invention of the internal combustion engine at the end of the 19th century, which triggered a wave of motorisation worldwide, finally, the invention of the computer in the 1940 years, which triggered an unprecedented wave of digitalisation, culminating in artificial intelligence. We cannot predict future single events with these complex stochastic systems such as in the deterministic mechanics of astronomy. But we receive early warning systems to better prepare us for future scenarios.

Examples of politics and society: The history of political orders and systems can also be understood in terms of phase transitions of complex systems. These are now societies of many people, institutions, and organisations. At critical economic, social and political parameter values, they become unstable and collapse. It is important to recognise the critical values at an early stage. Examples of such phase transitions were the collapse of the monarchies in the French and Russian revolutions, but also the period of stability in Europe for almost a century during the time of the Danube monarchy in the 19th century. But political phase transitions are not natural events that take place according to natural laws. We humans were and are involved here and can exert influence.

One successful example is the year 1990 - the „birth year" of the European Academy of Sciences and Arts. It is the year in which the Soviet Union and the Eastern

Bloc collapsed largely peacefully because people and responsible politicians recognised the opportunity of the hour. A rare peaceful phase transition in European and world history! An aftershock of this phase transition was the disintegration and war in the former Yugoslavia: But your country, Slovenia, emerged peacefully from this disintegration with a new democratic order, because apparently people and responsible politicians recognised the favour of the hour. Overall, the 1990s saw the emergence of hope for a peaceful organisation of the „House of Europe".

Challenges of the European Academy of Sciences and Arts

Our European Academy of Sciences and Arts was also founded in this spirit at that time. Bridges were to be built in science and culture in Europe in a spirit of tolerance. The founding presidents Franz Cardinal König, Prince Lobkowitz, and Felix Unger were inspired by this spirit and began the Academy's success story. What we are currently experiencing, however, is a tectonic shift in the global political landscape of the big political powers. New centres of power are emerging in Asia, Africa and America. Europe seems to be falling back into the old nationalistic trench warfare of before the First World War.

In the language of complex systems, the world situation is dangerously unstable and chaotic. Local conflicts such as the Ucraine-Russian war can escalate into global confrontations at any time. They are like smouldering, festering wounds on Europe's body that cost strength and energy. The economy and prosperity in East and West are currently suffering as a result.

But Europe and the world actually have completely different problems to deal with. These include the global climate and energy problems that are threatening our planet. If we do not observe the critical parameters and cross red lines, the planet is doomed according to the laws of complex dynamic systems. At the same time, with AI we are currently experiencing an unprecedented surge in innovation with unimagined potential that needs to be tamed. With respect to the conference topic, we should also mention the worldwide migration processes. These problems cannot be solved by individual nation states alone, nor by major powers such as the USA, China and Russia; it requires international cooperation.

What should we do ?

But what should we do as an academy? An academy is not a military and economic power. This reminds me of a story after the Second World War that might interest Ludvik Toplak as a former ambassador to the Holy See: When the new bodies and organisations such as the UN were founded after the Second World War, the Vatican was also

proposed as a member. Stalin tried to prevent this with the cynical question: „How many divisions does the Vatican have?" Yes, it is only a spiritual power.

As a European academy, we are also only an intellectual and spiritual power: We thrive on the creativity and innovative potential of our members. But we and other academies have the heads and brains that can solve the global problems of mankind. That is why we should and must work together again in science and culture across all borders before the politicians can and will do that.

This is the only way to counteract the slow decline. This is the only way we can solve the common problems of humanity. This is the only way to unleash synergies. This is the only way to prepare the peaceful world of tomorrow.

That is why we need to rediscover Europe as a space of innovation and culture. That is why I am calling for a new Renaissance for Europe! Let us reconnect with the creativity and innovation power of a Leonardo da Vinci in the spirit of the great European humanists such as Erasmus of Rotterdam, for whom mutual respect and tolerance was the request of the day, as it was for the founding fathers of the European Academy.

I thank you for your attention.

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