ART AND SCIENCE 4

The Art of the Origin of Life

ART AND SCIENCE

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ART AND SCIENCE


THIS IS MY MOVIE
M+M
M = M

Organizers & Partners

Institute of Fine Arts, University of Rzeszów
Nencki Institute of Experimental Biology of the Polish Academy of Sciences, Warsaw
Nencki Art Collection, Warsaw
Nencki Foundation for Supporting Biological Sciences, Warsaw
College of Natural Sciences of the University of Rzeszów
Institute of Philosophy of the University of Rzeszów
Herman Otto Museum — Miskolc Gallery, Hungary
BWA Gallery in Rzeszów
Gallery at Attavantich, Jarosław
Bašta — Cultural-community center, Bardejov, Slovakia
Polish Biochemical Society
U Attavantich Gallery — Center for Culture and Promotion in Jarosław
Rynek 6 Gallery — Jarosław Center of Culture and Art
Wela Art Gallery — Gasny, France

The 4th Scientific and Artistic Symposium: ART & SCIENCE — The Art of the Origin of Life

Ladies and Gentlemen

The inspiration for the three previous editions of the Art & Science projects, carried out by the University of Rzeszów and the Nencki Institute of Experimental Biology of the Polish Academy of Sciences (PAS) and the Nencki Foundation for Supporting Biological Sciences, was contemporary experimental biology. The first project "Biological imaging: inspiration with an invisible world?" (Mikołajki, 2017), referred to the aesthetics of microscopic images of microorganisms, cells, and cell organelles. The second project "The Art of Biodiversity" (Boska Dolina near Rzeszów, 2018), was devoted to biological diversity, and the important role of biodiversity for the proper functioning of our planet. The third project "Power of biological structures" (Przeworsk, 2019), concerned the visuality of the structural and functional aspects of the world of biochemistry and biology.

The current one — the fourth Art & Science project "The Art of the Origin of Life" — refers to the aesthetics of fundamental biological phenomena accompanying the emergence of life in the universe. Despite the enormous progress in natural sciences and space exploration in recent years, the phenomenon of the beginning of life is still unfathomable. We know the different stages of the evolution of living organisms, but the first phase — when chemical substances achieved the ability to duplicate and transmit information to subsequent "generations" — remains a mystery to us. Therefore, we believe that the visuality of the mysterious processes of the emergence of life can be an interesting inspiration for the imagination of visual artists.

An attempt to imaginatively bring the world of scientists and artists closer together as part of Art & Science, is based on three conceptual foundations shared by these activities. People involved in the Arts and Natural Sciences are primarily curious about the world. It is also difficult to imagine activities in these areas without an element of creativity. Both of these activities are accompanied by a strong sense of autonomy in the area of use of intellectual freedom. Curiosity, creativity, and intellectual autonomy, are important features of the activities of artists and scientists implementing the current project — "The Art of the Origin of Life". We also hope that the Symposia we organized reduced the hermetic nature of contemporary science, and effectively promoted contemporary art in its public perception.

The virus pandemic in 2020, meant that the organizers had to change the existing logistics of Art & Science projects. Instead of meeting scientists and artists in one place, new conference platforms were used, which we owe to the Internet. What initially seemed to be an organizational problem, in the opinion of the participants of the project turned out to be a very interesting experience. This form allowed an extremely innovative dimension to this edition of the Art & Science Symposium. So far, scientific lectures have been addressed only to a limited group of artists. Only exhibitions of works and publications describing the results of the projects attracted the attention of a wider audience. This year we decided to take advantage of the global nature of the Internet, thanks to which the scientific Symposium — starting the fourth edition of Art & Science project — was promoted more widely and more effectively. For this purpose, we used the ZOOM WEBINAR platform and live streaming on Facebook. The use of these tools made it possible to invite lecturers from various places in the country and the world, from Poznań, Warszawa, Rzeszów, and even from California. The use of modern communication tools also made it possible to create a channel on YouTube, where you can play and listen to all the lectures from the last Symposium.

The Symposium was broadcast on-line for three days — from 17th to 19th November 2020. The lecturers were scientists from the Institute of Bioorganic Chemistry of the PAS in Poznań, the Institute of Biology and Biotechnology, the Institute of Philosophy of the University of Rzeszów, Warsaw University of Life Sciences, the Nencki Institute of Experimental Biology PAS from Warsaw, and NASA in the USA. The very interdisciplinary subject matter has been divided into three thematic blocks. The first was focused on the chemical and biophysical phenomena accompanying the emergence of life. The second thematic block concerned simple organisms that appeared on Earth in the early stages of evolution. And although the biological subject of these lectures referred to strictly scientific information, it allowed for their original visualization. The third thematic block talked about the understanding of the phenomenon of the origin of life by philosophers from the University of Rzeszów. Lectures during the Symposium were heard by over 300 Symposium participants, and then played about 620 times on the Symposium YouTube channel (as of February 2021).

The participants of the artistic part of the fourth edition of Art & Science "The Art of the Origin of Life" in addition to the names of artists from Asia, Europe and America invited by name, include artists-educators from the Institute of Fine Arts — College of Humanities at the University of Rzeszów. From the first edition of the project, they coordinate the arrangement of all exhibitions with post-conference achievements, as well as their visual setting (catalogs, posters and invitations), for which Professor Mirosław Pawłowski was responsible. An innovative idea was to invite to this edition, a graduate of the Institute of Art, dr. Patrycja Longawa, who coordinated the participation of world-famous foreign poster designers in this project. Art works created as part of the 4th Art & Science project "Art of Origin of Life" will be presented during numerous exhibitions organized from spring 2021 in many galleries in Poland and abroad, including the BWA in Rzeszów, in Jarosław, in Bardejov in Slovakia and in Miszkolc in Hungary. The last exhibition of the art works of the artists invited to this project, is scheduled for December 2021 in Warsaw, in the exhibition hall of the Nencki Institute of Experimental Biology PAS. Then, selected works will be included into a specially created collection of contemporary art at the Nencki Institute of the Polish Academy of Sciences — the Nencki Art Collection.

The organizers would like to thank the institutions, without whose support, it would be impossible to implement the projects: the Nencki Institute of Experimental Biology of the Polish Academy of Sciences, the University of Rzeszów and the Nencki Foundation for Supporting Biological Sciences. We also thank the Polish Biochemical Society, which was a partner of the 4th Art & Science project "The Art of the Origin of Life".

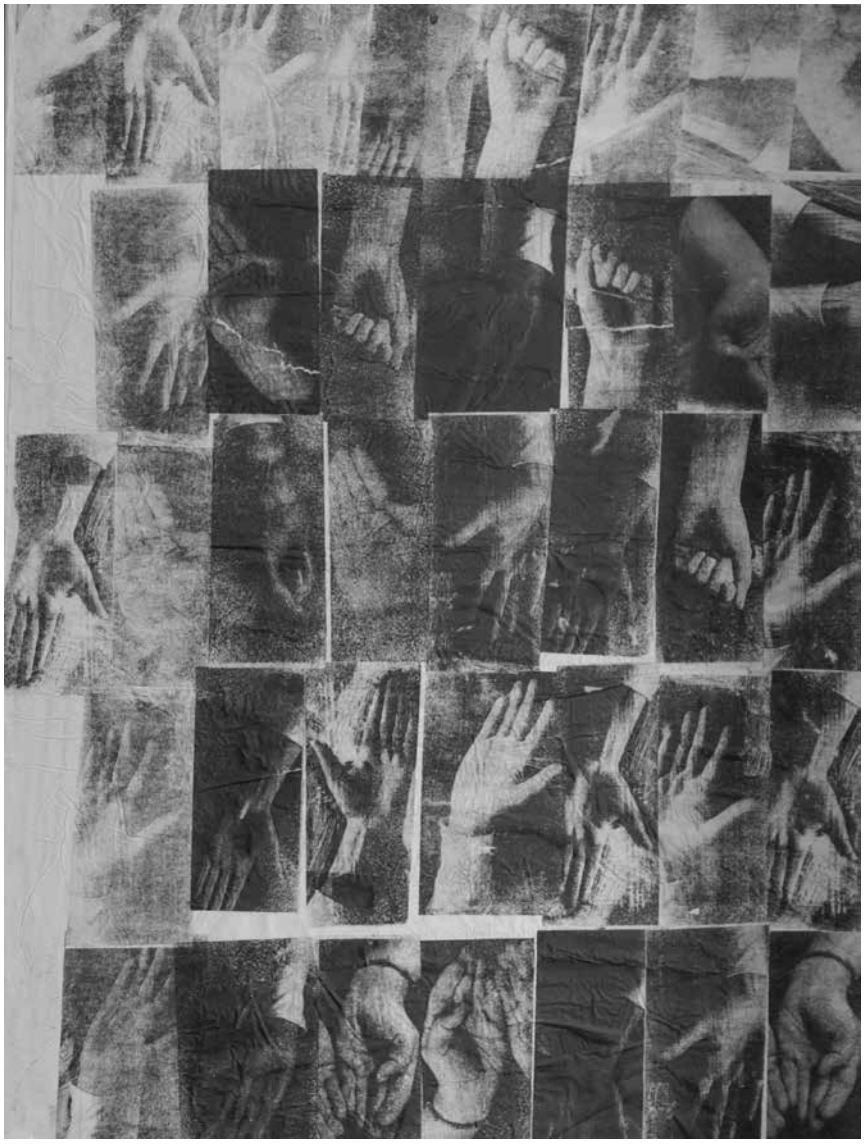
Hanna Fabczak, Nencki Foundation for Supporting Biological Sciences, Warsaw
Marek Adam Olszyński, Institute of Fine Arts, University of Rzeszów
Mirosław Pawłowski, Institute of Fine Arts, University of Rzeszów
Adam Szewczyk, Nencki Institute of Experimental Biology PAS, Warsaw

kamila**bednarska**
marta**bożyk**
sara**carrillo**
ewa**czerwińska-romanowska**
marta**dziomdziora**
paweł**frąckiewicz**
małgorzata**futkowska**
alexandra**grela**
andreas**guskos**
irwan**harnoko**
damian**idzikowski**
jarosław**janas**
agnieszka**jankiewicz**
peter**javorík**
peng**jun**
anna**kamycka**
natalia**karasińska**
jerzy**kierski**
keith**kitz**
marta**kołodziejska**
łukasz**konieczko**
ábel**kónya**
patrycja**longawa**
ewelina**maksimiuk**
zuzanna**marczak**
gyula**molnár**
malwina**niespodziewana**
antoni**nikiel**
chikako**oguma**
marek**olszyński**
mirosław**pawłowski**
krzysztof**pisarek**
marek**pokrywka**
jenifer**printz**
piotr**rędziniak**
adam**romaniuk**
justyna**ruchała**_maciej**wnuk**
tomasz**rut**
babak**safari**
christopher**scott**
kamil**skrzypiec**
jacek**sroka**
byoung-il**sun**
jolanta**szalanska**
anna**szklińska**
nicos**terzis**
krzysztof**tomalski**
magdalena**uchman**
elżbieta**wierzbicka-wela**
andrzej**wochnik**
piotr**woroniec jr**
katarzyna**woźniak**
piotr**wójtowicz**
luis**yáñez**
andrzej**załecki**
magdalena_salome**zawadzka**
jakub**zdejszy**
maria**zwolińska**

kamila**bednarska**

Polska
Poland

Was born in 1983 in Rzeszów. She deals with graphics, drawing and painting. A graduate of the Faculty of Arts at the University of Rzeszów. She obtained a diploma with honors in 2009 in the gravure printing studio of Prof. Marek Olszyński and Dr. Paweł Bińczycki and in the painting studio of prof. Stanisław Białogłowicz. Laureate of the Jerzy Panek Award for the Best Diploma at the Faculty of Arts in the 2008/2009 academic year. Since graduating, she has been working at the Graphics Department of the Faculty of Art of the University of Rzeszów. Participant of artistic projects (including inter-university exhibitions, art reviews, artistic symposia, charity auctions). Since 2012, the vice-president of the Foundation for Socio-Economic Development Invention, which supports cultural events in the Podkarpacie region. She organized 20 individual exhibitions and participated in several dozen group exhibitions, presented in Poland and abroad (including India, Morocco, Tunisia, England, Austria, Belgium, Greece, Romania, USA). She is a member of the Association of Polish Artists and Designers.



title	**giving**
year	2020
technique	flat print, paper, cotton fabric, wax
size	installation, 600 elements 20 × 7 cm

marta**bożyk**

Polska
Poland

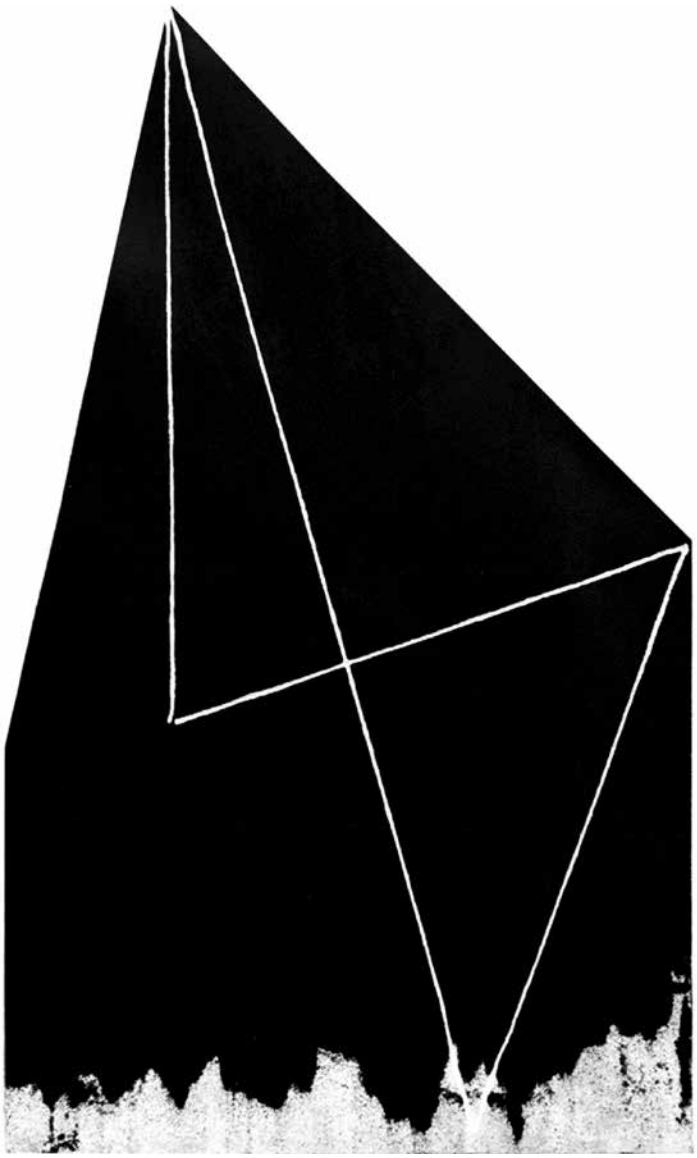
Assistant professor in the woodcut studio, Graphics Faculty of the Academy of Fine Arts in Krakow, 2013 doctor of art. Over 200 exhibitions in Poland and around the world. Awarded in Taiwan, Korea, Serbia, Macedonia and Poland. 20 individual exhibitions in Poland, Japan, USA and Serbia. Artistic residencies in Japan, Serbia, Great Britain and Poland.
Author and project coordinator:
2009/2011 Graphic Expedition — inspired by Northern Norway and Lesser Poland. EEA EEA Norwegian Grant.
2019 Washi no Fushigi, cooperation with the Manggha Museum, Museum of Papermaking in Duszniki Zdroj, Mino Cultural Hall in Mino, Museum Gifu Prefecture, Museum Washi in Japan.
2019–2020 — Mokuhanga, international project, exhibition, meeting with artists and workshops for students promoting the art of woodcut. Grant of the Ministry of Science and Higher Education No. 526 / P-DUN / 2019.
2018–2020 — Nature is my Homeland, financed by NAWA.

title	**hydrothermal chimneys**
year	2021
technique	linocut
size	75 × 107 cm

sara**carrillo**

Polska
Poland

Born in 1989, Mexico. MFA in Academy of Art in Szczecin. Diploma in intaglio techniques, supervised by professor Maria Radomska-Tomczuk.
Carrillo has been technician in print studios at her alma mater in the period 2014–2018, since 2018 is an assistant professor in relief print studio. Awarded with Rector's scholaship for the best students in the Academy.
She has presented her art works in more than 50 group exhibitions, for example The 4th International Printmaking Triennial — 2020 (Belgrade Serbia), The 8th International Triennial of Graphics Art — 2019 (Sofia, Bulgaria), Tokyo International Mini-Print Triennial — 2018 (Tokyo, Japan), VI Bienal Internacional de Grabado Aguafuerte — 2018 (Valladolid, Spain).



title	**box04.01**
year	2020
technique	monotype
size	100 × 70 cm

ewa**czerwińska-romanowska**

Polska
Poland

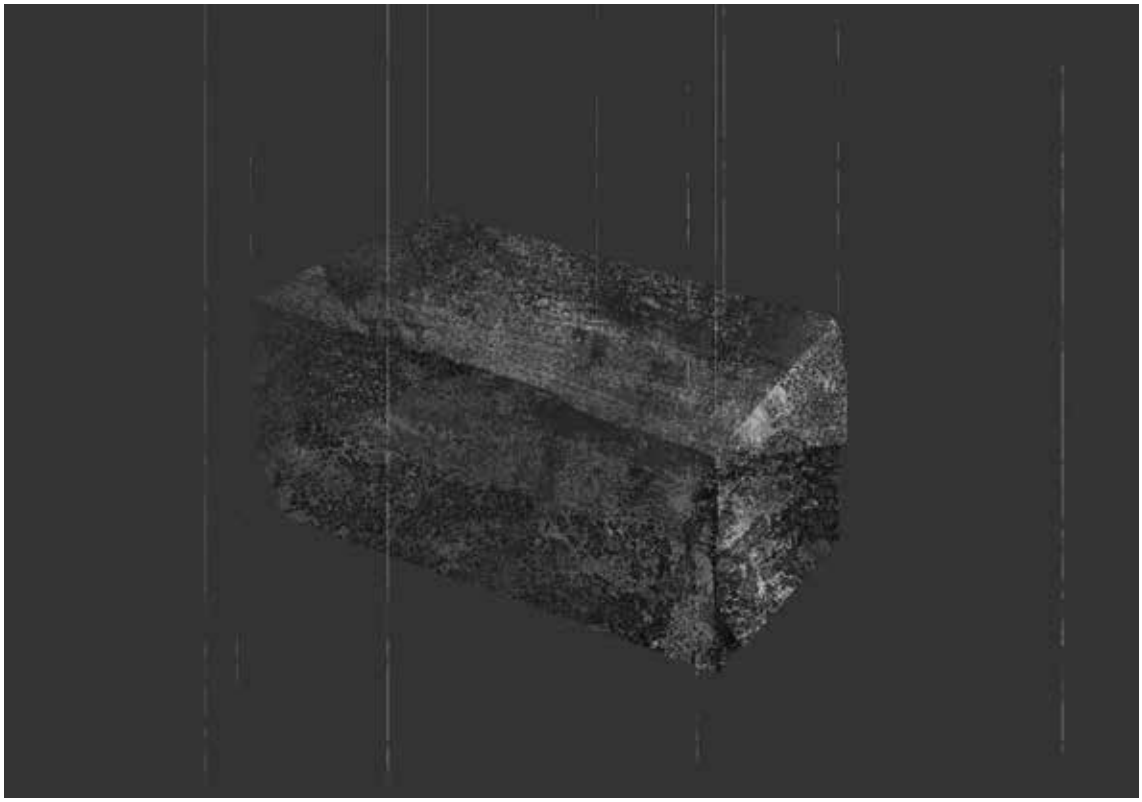
Associate professor at Academy of Art in Szczecin. She works in graphics, painting and digital art. An important element of her artistic activity is the study of the properties and potential of materials and the methods of their use in art. In her work, she takes up topics related to human relations with civilization processes, which constantly define and redefine their identity.
The multithreading of the topic, the constant layering of scientific thought and the interpenetration of various activities give these phenomena, as well as their artistic interpretation, a transcendental dimension.

title	**antropolis — high pressure**
year	2020
technique	digital print
size	70 × 100 cm

marta**dziomdziora**

Polska
Poland

Doctor of Arts – degree obtained at the Faculty of Fine Arts of the Nicolaus Copernicus University in Toruń. A graduate of the following faculties: Printmaking and Protection of Cultural Property at the same Faculty.
Assistant professor at the Faculty of Printmaking of the Academy of Art in Szczecin, where she runs the Multimedia Printmaking Studio.
In 2017–2020, she was a curator of the R + Gallery.
In 2013 and 2018, she completed research and teaching internships at the University of South-Eastern Norway in Notodden.
Author of individual exhibitions. She took part in dozens of collective exhibitions in Poland and abroad, incl. in Belgium, Bulgaria, Croatia, Israel, Japan, Canada, Spain, France, Germany, Norway, Serbia and Hungary.

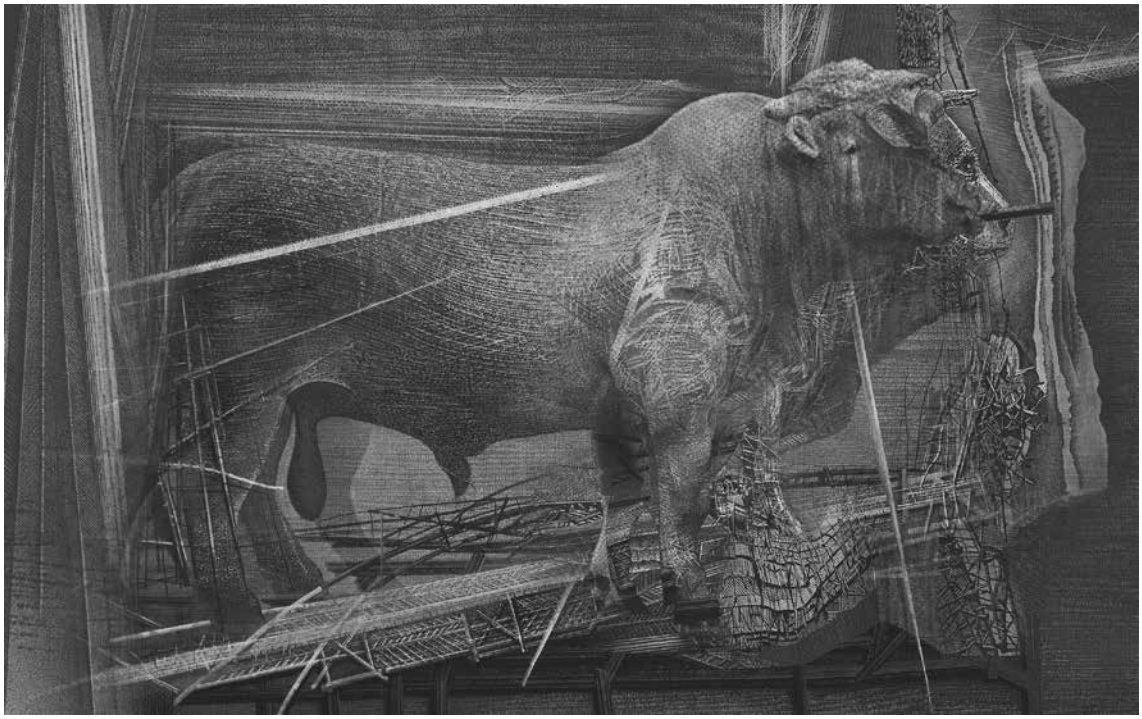


title	**beginning**
year	2020
technique	digital print
size	70 × 100 cm

paweł**frąckiewicz**

Polska
Poland

Professor, born in 1958 in Wrocław. He works with lithography, digital printing, drawing and painting. He runs the Lithography and Graphic Promotion Laboratory at the Academy of Fine Arts in Wrocław. He presented his works at 27 individual exhibitions in Poland and abroad. He participated in over 200 collective exhibitions in Poland, Europe, both Americas, Australia and Asia. In 1999–2012, curator of the International Drawing Competition in Wrocław. Winner (among others) of the Prize in the drawing category of the National Biennale of Young Art "The Way and the Truth" Wrocław 1985, the Prize of the President of the City of Pilzno in the 5th Biennale of Drawing (2005), Honorary Mention in the 2nd International Lithography Competition LItho-Kielce 2019/2020, scholarship of the Department of the US State at the Tamarind Institute in Albuquerque (1989–1990).

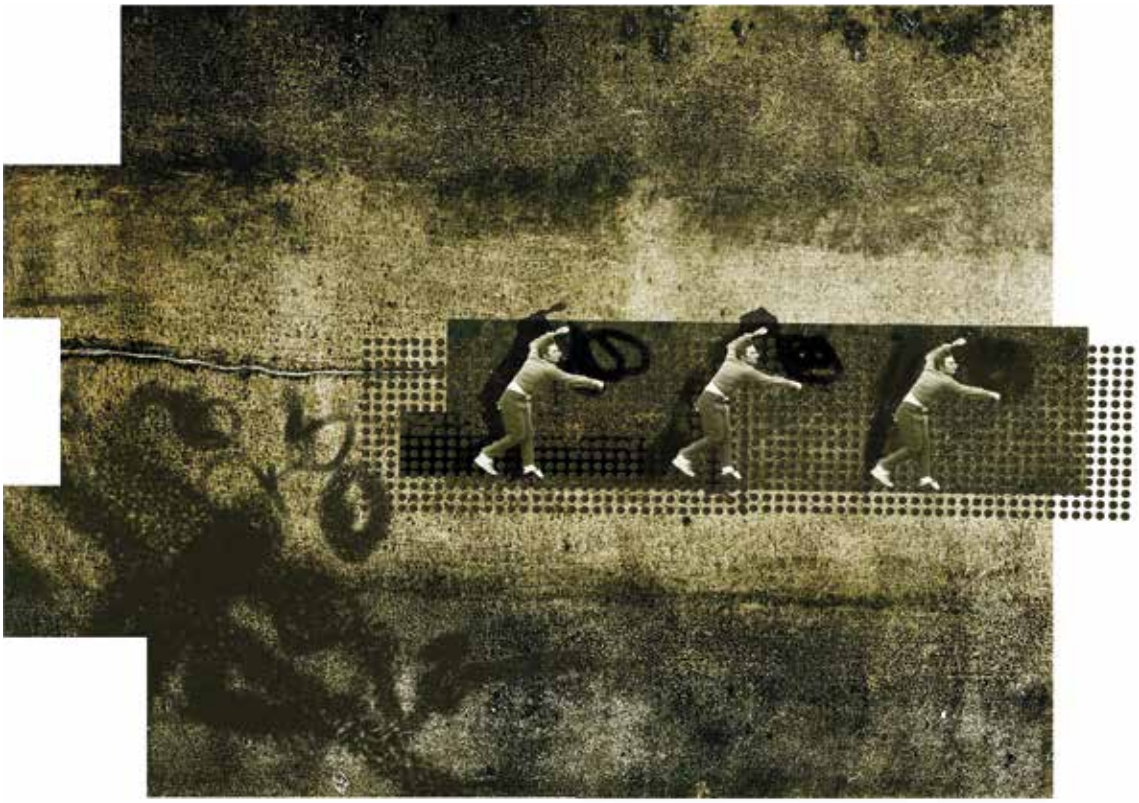


title	**gray bull**
year	2019
technique	lithography
size	63 × 100 cm

małgorzata**futkowska**

Polska
Poland

Born 1975, Opole. Visual artist.
A graduate of the Academy of Fine Arts in Wrocław. She defended her master's thesis in 2001. In 2018, she received a doctor's degree in Fine Arts in painting at the Academy of Fine Arts in Katowice. Currently, she works as an assistant professor at the Opole University of Technology, where she conducts classes in the field of Industrial Design. She is engaged in easel painting, graphics and photography. She has participated in numerous exhibitions presenting her works at art reviews and competitions, both in Poland and abroad.



title	from the series **evolution — evolution 01110**
year	2020
technique	digital print
size	40 × 50 cm

alexandra**grela**

Węgry
Hungary

Born in Świętochłowice (Poland) in 1974. She graduated from the Academy of Fine Arts in Krakow at the Faculty of Painting, where in 2012 she obtained the title of Doctor of Arts (DLA). She has been living in Hungary since 2005. She took part in nearly one hundred exhibitions presenting her artistic achievements in the field of painting, graphics and illustration. Her works are in many Polish and foreign collections. They were presented in Hungary, Poland, France, Italy, Germany, Russia, Romania, Slovakia, Macedonia, Turkey, Egypt, China, Japan, Argentina and Uruguay. Major awards: Grand Prix at the 1st Festival of Illustrations in Budapest (Billufeszt) — 2019, Grand Prix at the VIII. Silver Quadrangle International Painting Triennial in Przemyśl — 2006. She also received numerous distinctions and honorary awards at many painting and illustration reviews.

title	**arcanum**
year	2014
technique	mixed technique on paper
size	69,4 × 60 cm

andreas**guskos**

Polska
Poland

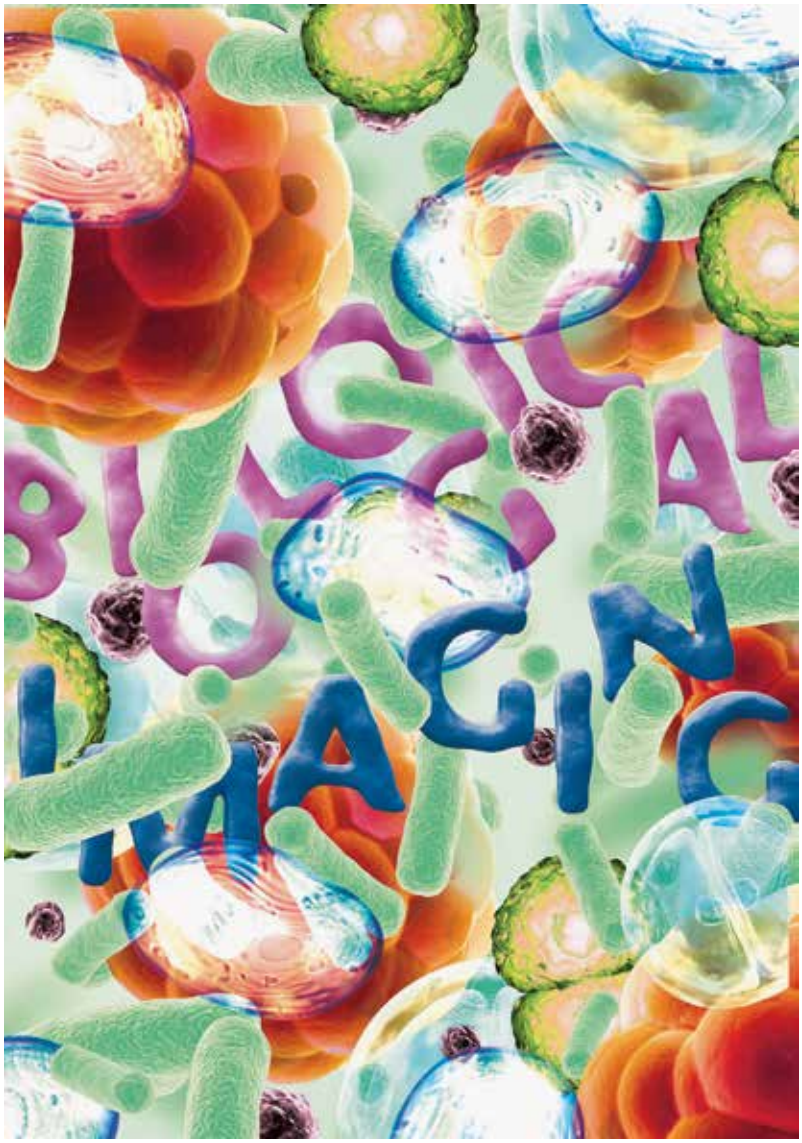
PhD D.Sc., Associate Professor Ph.D. and D.Sc. in Art. MA Eng. in Architecture. Working in the fields of Art, Design and Architecture. Exhibited and presented his works in Poland, Germany, Ukraine, Czech Republic, Greece, Italy, UAE, USA, Taiwan, Hongkong, Mainland China, Israel and Japan. Vice Rector for International Cooperation, Academy of Art in Szczecin, Poland. President of the Association for the Support of Art, Science and Technology Development MEDEA. Originator and developer of the International Interdisciplinary Symposia on Art, Science and Technology MEDEA.

title	**fractal 299**
year	2020
technique	digital print
size	75 × 100 cm

irwan**harnoko**

Indonezja
Indonesia

He was born in Bandung (July 18. 1971), Indonesia. Irwan is graduate of design and fine arts at Trisakti University, where he received a Master's degree at the same University. He is a graphic designer, educator, art curator and jury. He designs posters and visual identity. He has held exhibitions and design events, but also been a jury and participated in various prestigious poster exhibitions, both in Indonesia and abroad (especially in China, Poland, South Korea, Japan, Russia, USA, Greece, United Arab Emirates, Lithuania, Ukraine, Mexico, Ecuador, Hungary, Cyprus). He is the founder and the leader of the Worldwide Graphic Designers community which has held exhibitions in four countries: Cyprus, Greece, Indonesia, Iran. Worldwide Graphic Designers (WGD) is a group of graphic designers which organize projects of poster design with social content. The participants, all established designers from all over the world, are invited to create collaboration posters, aiming the awareness, the sensitization and social reflection. He is also one of the founder of the Type Unite (TU) community (Members consist of several countries from within and outside the country: Indonesia, USA, Poland, Turkey, Ecuador, Hungary, United Arab Emirates and South Korea). TU has held exhibitions in four countries: Indonesia, Unied His works have been presented at over 100 exhibitions. Irwan works as a Professor at Pradita Institute in Jakarta — Indonesia especially in Typography course.



title	**biological imaging**
year	2020
technique	poster
size	100 × 70 cm

damian**idzikowski**

Polska
Poland

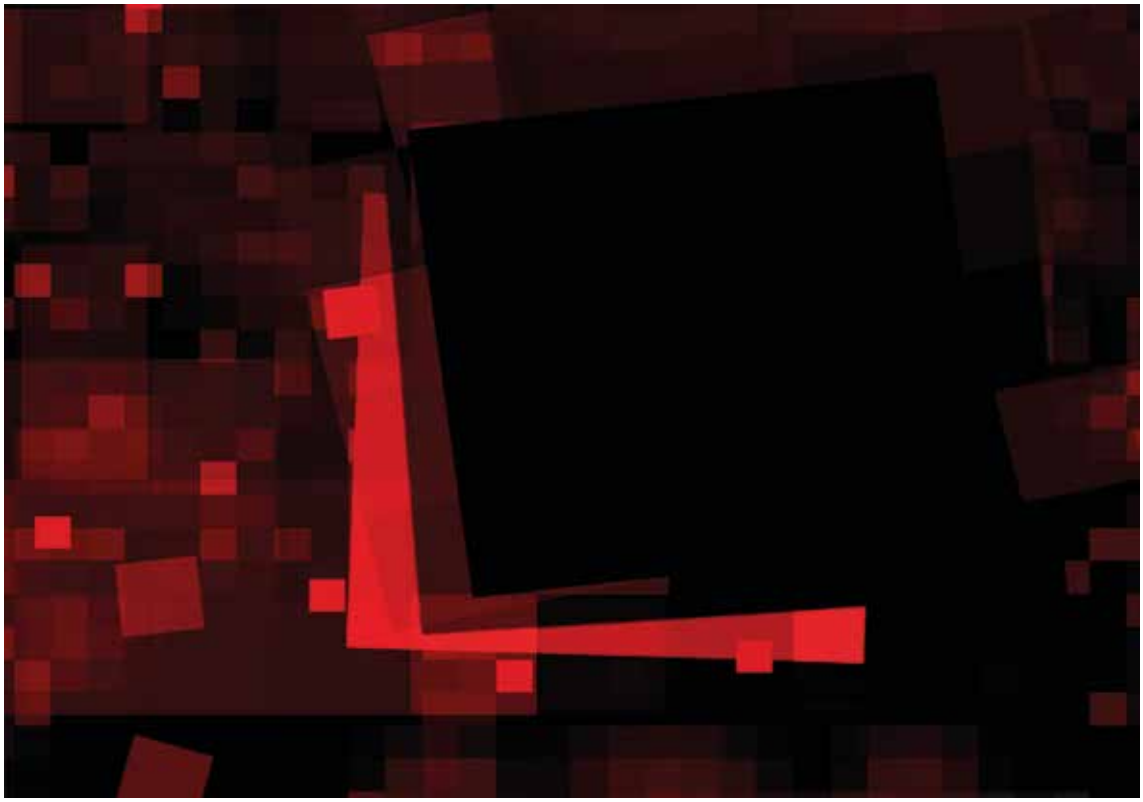
Was born in 1991 in Lodz. In the years 2010–2015 he studied at the Faculty of Graphics and Painting of the Strzemiński Academy of Art Lodz. In 2015, he defended his diploma with distinction in the Mixed Techniques Studio.
From 2010 to the present, he has been cooperating with the Association "Every day and from Holidays" in creating a path of Memory Murals — Children of Baluty. In 2017, he made an artistic residency at Guanlan Original Printmaking Base in China and took part in the "Belt and Road" art project. In the same year he took part in an artistic residency in the Proyecto Ace program in Argentina. In 2019 he achieved PhD title, and since 2015 he is working as an lecturer at home university with Krzysztof Wieczorek in Basic of Graphic Studio.
Solo exhibitions:
2017 — Lenguaje Grafico, exhibition of graphics of the ACE proyecto, Argentina, Buenos Aires.
2017 — Damian Idzikowski Graphics, City Art Gallery in Łódź: Chimera Gallery
2018 — Damian Idzikowski Graphics, The Arthur Rubinstein Philharmonic in Lodz.
Group exhibitions
2016 — Biennial Print Exhibit, Taiwan, Republic of China.
2016 — Participation in the 1st Xuyuan International Print Biennial, Beijing, China.
2017 — "Belt and Road" supported by the Chineese National Academy of Arts.
2017 — Self Images & Other Eyes, Seosan City Institute from Visual Modern Arts, Korea.
2019 — Lodz Graphics on a Silk Road, China Printmaking Museum, Guanlan, China.
2019 — ExExExhibition, ZadArt Gallery, Croatia.
2019 — 4 Global Print, Municipal Auditorium Douro Museum, Portugalia.

title	**structure portrait**
year	2020
technique	Digital print, waterless lithography
size	66 × 96 cm

jarosław**janas**

Polska
Poland

Born in 1981 in Opole. Graduate of PLSP in Opole. In the years 2001–2002 EA studies at the Institute of Art at the University in Opole and next at the Faculty of Graphics of the Academy of Fine Arts in Poznań. Graduated with distinction from Serigraphy Studio. In the years 2007–2019 he was associated with the II Printmaking Studio — Serigraphy at UAP. Currently he works as an assistant professor at the Department of Artistic Graphics at the University of Arts in Poznań. He deals with artistic graphics, sculpture and set design. Three times awarded at TGP in Katowice. He took part in over a hundred exhibitions in Poland and abroad.



title	**episode 0 (zero)**
year	2020
technique	multiple pigment printing
size	70 × 100 cm

agnieszka**jankiewicz**

Polska
Poland

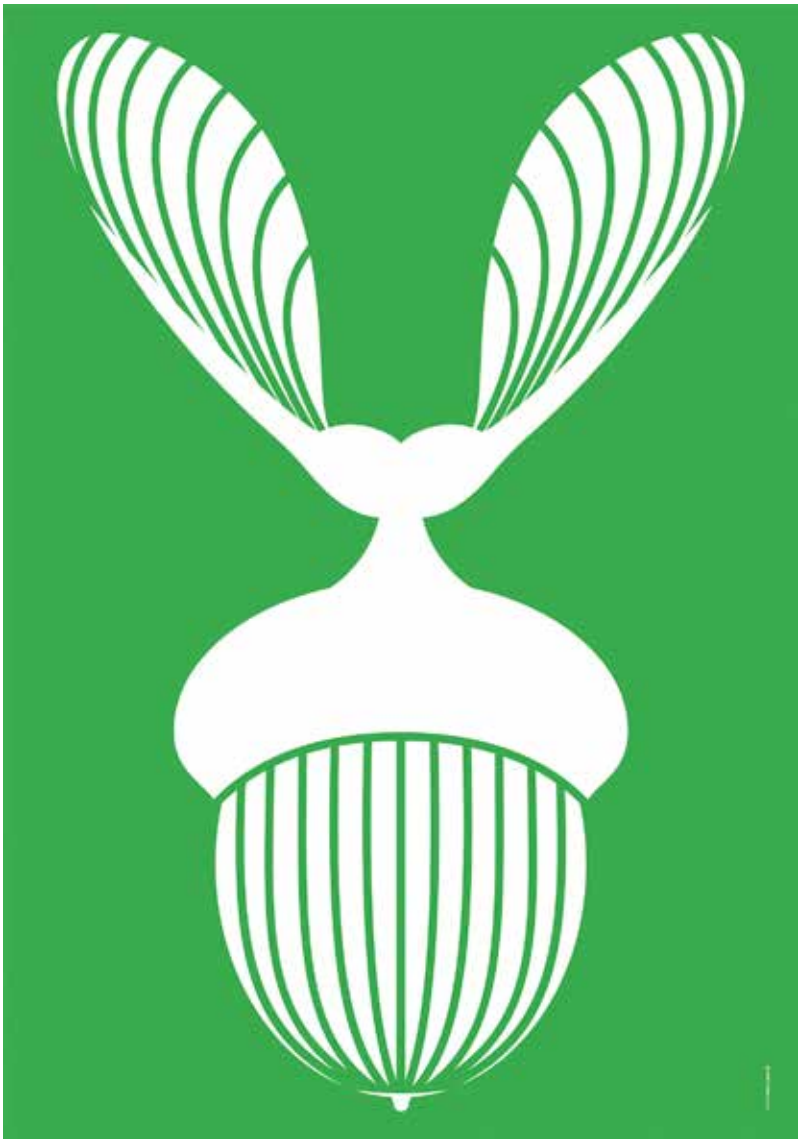
Born in 1983 in Świnoujście.
She obtained a master's degree in the field of Printmaking at the Academy Art in Szczecin in 2009 — diploma thesis in linocut technique in the studio of prof. Andrzej Załecki. Since 2010, she has been working in the relief printing studio at the Department of Printmaking at the Academy of Art in Szczecin. After defending her doctoral dissertation in 2018 (at the University of Arts in Poznań, Faculty of Printmaking and Visual Communication), she runs the Studio of flat and spatial forms of relief printing at the Academy of Art in Szczecin. She has taken part in many collective and individual exhibitions as well as national and international competitions. Most important awards: in 2015, she won the Grand Prix of the Polish Woodcut and Linocut Quadriennial in Olsztyn for her works from the „Return of Form" series, a special award of the Dean of the Faculty of Fine Arts of the Nicolaus Copernicus University in Toruń in the "Pomeranian Printmaking of the Year 2017" and the First Award For Young Artist as part of Osten Biennial of Drawing Skopje 2018 Awards. In her works, she most often uses the linocut technique. It draws inspiration from selected phenomena, processes and events characteristic of modern man.

title	**identity**
year	2020
technique	linocut
size	90 × 70 cm

peter**javorík**

Słowacja
Slovakia

Peter Javorík, born in 1982 in Žilina (Slovakia). Most of the time he works as a lecturer in the Faculty of Industrial Design at Academy of Fine Arts in Krakow. But as a freelancer, he also commutes between Bardejov and Košice, which is his hometown. He studied at the Faculty of Arts in the Technical University of Košice, were in 2012 he finished his master studies, and in 2016 he accomplished doctoral studies in the field of Visual Communication at the Department of Design. He achieved significant international success (Golden Bee Award) in Moscow in 2014 for a poster called Athe-ism. During 2015, he was successful at several international exhibitions, such as Mexico exhibition, Death With a Smile. In the same year, he participated in the Bienal del Cartel in Bolivia and Italian Poster Biennial. In 2016 he had an individual exhibition in Košice and Bardejov and was successful at several international exhibitions, such as the Biennale in Ecuador, Moscow, Auschwitz, Mexico, Sofia, Monse, or Taichung. In 2017 he organized his own exhibition named "Graphic Signs", in Krakow, and in 2018 he prepared two curatorial projects in Bardejov — a Chinese graphic poster (130 authors) and 100 years of the Russian revolution (440 authors) — both of them have publications. He has participated in more than 50 global and local exhibitions. Besides, he earned several awards — he took first place at the Moscow Biennale (Russia) for cultural posters, he placed second for the theater poster in Chişinău (Moldova), and he got an honorable mention at the Quito Biennale (Ecuador).
In 2019 he created the City of Bardejov project, which invited more than 600 designers from around the world to create a poster for Bardejov.



title	**naturalistic shapes and forms**
year	2020
technique	poster
size	100 × 70 cm

peng**jun**

Chiny
China

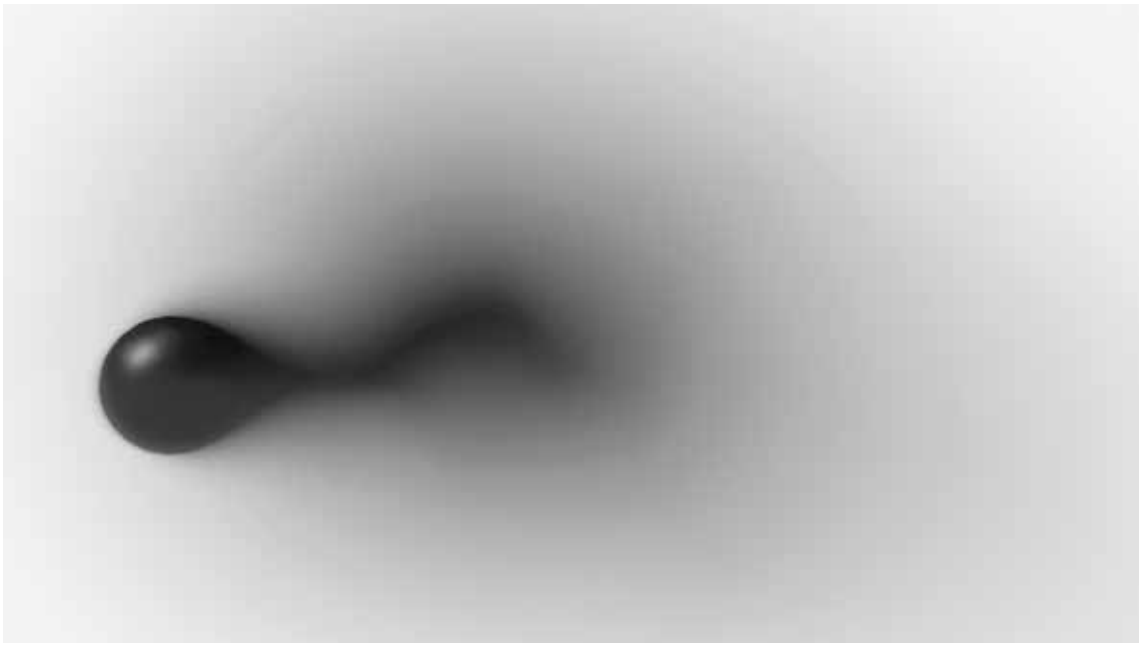
He is the dean of advertising Department of Wuhan Polytechnic University. International council of graphic design associations/ membership. China Europe International Design Culture Association/director.
Organization and planning activities: 2020 Beijing the 3rd Exhibition of Contemporary International Ink Design Exhibition. 2020 the CCII linternational Biennial Award "Father Love, Wisdom Design". 2019 The 2nd Yangtze river light cross-strait poster invitation exhibition. 2019 Hebei in world's view international poster. 2019 "Jinyuan Tourism" Cultural and Creative theme competition of the 5th Taiyuan Youth Entrepreneurship Innovation Competition. 2019 the first racing culture international poster invitation exhibition. 2019 Wuhan Commemorative Exhibition of the 108th Anniversary of the Revolution of 1911.

title	**bloodstain**
year	2020
technique	poster
size	100 × 70 cm

anna**kamycka**

Polska
Poland

Born in 1993 in Rzeszów.
In 2017, she graduated with honors from the Faculty of Art of the University of Rzeszów. Honored with the Rector's Recognition Diploma. She was successful in design and art competitions. Since 2014, she has participated in over 20 individual and collective exhibitions. She specializes in creating 3D models, 3D printing and comics. Many of her 3D projects were published on Polish and foreign websites. Since 2017, she has been teaching 3D Graphics at the Institute of Fine Arts (former Faculty of Art) of the University of Rzeszów and creates commercial projects.



title	**orb**
year	2020
technique	digital print and photogrammetry
size	56 × 100 cm

natalia**karasińska**

Polska
Poland

Born in 1982 in Gorlice. Graduate of the Faculty of Art at the University of Rzeszów. Studies in the field of graphic arts in the studio of prof. Marek Olszyński. In 2006, a diploma in painting in the studio of prof. Antoni Nikel with a very good result. In 2017, she graduated from the Postgraduate Studies in Museology at the Institute of Ethnology and Cultural Anthropology at the Jagiellonian University in Krakow. Since 2008, a member of the Art Club of Alfred Długosz at the Art Gallery "Dwór Karwacjanów and Gładyszów" in Gorlice. Author of individual exhibitions, also participates in group exhibitions.

title	**the second is poor**
year	2020
technique	mixed technique
size	14,5 × 20,8 cm

jerzy**kierski**

Polska
Poland

Born in 1954. Studies at the Institute of Fine Arts of the Maria Curie-Sklodowska University in Lublin. In the years 1979–2003 he worked at his alma mater as a teacher. Since 2003, he has been working at the Faculty of Art (formerly the Institute of Fine Arts) of the University of Agriculture, where in 2008–2016 he was the Dean of the Faculty. He practices sculpture. Artistic achievements: 26 individual exhibitions and participation in several dozen group exhibitions. Author of the Way of the Cross — a series of full-size stone reliefs for the church in Miedzyrzecz (Lubuskie Voivodeship). Associate professor at University of Rzeszów.

title	**source**
year	2019
technique	stone, bronze
size	24 × 24 × 14 cm

keith**kitz**

Stany Zjednoczone
United States

An artist, designer, and educator living in Boston, Massachusetts. He is the founder of Keith Kitz Design, a private practice that services clients both nationally and internationally. Kitz is also the Program Director, Master of Arts in Graphic Design (MAGD), and an Assistant Professor, Graphic Design in the College of Arts & Sciences at Suffolk University. Keith studied graphic design at Mount St. Joseph University (BA) and at The College of Fine Arts at Boston University (MFA). His award-winning work has been chronicled in books, periodicals, exhibitions, and collections throughout the United States, and internationally in Albania, Aruba, Austria, Belarus, Belgium, Bulgaria, China, Columbia, the Czech Republic, Ecuador, Estonia, France, Germany, Greece, Hungary, Iran, Indonesia, Italy, Lithuania, Mexico, the Netherlands, Peru, Poland, Republic of Moldova, Russia, South Korea, Slovakia, Spain, Switzerland, Taiwan, Turkey, Trinidad and Tobago, Ukraine, United Kingdom, Uruguay, and Venezuela.

title	**need forethought**
year	2020
technique	poster
size	100 × 70 cm

marta**kołodziejska**

Polska
Poland

Born in 1979 in Świnoujście, a graduate of WSSU in Szczecin. Diploma in the studio of Prof. Maria Radomska Tomczak and Prof. Andrzej Załecki in 2006. Since 2010, assistant in the Rotogravure workshop in the Academy of Art in Szczecin.
It combines traditional graphic techniques with broadly understood experiment. In her works, she presents a wealth of textures etched in metal, shown as a graphic object. Structural, expressive forms refer to contemporary and human problems. Organizer of cyclical actions, including "Prints for the Christmas tree", "Picnic with graphics". Since 2016, she has been running the Atelier Pink Rhino studio (Pomellen / Germany), where she integrates children and youth of the borderland through art.

title	**sensiti(se)verity**
year	2020
technique	etching, aquatint, monotype
size	100 × 70 cm

łukasz**konieczko**

Polska
Poland

Artist-painter, born in 1964 in Krakow. A graduate of the Faculty of Painting at the Jan Matejko Academy of Fine Arts in Krakow. Diploma with honors in 1990 in the studio of doc. Z. Grzybowski. Since 1990, he has been employed at his alma mater, since 2005 as a professor at the Faculty of Conservation and Restoration of Works of Art, where he has been running a Painting Studio since 2012. In 2016, he was awarded the title of professor.
Author of eighteen individual exhibitions, participation in 120 exhibitions at home and abroad (Lithuania 1991; France 1992; Germany 1992, 1993, 1994, 1995, 1997, 2001, 2002, 2016; Netherlands 1992; USA 1992, 1993, 1994; Switzerland 1994; Sweden 1995; Belgium 1995; Denmark 1998; Ecuador 2005; Croatia 2008; Spain 2010, 2011, China 2016; Czech Republic 2018 and Bulgaria 2018).

title	**reality image: birth of a painting**
year	2018
technique	oil on canvas
size	197 × 197 cm

ábel**kónya**

Węgry

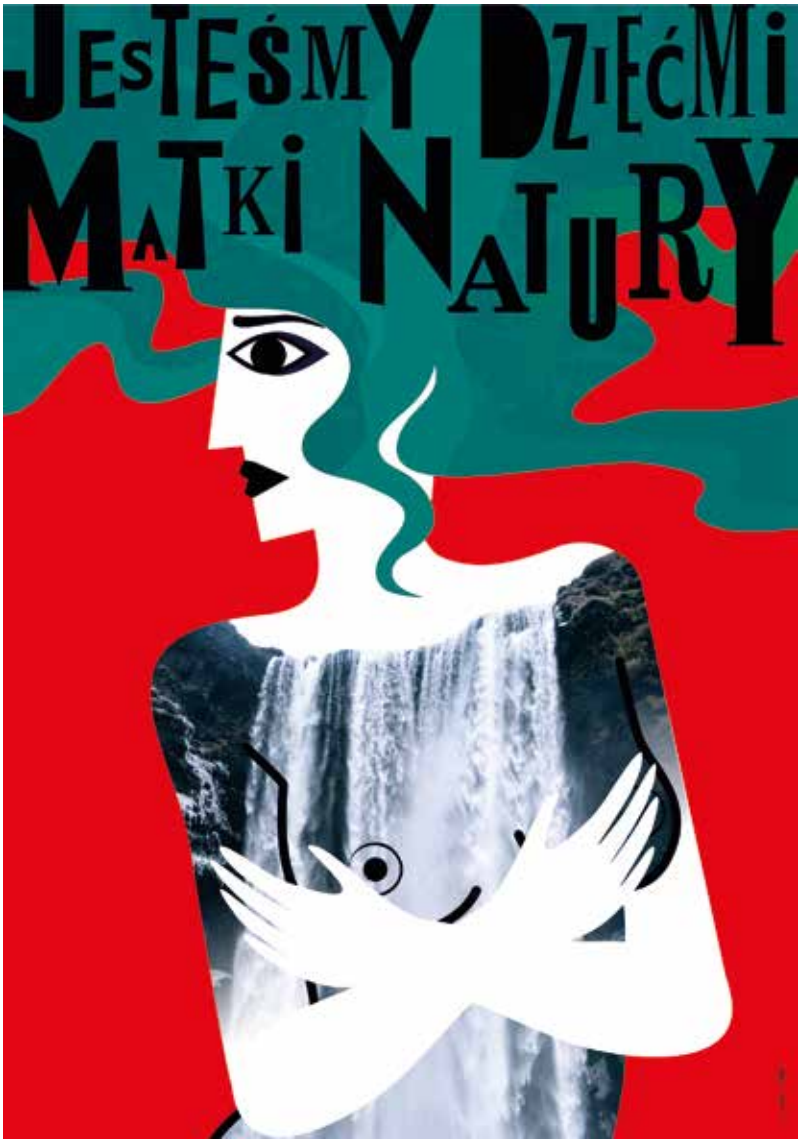
He lives in Debrecen. He studied graphics at the Academy of Fine Arts in Krakow, where he graduated from Intermedia. In 2003–2005 he lived in Germany as an associate of the Batuz Foundation. In 2005 he moved to Hungary. In the field of visual arts, he mainly creates graphics, videos, digital paintings, objects and installations. His experimental animation TRANSIT has been shown in 16 countries at international festivals and film screenings. He has participated in many individual and collective exhibitions in Hungary, Poland, England, Germany, Switzerland, Austria, Italy, Macedonia, Slovakia, Romania, Cuba, China, South Korea, Japan, Uruguay and the United States. In addition to artistic work, he is involved in graphic design, teaching and curatorial work. From 2016 to 2019, he was the chief curator of the MODEM Center for Modern and Contemporary Art in Debrecen. Since 2019, he has been the director of the Gallery of Contemporary Art in Miskolc.

title	**aquarius** frome series **neo-genesis**
year	2009–2020
technique	c-print on paper
size	126 × 70 cm

patrycja**longawa**

Polska
Poland

I was born on February 9, 1988 in Sanok. In 2012, I was awarded a Master of Arts at the Faculty of Art of the University of Rzeszów. In 2013 I graduated from the second faculty of graphics, at the Faculty of Art of the University of Rzeszów. The diploma in graphic design was nominated for the Jerzy Panek Award for the best artistic diploma of the Faculty of Art at the University of Rzeszów in 2013. I am involved in illustration, drawing, graphics, poster and satirical drawing. I presented my art works at about 270 exhibitions in Poland and abroad, among others in 40 countries. I have won 47 awards, distinctions and nominations in Poland and abroad. In 2020, I received a creative scholarship from the Marshal of the Podkarpacie region. I was a Juror in the following international competitions: Poster Contest — Escuchamivoz, UDA, Ecuador Poster Bienal, Pre-Selection Committee and many others.

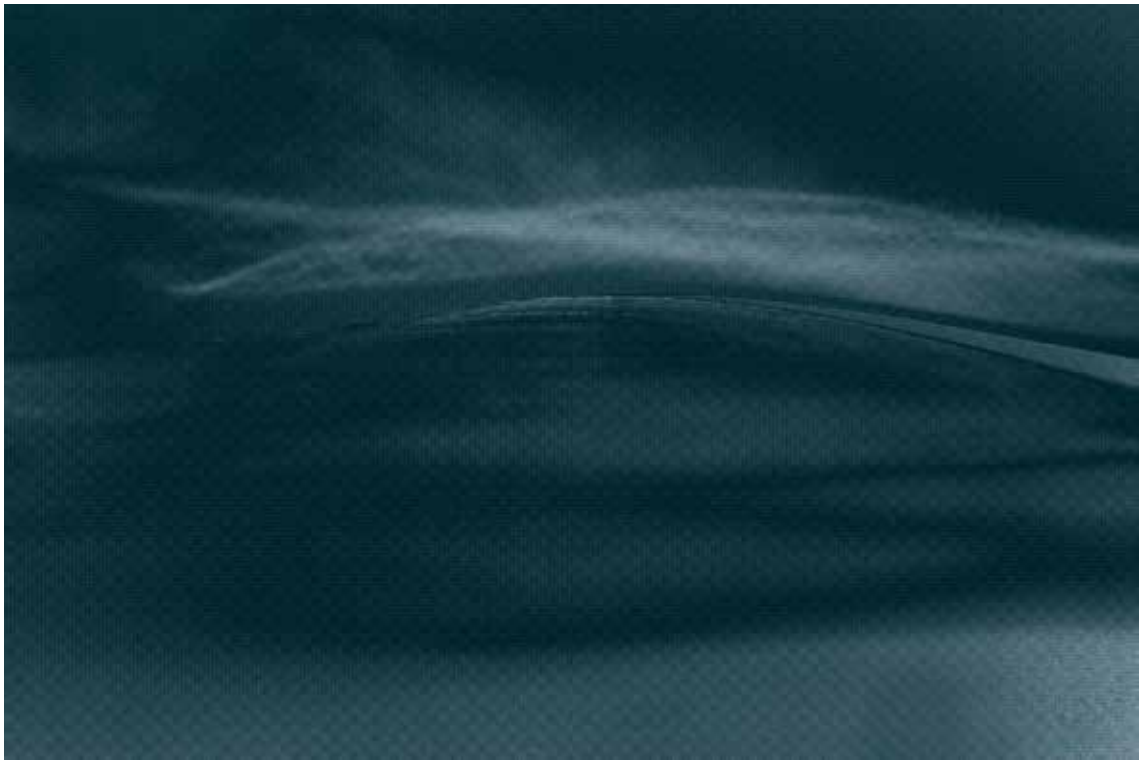


title	**we are children of mother nature**
year	2020
technique	poster
size	100 × 70 cm

ewelina**maksimiuk**

Polska
Poland

A graduate of Printmaking at the Faculty of Visual Arts, Academy of Art in Szczecin. Master's degree defended with honors in 2018. Currently an assistant at the Faculty of Printmaking, AS in Szczecin. Author of individual exhibitions, participant of several dozen international and national exhibitions, including: 8th International Print Triennial in Sofia, 8th Graphic Biennial in Macedonia, 10th International Biennial of Small Forms in Pleven — Bulgaria, and the International Biennial of Graphic Art in Mexico. Her works could also be seen at the Center for Contemporary Art in Toruń, at the National Museum in Szczecin, at the Art Armory in Gdańsk during the "The Best Diplomas of Academies of Fine Arts 2018", at the Polish Young Printmaking GP in Krakow.
A scholarship holder of the Artistic Award of the President of the City of Szczecin. Maksimiuk, deals with the creation of sculptural objects, installations, digital graphics and design. In her works, she often uses traditional sculptural media, supplementing them about digital media.



title	**mareas**
year	2020
technique	digital print
size	70 × 100 cm

zuzanna **marczak**

Polska
Poland

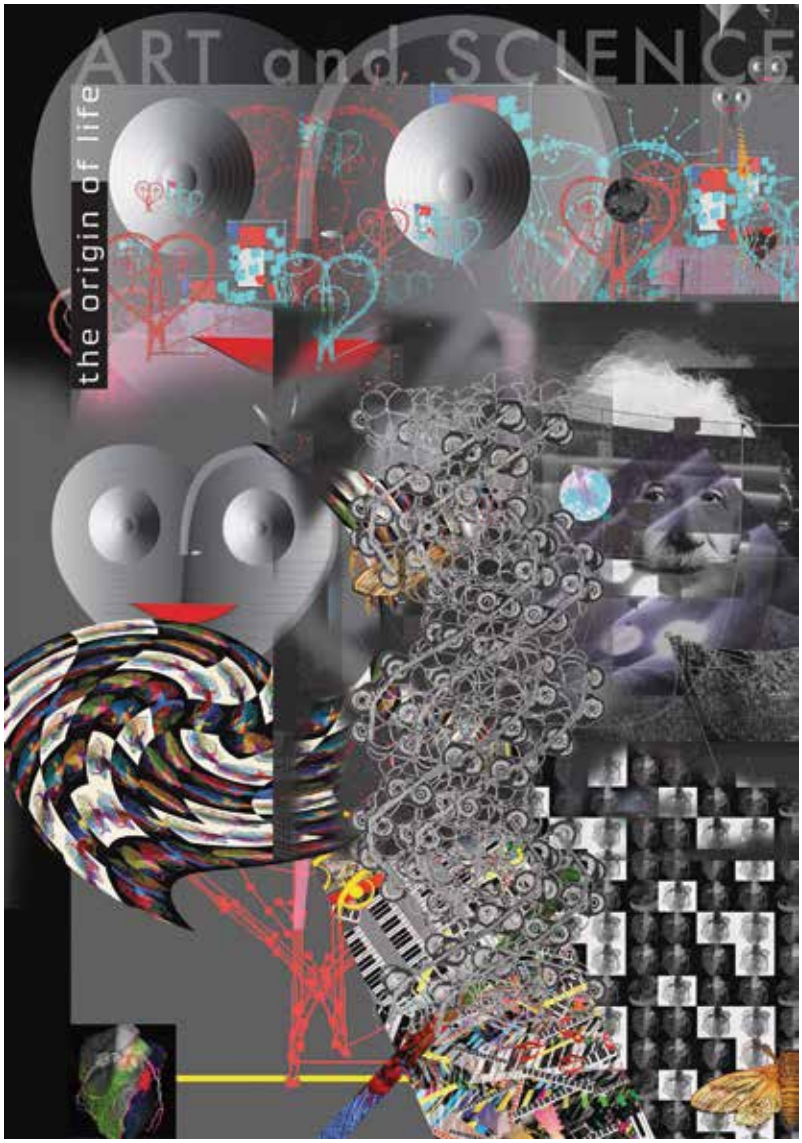
A graduate of the Academy of Art in Szczecin. In 2019, the master's diploma "Exercises in space-time", carried out in the studio of Sculpture and Digital Transformation of dr hab. Małgorzata Kopczyńska (award of the Marshal of the West Pomeranian Voivodeship for the best artistic diplomas). Bachelor's diploma "Poster Laboratory — Posters for Jerzy Grotowski's plays" was defended with distinction in the Poster and Illustration Studio of prof. Leszek Żebrowski in 2018. An intern in the lighting and stage design department at the Współczesny Theater in Szczecin. From 2019, a member of the Transeunte group: Laboratory of artistic creativity. The performance "Ayes del Alma" was shown at the Canson Theater in Havana and at the Kana Theater in Szczecin. Participant of exhibitions in Poland and abroad.

title	**biosystems of (un)known people**
year	2020
technique	serigraphy
size	100 × 70 cm

gyula**molnár**

Węgry
Hungary

He is a graphic designer and art teacher. Graduated in graphic design from the Hungarian Academy of Applied Arts in 1971. Between 1998 and 2013 he was chair of the Department of Visual Communication and the Department of Graphic Design at the institution known today as the Moholy Nagy University of Art and Design, where he was appointed professor in 2002. He's been a member of the Hungarian Poster Association since 2010. His posters were to be seen in different cities in over 25 countries and featured in more than ninety individual and group exhibitions in the past seven years alone. He's had thirteen national and international individual exhibitions in Graz, Cracow, Belgrade, Budapest and Nyíregyháza among other places. He is the holder of over twenty national and international awards including five "Poster of the Year" prizes. In 1993 he won a gold medal at the New York Festivals "Best Works of the World" exhibition. He was awarded the Noémi Ferenczy Prize in 1999, the Golden Pin Lifetime Achievement Award in 2004 and the György Konecsni Lifetime Achievement Award in 2010. His international awards from the last few years alone include the 2016 Outstanding Design Award from Xiamen, China, the 2019 Huqlu Pisa Award from Suzhou and the 2018 Excellence Award from the China Printing Design Biennale from Beijing. 2020 Laureate in Univos XXI. Century International Poster Contest in Vitebsk.



title	**the origin of life**
year	2020
technique	poster
size	100 × 70 cm

malwina**niespodziewana**

Polska
Poland

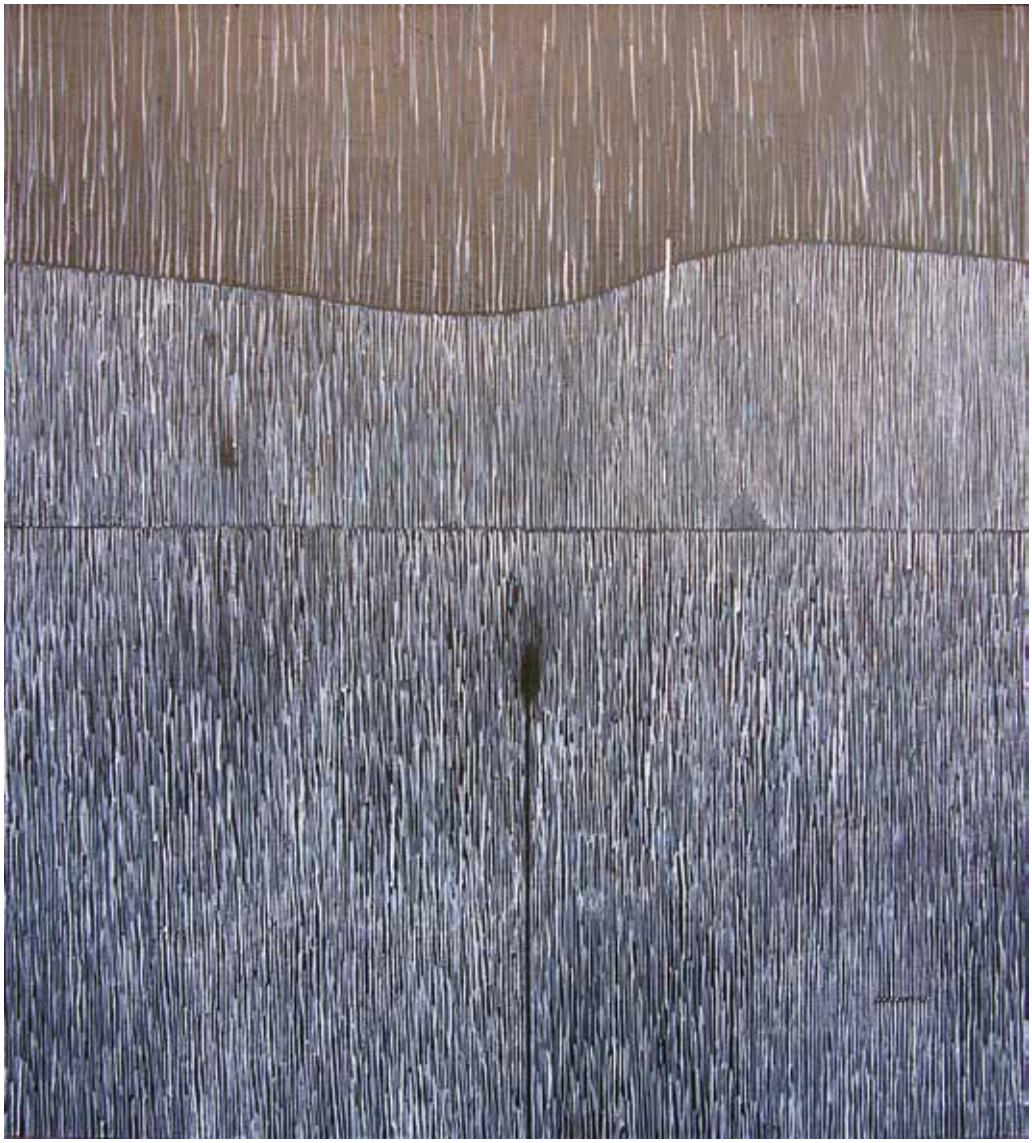
Graphic artist, draftsman, author of objects, installations and videos, researcher, graduate of the Faculty of Graphics at the Academy of Fine Arts in Krakow, dr hab., Prof. UP in Krakow. The body remains a constant point of reference in her work, in her works she also refers to the biographies, texts and works of avant-garde artists. An important element in her work is a journal that has been written for many years and the artistic journeys she has made, especially to the Far East. The artist also takes up narrative threads in her work. She is mainly interested in the topic of a female figure in fairy tales, especially in the feminist, anarchist and negative terms, as well as the topic of the transformation of the female body into, for example, a plant or an animal.

title	**relativity of forms**
year	2020
technique	linocut, handmade lokta paper, archival paper
size	78,5 × 52,5 cm

antoni**nikiel**

Polska
Poland

Born in 1959 in Gorlice. Associate professor of the University of Agriculture. He practices painting and drawing. A graduate of the State Secondary School of Fine Arts in Jarosław. Studies at the Institute of Artistic Education of UMCS in Lublin. He obtained his diploma in the Painting Studio of prof. Marian Stelmasik (1986); doctorate (2000) and habilitation (2012) at the Academy of Fine Arts in Krakow. He has been professionally associated with the University of Rzeszów since 1995.
In 2001–2003 he was the Deputy Director for Didactics at the Institute of Fine Arts of UR, in 2008–2011 he was the Deputy Dean for Didactics at the Faculty of Arts of UR, and from 2016 to 2019 he was the Dean of the Faculty Fine Arts UR. He is employed as a professor at the Department of Painting at the Faculty of Arts of the University of Rzeszów, where he runs the Painting Diploma Workshop. He is a member of ZPAP, the "Fraza" Literary and Artistic Association and the "Na Drabinie" artistic group.
He understood 25 individual and over 200 collective exhibitions in Poland and abroad. His achievements include 15 awards and distinctions for artistic activity.

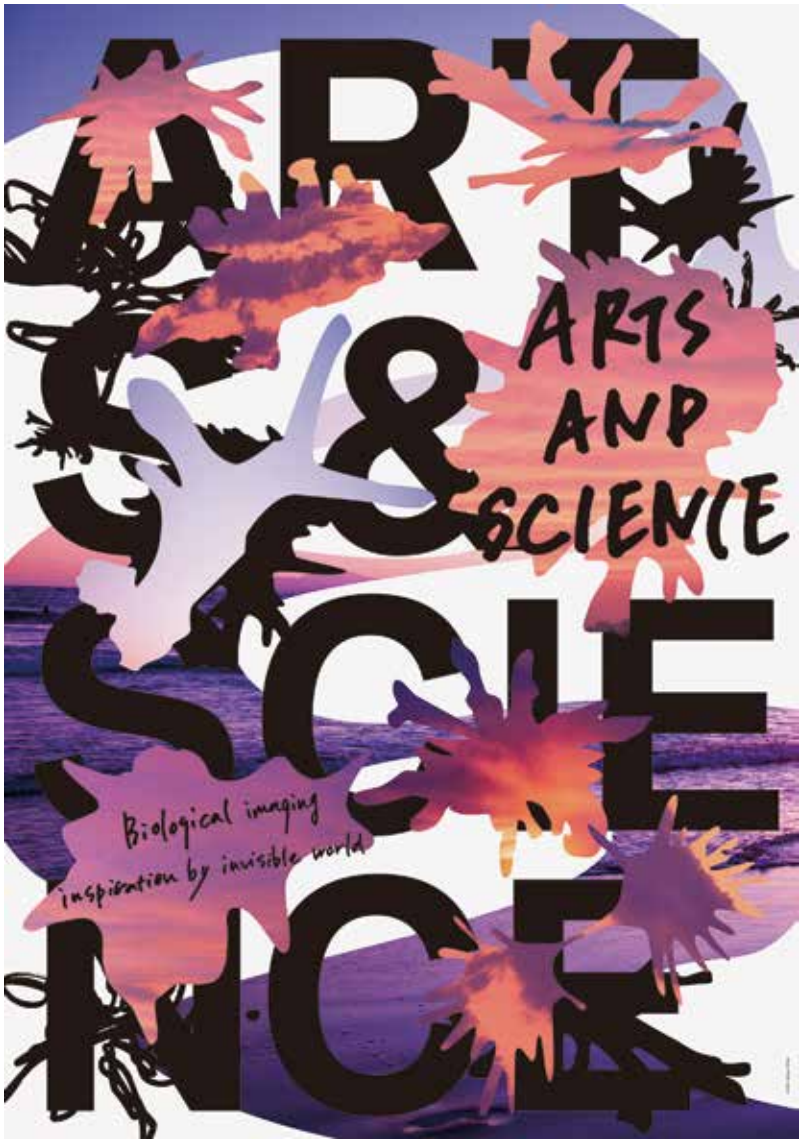


title	**landscape of life**
year	2006–2020
technique	acrylic on canvas
size	100 × 92 cm

chikako**oguma**

Japonia
Japan

Art director, graphic designer.
Graduated from Nihon University College of Art, majoring in painting.
My work is based on graphic design and includes editorial, branding, CI, VI and signage planning. I ran Little Book Label “Prelibri” with photographer Chihiro Ichinose from 2011 to 2016, and “You are here” from 2017.
I have participated in poster exhibitions in Japan and abroad.
Has received many awards.
Member of the Japan Graphic Designers Association (JAGDA)
Member of Asia Designer Communication Platform (ADP)
Member of RINC Red Internacional De Creadores Visuales
Member of Worldwide Graphic Designers.



title	**art and science**
year	2020
technique	poster
size	100 × 70 cm

marek**olszyński**

Polska
Poland

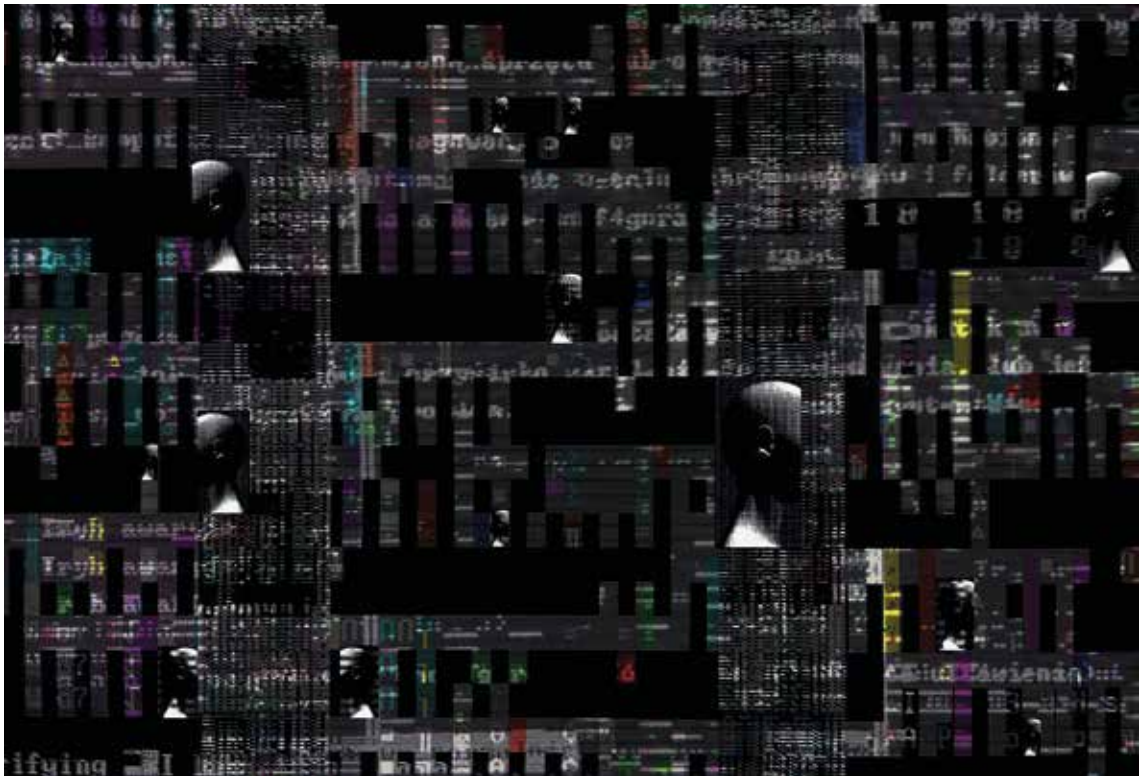
Born in 1963. Cultivated fields of artistic creativity: painting, graphics, drawing, installation and objects, illustration and cover design, press drawing. Studies at the Faculty of Printmaking of the Academy of Fine Arts in Krakow, specialty: drawing, lithography, painting; diploma with distinction in 1989. Defense of doctoral dissertation at the Faculty of Graphic Arts of the Academy of Fine Arts in Warsaw (2001); habilitation at the Faculty of Graphic Arts of the Academy of Fine Arts in Krakow (2005). Scholarship holder of the Ministry of Culture and Arts in 1992. In the years 2012–2014, the president of the Rzeszów District of the Association of Polish Artists and Designers runs a diploma Multimedia Workshop and a Studio of Lithography and Flat Printing — together with Magdalena Uchman and Kamila Bednarska. He participates in projects, actions and artistic activities as a co-founder and co-organizer of charity events, plein-airs, workshops, exhibitions and artistic symposia; coordinator and co-organizer of artistic projects. Participant of about 260 individual and collective exhibitions, in Poland and abroad; laureate of several awards and distinctions — at home and abroad. Works in national collections and in private collections in the USA, Japan, Austria, the Netherlands, Belgium, Brazil, Germany, France and Scotland.

title	from the series **life — eden k.**
year	2020
technique	monotype, drawing, collage on paper
size	diptych: 21 × 19,5 cm and 77 × 67 cm

mirosław**pawłowski**

Polska
Poland

Born in 1957. Since 2001 he is a full professor. In the years 1983–2021 he had 77 graphic solo exhibitions and attended 487 collective presentations in Poland and worldwide.
He has received various awards, i.a. International Biennial of Graphic Arts in Krakow — Statutory SBWA Award (1986); International Biennial "Facing the Values", Katowice — Award of the Independent Culture Committee (1990); International Triennial of Printmaking in Krakow — Statutory Award (2006); International Triennial of Printmaking in Krakow — Award of the Academy of Fine Arts in Warsaw (2012); 2nd Prize at the II. Contemporary Engraving Biennale, Iaşi, Romania. Curator of the Student Printmaking Biennial in Poznań 1999–2017, curator of the International Triennial of Printmaking "Color in Graphic Art" — Toruń 2003–2021; member of the Organization Committee and juror of the Polish Printmaking Triennial in Katowice in 2006–2018 and International Biennial of Digital Prints in Gdynia in 2008–2019 and juror of the International Triennial of Printmaking in Kraków, 2009.



title	**camouflage: utopology**
year	2021
technique	UV print on aluminium plate
size	70 × 100 cm

krzysztof**pisarek**

Polska
Poland

Born in 1955 in Rzeszów. Studied at the Faculty of Printmaking in the Academy of Fine Arts in Kraków in 1973–1978. Diploma in 1978 realized in the studios of prof. Andrzej Pietsch and prof. Stanisław Kluski.
In 1981–1982 he studied at the Hochschule für Angewandte Kunst in Vienna in the photography studio of prof. Eva Choung-Fux. PhD from the Faculty of Arts of the Academy of Fine Arts in Katowice in 2016. Since 2004, he has been teaching photography at the Faculty of Art of the University of Rzeszów. He practices graphics and photography. He has realized a dozen or so individual exhibitions, including in Rzeszów, Lübeck, Dębica, Opole, Chorzów, Łódź, Katowice, Przemyśl and Jarosław. He took part in several dozen group exhibitions in Poland and abroad, incl. in Bregenz, Lublin, Paris, Przemyśl, Rzeszów and Warsaw. He participated in national (in Łódź, Warsaw and Katowice) and international (Ljubljana, Kraków, Prague) competitions and graphic reviews. He has realized several curatorial projects. He is a laureate of awards and distinctions. His works are in the collections of museums and galleries in Poland and abroad.

title	**happy breath of nastulatula**
year	2020
technique	photography, pigment printing
size	61 × 91,5 cm

marek**pokrywka**

Polska
Poland

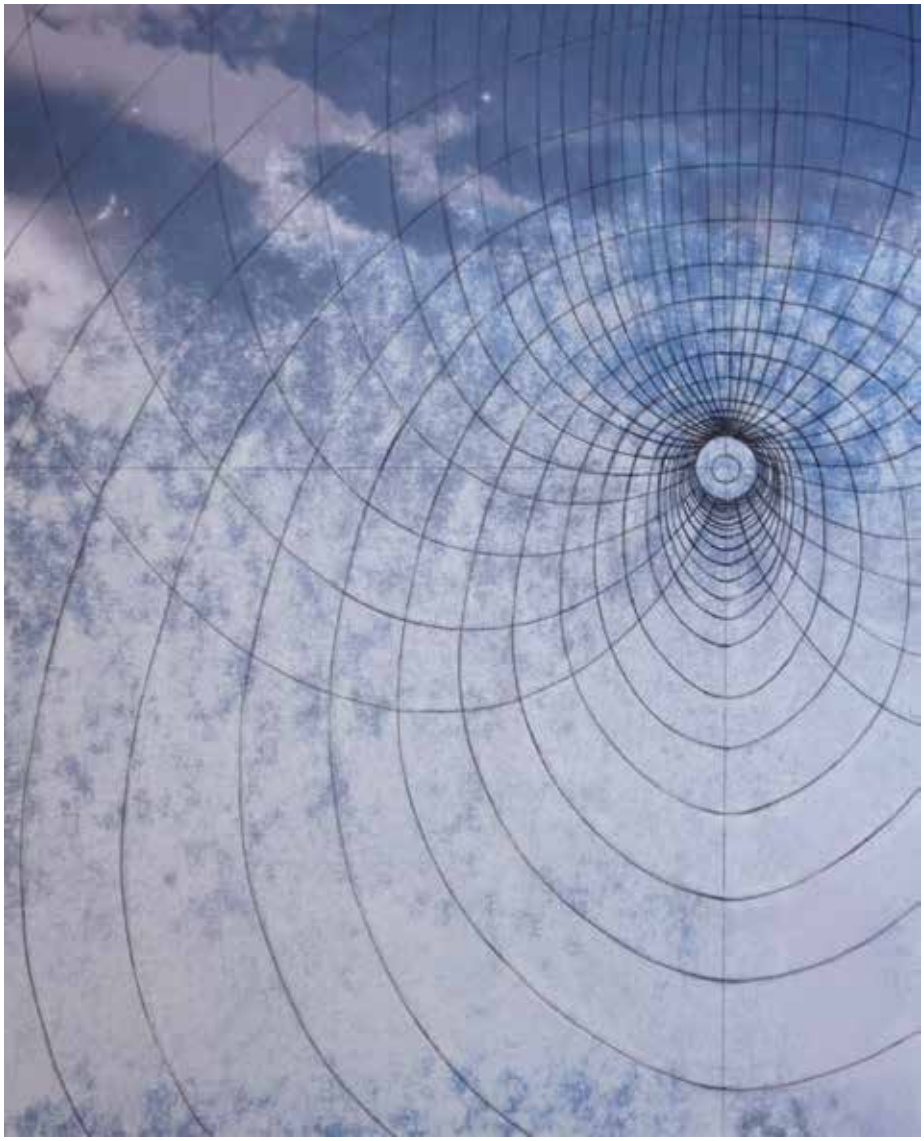
Born in 1956 in Rzeszów. Studied at the Institute of Artistic Education at the Maria Curie-Skłodowska University in Lublin. Diploma in the painting studio of prof. Marian Stelmasik (1983), graduate of the Theater, Film and Television Stage Design Studies at the Academy of Fine Arts in Krakow — diploma with honors under the supervision of prof. Jerzy Skarżyński (1986). Scholarship holder of the Minister of Culture and Art (1986/1987).
He practices painting, drawing, and sometimes ceramics, he is the author of stage designs and graphic designs for books, he collaborates with the nationwide literary magazine "Fraza". He works as a professor at the Painting Department of the Institute of Fine Arts of the University of Rzeszów.
Member of ZPAP and the Artistic Group "Na Drabinie", with which he exhibited, among others in Tarnów, Kraków, Warsaw, Rzeszów, Przemyśl, Krosno and Gorlice. He has presented his works as part of individual (39) and collective (approx. 200) exhibitions in Poland and abroad.

title	**the birth of a planet**
year	2020
technique	oil on canvas
size	70 × 60 cm

jennifer**printz**

Stany Zjednoczone
United States

She uses photography, printmaking, and drawing as differing means to observe her world and unifies them together to make poetic works that reflects on the structure of the universe. These beautiful creations have been exhibited widely including recent exhibitions at the Spartanburg Museum of Art, Chroma Gallery, and as far away as Portugal, Egypt, and Russia. Printz has completed artist residencies in Paris and Malta, both locations having a great influence on her current practice. Her work has been included in publications as diverse as Tricycle and the Carolina Review. In 2019, her studio practice was included in in-depth articles in "In Her Studio" and "Peripheral ARTeries". Printz' scholarly output includes papers given at the SGC International, College Art Association, and Southeastern College Art conferences. The Norton Simon Museum included her essay "Print University" in Proof: The Rise of Printmaking in Southern California. Printz received a MFA from the University of Georgia. She has taught and lectured at institutions across the United States including workshops at the J. Paul Getty Museum. Printz has also been an active arts leader serving as president of the Los Angeles Printmaking Society and Vice President of External Affairs for SGC International and was awarded a NCAA Emerging Arts Administrators Fellowship.

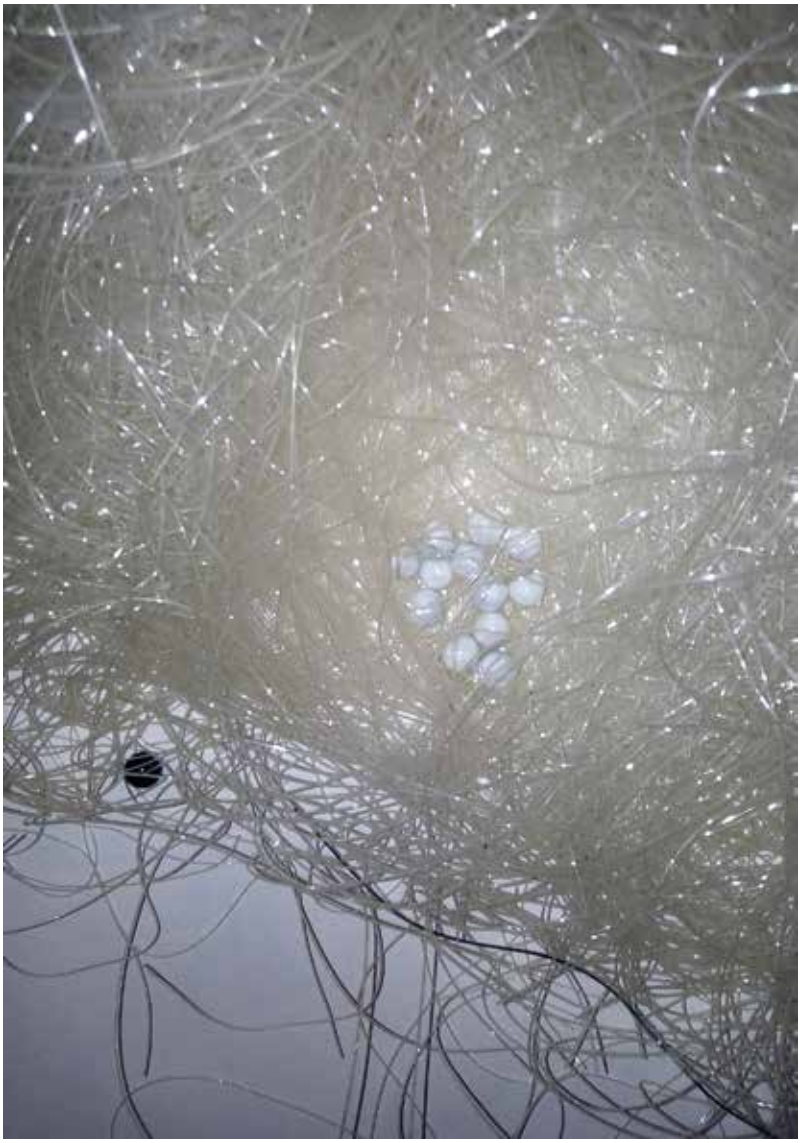


title	**not imponderable**
year	2021
technique	mixed media drawing sanded epson ultrachrome inks and graphite on paper
size	50,8 × 40,64 cm

piotr**rędziniak**

Polska
Poland

Was born in 1968 in Gorlice. He graduated from the Secondary School of Fine Arts in Rzeszow. He graduated from the PWSSP (now Academy of Fine Arts) in Łódź at the Faculty of Industrial Design with a specialization of Unique Fabric. In 1995 he obtained a degree in the Studio of Tapestry of professor A. Manczak. He obtained an annex to his diploma in the Painting Studio of professor M. Wagner and in the Studio of Decorative Fabrics of professor K. Nadratowska-Górska. Since 1996 he has been a member of the Union of Polish Artists Rzeszów District. He specializes in painting, drawing, artistic fabric and the art of fiber and paper. He has organized over 20 individual exhibitions and participated in over 100 group exhibitions. He received over a dozen awards and distinctions.
Author of numerous texts about artists published in exhibition catalogs, in four volumes "Artists of the Subcarpathian Region" (published by PTZSzP Zachęta) and the social and cultural monthly "Rzeszów our House ".
In 2017, he was awarded Honorary Badge of Merit for Polish Culture. Currently, he is the director of BWA in Rzeszów.



title	**the outsider**
year	2020
technique	digital print
size	100 × 70 cm

adam**romaniuk**

Polska
Poland

He was born in 1949 in Gliwice. He graduated from the Printmaking in the Academy of Fine Arts in Kraków (branch in Katowice), 1968–1973. He graduated in Printmaking Studio with prof. Andrzej Pietsch and in the Studio of Spatial Graphic Design with prof. Gerard Labus. Since 1974 he has been associated with his home university and since 2008 also with the Faculty of Art of the University of Technology and Humanities in Radom. He practices Printmaking, digital and design prints. He organized 79 individual exhibitions and participated in over 290 exhibitions in Poland and abroad. At the Academy of Fine Arts, he was the head of the department, deputy dean and vice-rector for student affairs and research. In 2006–2011 he was a member of the Board of the International Print Triennial in Krakow. He was the curator of the Polish Print Triennial in Katowice in 2006–2012.
In 2011 he received — the Silver Medal for "Merit to Culture Gloria Artis."

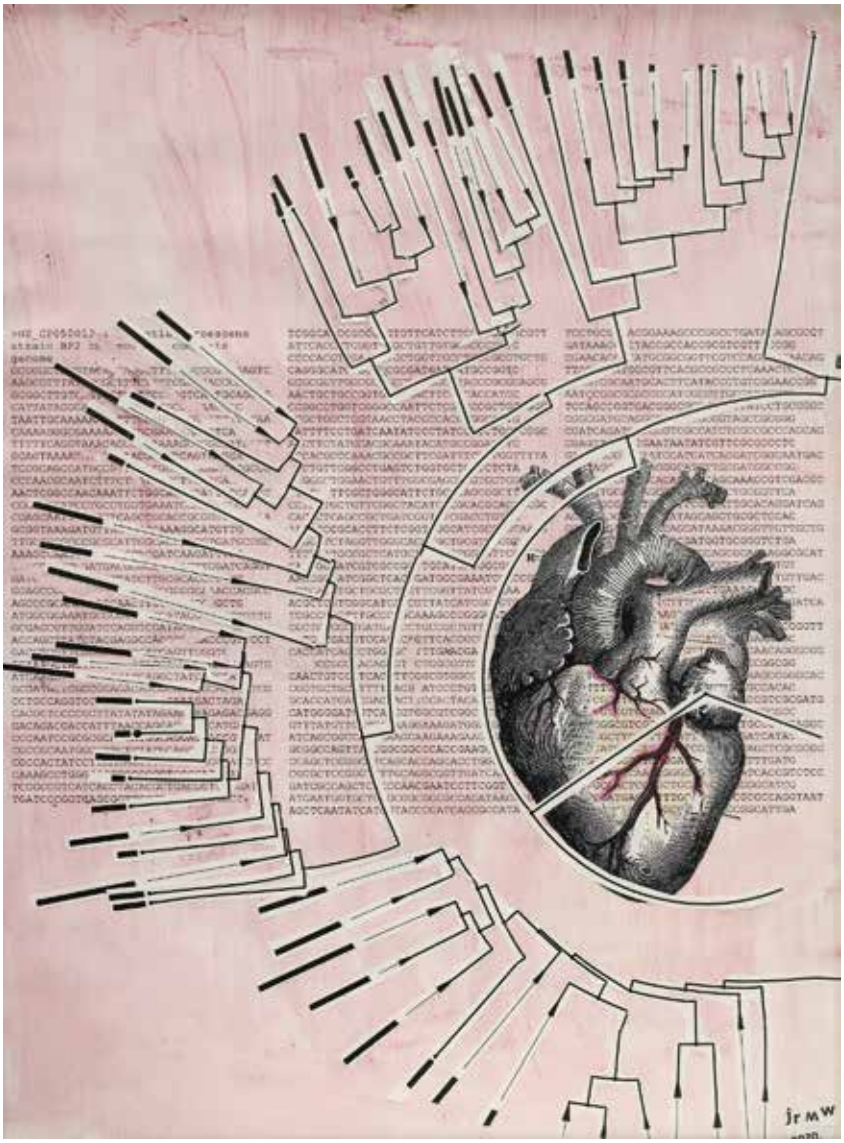
title	**hold your breath**
year	2020
technique	digital print
size	70 × 100 cm

justyna**ruchała**_maciej**wnuk**

Polska
Poland

Justyna Ruchała, Ph.D. D.Sc.
Assistant professor at University of Rzeszow (Poland), Department of Microbiology and Molecular Genetics. Co-author of 21 publications in peer-reviewed international scientific journals and 3 patents. Her hobby is to grow houseplants.
—
Maciej Wnuk, Ph.D. D.Sc.
Associate professor University of Rzeszow (Poland), Department of Biotechnology, Group Leader, member of Editorial board of Biogerontology Journal. Co-author of 90 publications in peer-reviewed international scientific journals and 4 patents. His research interests are focused on molecular mechanisms of cellular senescence, genomic plasticity and cellular heterogeneity. His hobby is to create digital collages based on images and textures from different research sources. The leitmotif of his collages is human and interpersonal relations in the world of "-omics".

The variation about the blood-red pigment produced by S. marcescens. S. marcescens has a fondness for growth on communion wafers, where the pigmented, aged colonies have been mistaken for drops of blood. Background — part of NCBI Reference Sequence: NZ_CP050013.1 after staining with prodigiosin produced by Serratia marcescens, Dendrogram of Serratia marcescens, human heart from the anatomical atlas, the coronary artery staining with the red chromoprotein (eforRed).



title	**the miracle**
year	2020
technique	collage, painting
size	54 × 41 cm

tomaszrut

Szwecja
Sweden

Artist born in Zabrze in 1968. He graduated from the Faculty of Printmaking of the Academy of Fine Arts in Krakow with a diploma at the Intaglio Printing Studio under the supervision of prof. Stanislaw Wejman. In 1991, he received a scholarship from the Academy of Arts in Nuremberg. He was an assistant to prof. Stanisław Batruch at the Painting Studio at the Faculty of Printmaking of the Academy of Fine Arts in Krakow and worked as an assistant to prof. Włodzimierz Kotkowski at the Art Faculty of the Fine Arts in Rzeszów. In the years 2002–2006 he was the director of BWA in Rzeszów. In 2006, he and his family moved abroad, where he works and conducts artistic activities. In 2017, he graduated from the Pedagogical Faculty of the University of Linköping. In the years 1993–2020 he took part in many individual and collective exhibitions in the European Union. The artist's creativity is aptly defined by the words of Agata Sulikowska-Dejen „For Tomasz Rut, artistic creativity acts as a medium, for with which he makes a journey into the subconscious, in search of the archetypes hidden there. In them all the knowledge given to man about the ontology and essence of the world around us has been dormant. Traveling in time through internal spaces, an attempt to touch the mystery of life and death of omnipresent passing are the artist's main areas of interest. Time is the key concept here."

title	**panspermia of time**
year	2020
technique	oil, acrylic, cardboard
size	30 × 84 cm

babak**safari**

Iran

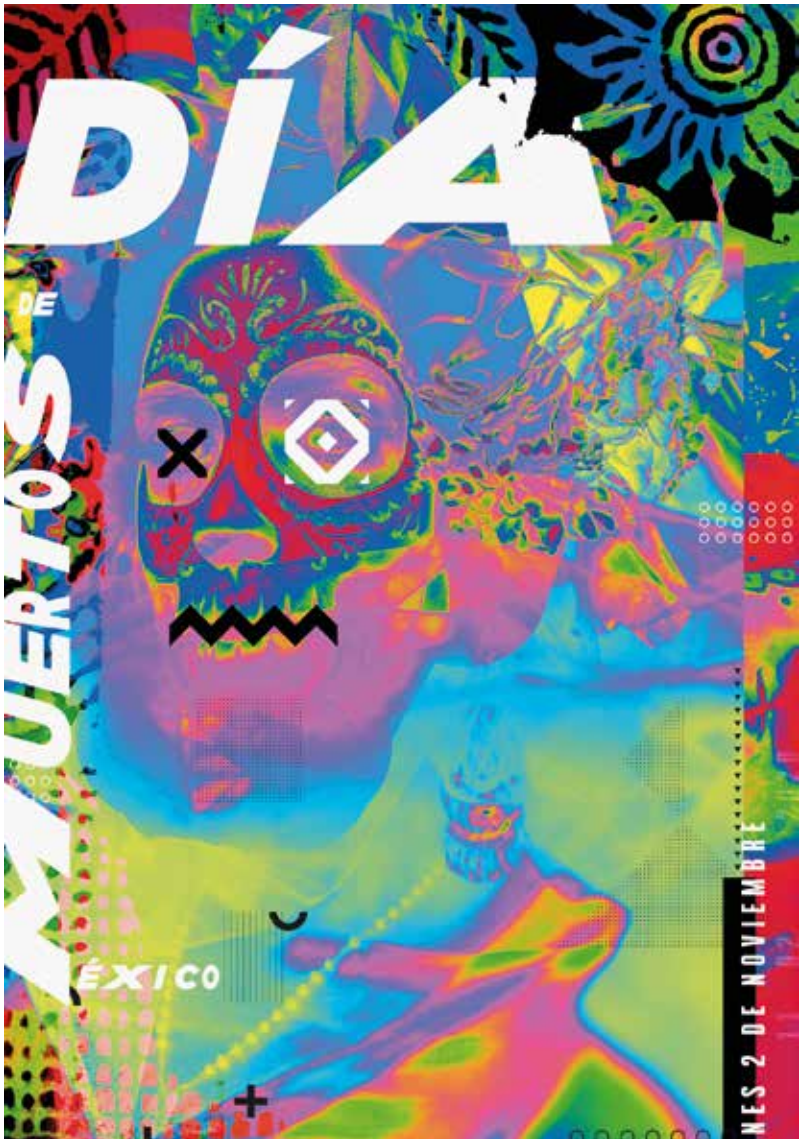
Born in 1986, Bandar Abbas, Iran. Master Degree: Graphic Design, Tehran.
Art Director and Graphic Designer.
– Graphic Design Teacher at Sepehr Art University.
– Art Director and Graphic Designer of Self Graphic Design Studio.
– Member of Online Jury (Work Right poster Competition), France.
– Member of Online Jury (Cow Design Biennale), Ukraine.
– Member of Online Jury (Super Heroes), Poland.
– Senior Art Director of First International Event of Isfahan Graphic Design, Iran.
– Graphic designer of bliss international film festival, USA.
– Graphic designer of Sao Paulo jazz festival, Brazil.
– Graphic designer of monilazariston festival, Greece.
– Graphic designer of Cow international design festival, Ukraine.
– Graphic designer of International reggae poster contest, Greece.
– Illustrator of curious classics, Klassiska traditioner från Hela världen, Sweden.
– Senior Art Director in Brang Food company, Iran.
– Graphic Designer of Karmisen theater group, Iran.
– Graphic Designer of the home of book publisher, Iran.
– Book cover Designer of Soore book Publisher, Iran.
– Designer of Isfahan Museum of Contemporary art, Iran.
– Designer of Municipality (Beautification Organization), Iran.
– Self Promotional Posters at Fillharmonia, Poland.
– Self Promotional Posters at Blissfest 33 Gallery, USA.
– Self Promotional Posters – Isfahan, Iran.
– Self Promotional Posters – Ahwaz, Iran.

title	**destroyer hands**
year	2020
technique	poster
size	100 × 70 cm

christopher**scott**

Ekwador
Ecuador

Christopher Scott is an internationally recognised award-winning designer. Born in Northern Ireland, he received both a bachelors and a Masters degree in Design from the University of Ulster, Magee.
The concepts of his posters are paramount to his visuals, and his work communicates strong and meaningful messages with humanity at the core of his designs.
Scott has won more than 200 international awards and has been recognised by many organisations such as the WWF, International Poster Biennale Warsaw, Poster For Tomorrow, Designboom, Moscow Global Biennale of Graphic Design Golden Bee, Adobe Design Achievement Awards and he received a silver medal in the International Design Awards and also 3 Gold awards at the prestigious Graphis in United States.
His work has been exhibited all around the world including countries such as Iran, Mexico, Russia, China, Korea, Ecuador, Germany, Poland, Italy, Peru, Korea, the United States and many more, including the Louvre in Paris, France. He has been a member of multiple international juries and he is also the Co-Founder of Poster Poster and the Founder of Designers Speak.
Scott has also given conferences and workshops in countries such as China, United States, Argentina, Ecuador, Indonesia, Venezuela, Mexico, Northern Ireland and Russia.
Currently he is a Professor of Graphic Design at the Universidad UTE and President and Founder of the Ecuador Poster Bienal.

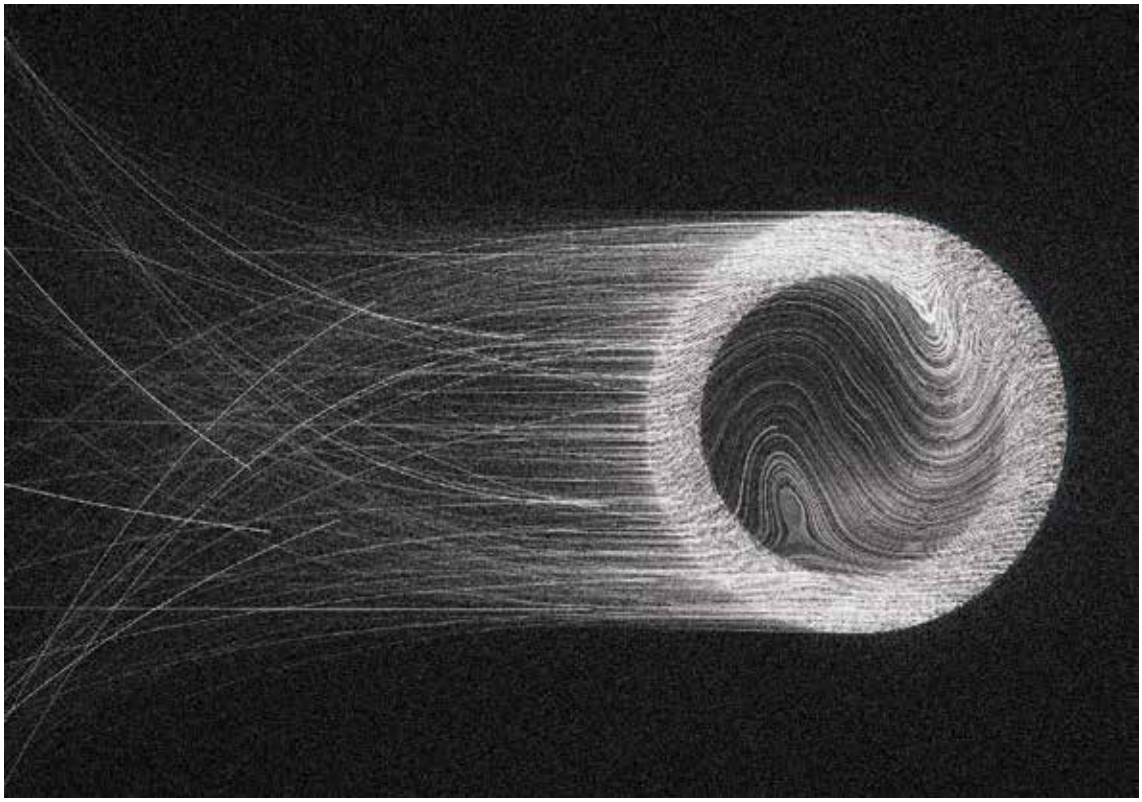


title	**color in life and death**
year	2020
technique	poster
size	100 × 70 cm

kamil**skrzypiec**

Polska
Poland

Born on March 18. 1993 in Rzeszów. A graduate of the Secondary School of Fine Arts in Rzeszów in the field of visual advertising and the Faculty of Art of the University of Rzeszów in the field of printmaking. He completed his diploma in the Graphic Design Studio under the supervision of associate professor Wiesław Grzegorczyk and in the Flat Printing Studio under the supervision of associate professor Marek A. Olszyński. Currently, he works as an assistant in the Department of Design Graphics and Multimedia at the University of Rzeszów. At the same time, he is a professional teacher of photography and multimedia in the Complex of Energy Schools. The most important achievements are: an award in the International Stop Hate Poster Show (2019) competition, an award in the International Baltic Poster Contest 2019. Reduce, Reuse, Rethink! (2019), participation in the 2nd National Festival of Graphic Design Ideografia in Poznań (2018), 1st place in the National Competition "Depth of a Look" (2017). He designs posters and other forms of utility projects, as well as graphics and artistic photography. The main topic of his works is space and its meaning in the context of contemporary multimedia techniques, broadly understood vector and raster graphics, as well as html, css coding and Java Script scripting language.



title	**constellation_011**
year	2020
technique	digital print
size	70 × 100 cm

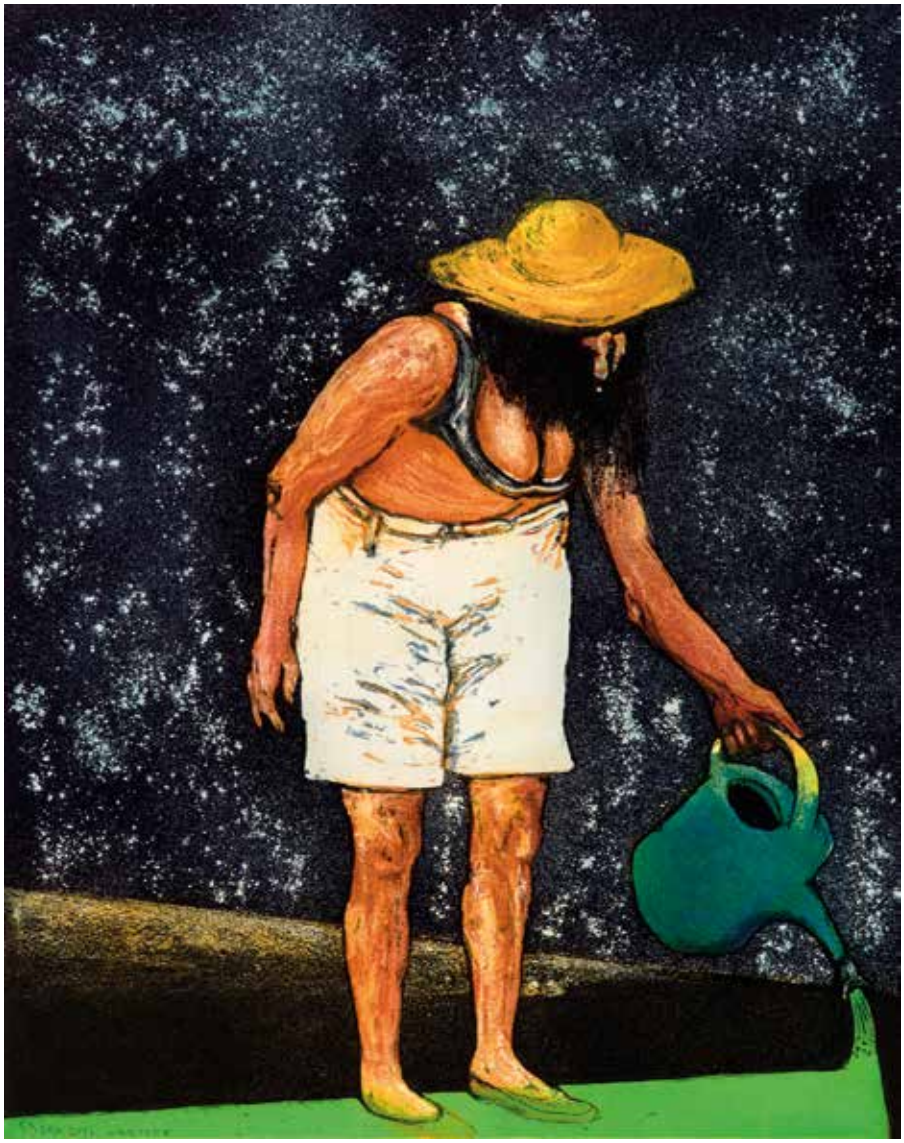
jacek**sroka**

Polska
Poland

Born in 1957 in Krakow, painter and graphic artist.
Health Biography:

1. childhood — fish oil
2. youth — aspirin / polopyrin and biseptol
3. mature age — telmizec, amlopin, tertensif, milurit, betalog, magnocal, colchicine, voltaren, norvasc, captopril, metocard, furosemide, metypred, ibuprom, paracetamol, nitrendipine, co-prestarium, calipoz, magne B-6, eliquis, spironol, glucophage, primacor...

← *artist's photo: Wu Qing*

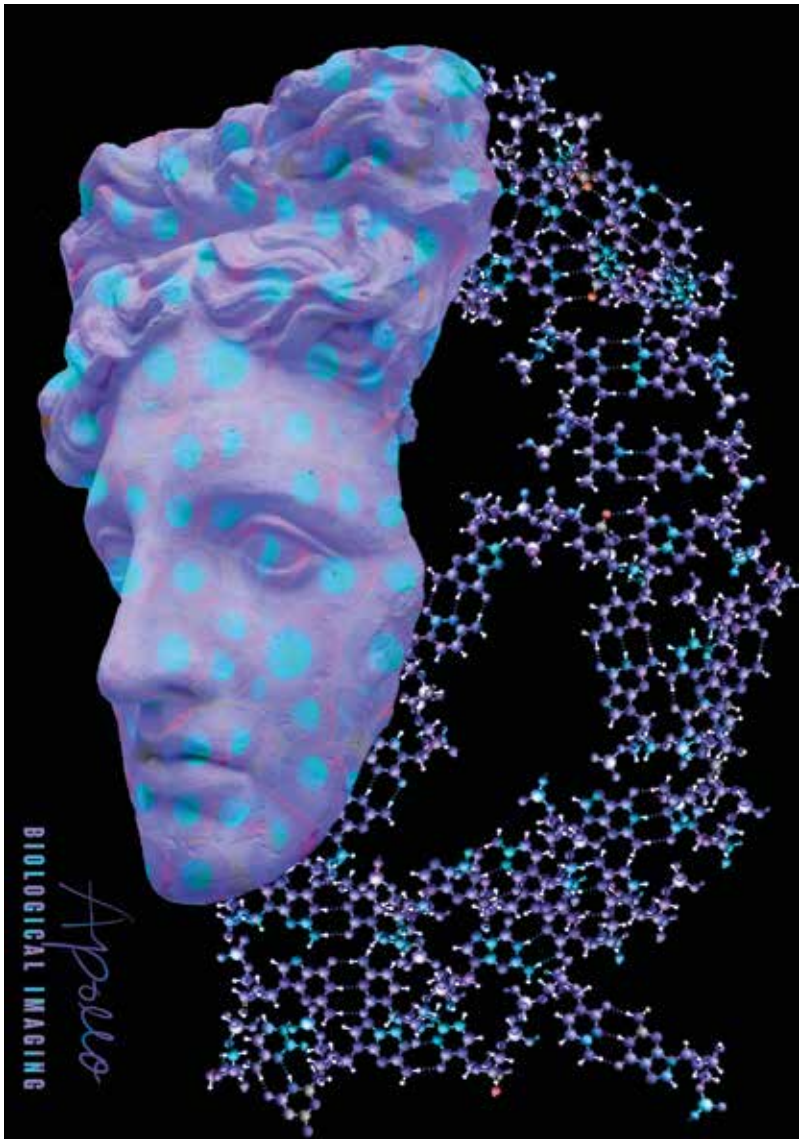


title	**water**
year	2017
technique	etching, aquatint
size	49,5 × 39 cm

byoung-il**sun**

Korea

Was Born in 1958, in Korea.
Since 1995, he has been a professor in Visual Information Design at Namseoul University.
He is a graduate of Visual communication design in Hongik University, where he receiving his master's degree in 2005.
Byoungil-Sun has been awarded various prizes such as the Presidential Award for his contribution to the development of design at the Government of the Republic of Korea. International Awards Golden Bee, Graphis, Taiwan, Red Dot, Gdie, Ekoplakt, Information War, World Without Violence, Poster for tomorrow and 160 int'l selections with posters.
He has also served on the juries of numerous international design competitions such as Slovakia, Belarus , Lublin, france, Iran, China, Turkey, Ukraine, Korea.
He has participated in solo exhibitions, both in Korea and abroad (notably in London, Canberra, Osaka, Akita, Beijing, Turkey, Indonesia. Poland).
He was the Chair at the Hongik Communication Design Forum in 2011 and at Korea Institute of Cultural Product & Design in 2005 over the years.
Poster Collections:
Library of Congress Washington DC, USA, Moscow Golden Bee, Colorado University, Lahti, Chaumont, Toyama, Mexico, Beijing, 4th Block Kharkov, Modium museum Seoul, Iang Gallery Seoul, Shunzen Museum China. Taiwan CPC Center. etc.



title	**apollo**
year	2020
technique	poster
size	100 × 70 cm

jolanta**szalanska**

Niemcy
Germany

1986 — Graduate of the Secondary School of Art in Jarosław.
1996 — Graduate of the Academy of Fine Arts at the Faculty of Painting in Krakow.
2002 — Departure to Germany.
Lives and works as a painter in Lindau on Lake Constance in southern Germany.
At the same time, she is a lecturer at art departments in many schools in the Lake Constance region.
The artist takes part in numerous individual and collective exhibitions.
Participates in organizing local cultural and artistic life.
Her works are mainly in private collections.

title	from the series **malina 23.10.2013**
year	2020
technique	oil on canvas
size	110 × 60 cm

anna**szklińska**

Polska
Poland

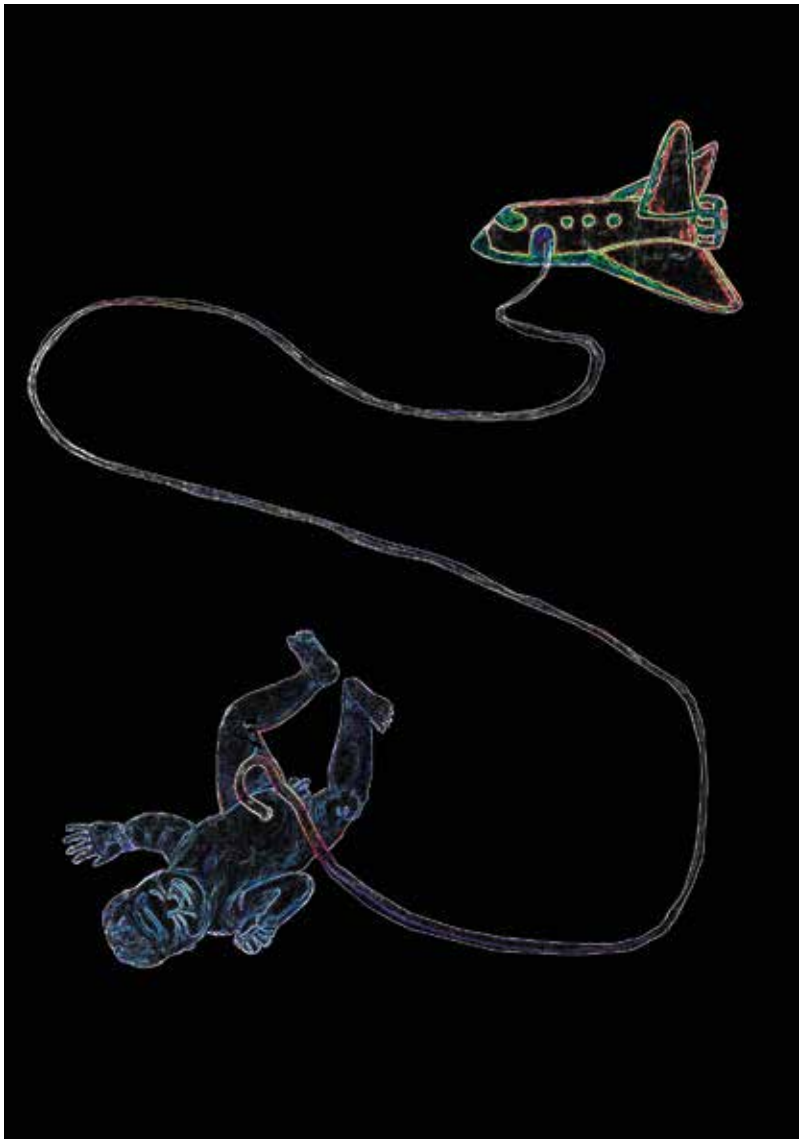
Born in 1982 in Wałcz.
A graduate of the Design Institute of the Koszalin University of Technology. In 2016, she obtained a PhD in Art at the Faculty of Interior Design and Stage Design at the University of Arts in Poznań. Currently, assistant professor at the Department of Fine Arts at the Faculty of Architecture and Design of the Koszalin University of Technology.
The concepts of sculpture, fabric, clothing and body mark the areas at the meeting point of which she undertakes her activity, experimenting in the matter of fabric, developing the concept of "empty forms". For the implementation of projects, it uses materials with the potential to transfer content, most often these are culturally and civilizationally degraded rubbish materials.

title	**fleshy pink**
year	2019
technique	photography
size	21 × 42 cm

nicos**terzis**

Szwecja
Sweden

He is a visual artist born in Evros, Greece and based in Stockholm, Sweden. He received his MFA´s in Graphic Art, Poster and Painting from the Academy of Fine Arts in Warsaw, Poland in 1987 and made his Post graduate in poster art and painting, at the Academy of Fine Arts, Warsaw, Poland in 1989.
He is a member of the Swedish Art Organisation (KRO), and has been invited as guest teacher to several art schools in Sweden and Greece.
He has exhibited extensively in Sweden and abroad, both individually and in group shows. He has also been the recipient of various grants, prizes and awards at earlier occasions.
His works are in the collections of museums and institutions all over Europe.
In his practice, he focuses mainly on painting, printmaking and illustration but one of his central interests are posters, and in particular, those with a socio-political message.

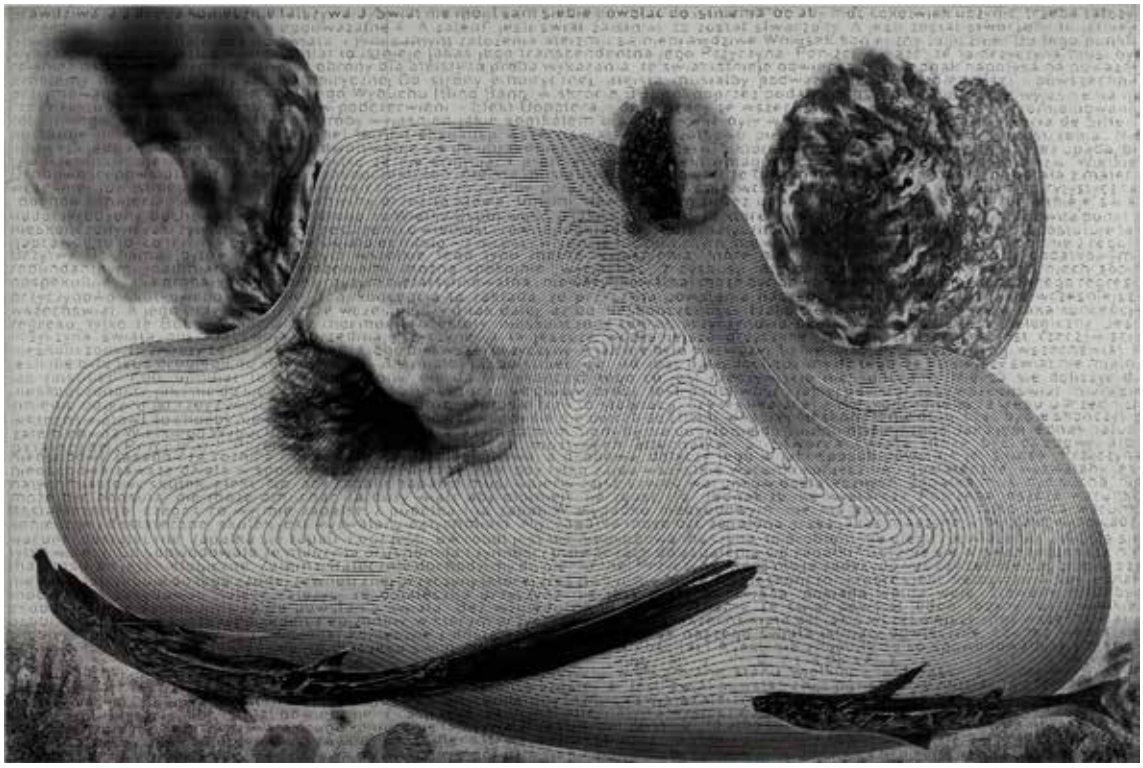


title	**step of science**
year	2021
technique	poster
size	100 × 70 cm

krzysztof**tomalski**

Polska
Poland

Born in 1963 in Gorlice. 1978–1983 — student of A. Kenar Art High School in Zakopane. 1983–1989 studies at the Academy of Fine Arts in Krakow, diploma (1989) with honors in the Copperplate Engraving Studio. Since graduating, he has been associated with the Graphic Department of the Academy of Fine Arts in Krakow. 2008–2016 dean of the Faculty of Printmaking. From 2012, full professor. He runs the Copperplate Laboratory. From 2008, also a lecturer at the IP PWSZ in Nowy Sącz. From 2016, co-founder and board member of the International Academic Printmaking Alliance based in Beijing, China. Over 40 individual exhibitions and about 400 group exhibitions in several dozen countries around the World, where he won over 20 awards and distinctions, including: EGF in Canada, 1990; in Yunnan, China, 2012; at the PTP in Katowice, 2012 and 2015; at VII. ITP Splitgraphic in Croatia in 2015 and the last at The International Graphic Biennial in Yerevan, Armenia, 2019 and in Sarcelles in France, 2019 and at The Graphic Triennial in Novosibirsk, Russia, 2019.



title	**eighth day** from the big bang series. genesis
year	2018
technique	drypoint, mezzotint
size	65 × 95 cm

magdalena**uchman**

Polska
Poland

She was born in 1981 in Przeworsk. A graduate of the Institute of Fine Arts at the University of Rzeszów. In 2006, she graduated with honors in the Rotogravure Studio of Prof. Krzysztof Skórczewski. In 2010, she graduated from Environmental Doctoral Studies at the Faculty of Printmaking at the Academy of Fine Arts in Krakow. Currently, she works as a Associate professor at the Institute of Fine Arts of the University of Rzeszów.
She organized 30 individual exhibitions. She took part in 180 collective, national and international exhibitions.
Winner of awards and distinctions, including: distinction for graphic objects "The Gift" at the 3rd Biennial of Experimental Graphics in Romania (2008); 1st prize in the 8th International Review of Small Format in Romania (2006); 2nd Prize of the Art Exhibitions Bureau in Kielce in the International Lithography Competition Litho-Kielce 2015 (2016); an award funded by the Academy of Fine Arts in Gdańsk at the 5th International Biennial of Digital Printmaking — Gdynia 2016; honorable mention at the 6th International Biennial of Digital Printmaking — Gdynia 2019; Senefelder 2nd Prize ISS Award 2020 — Offenbach, Germany.

title	**days of the week**
year	2020
technique	acrylic on canvas, marker
size	100 × 100 cm

elżbieta**wierzbicka-wela**

Francja
France

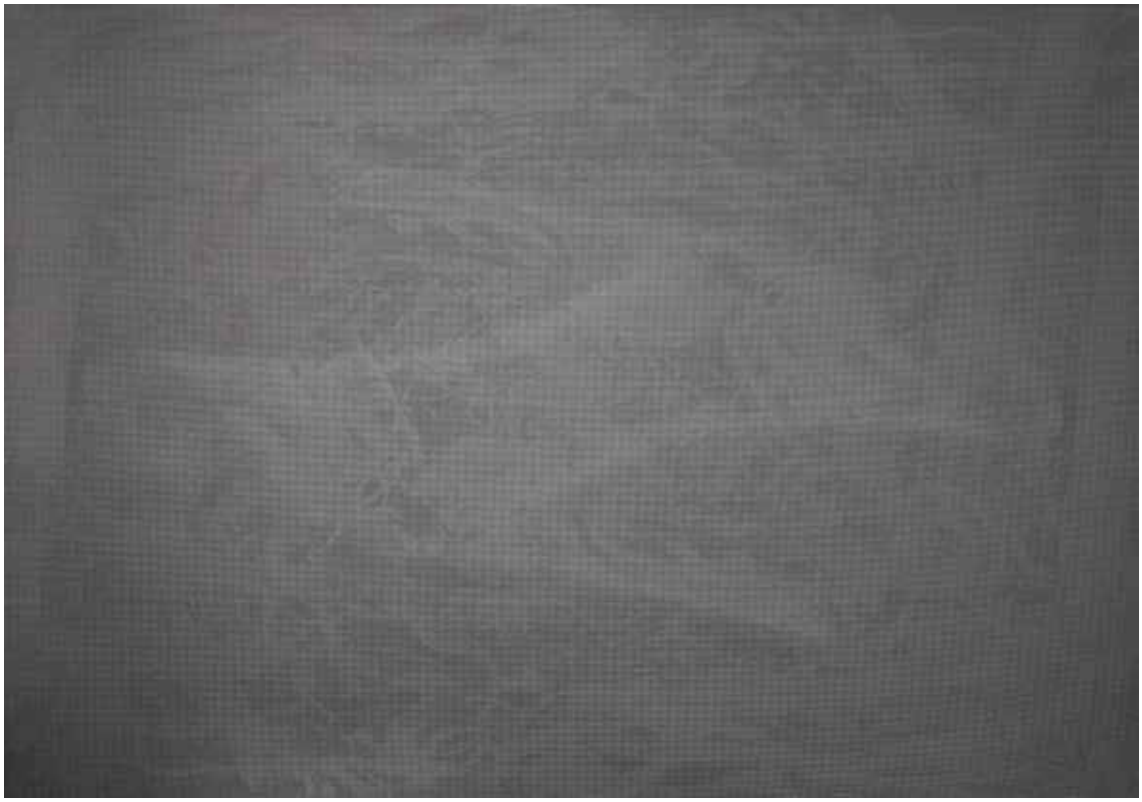
WELA (Elisabeth Wierzbicka) — polish visual artist living in France. Sculptor, painter, author of numerous spatial installations, such as: "Whisperers" at the Copernicus Science Center in Warsaw and "Artificial Life" at Futuroscope in Poitiers, France. Born in 1964 in Cracow. 1984–989 she studied at the Faculty of Printmaking at Academy of Fine Arts in Krakow. Diploma in the Intaglio Studio of prof. Stanisław Wejman. In 1989 she moved to Paris and started her international career in several countries with more than 200 exhibitions, several public commissions. She works on identity, human relationship with Nature, and coexistence.

title	**roots of the sky**
year	2017
technique	acrylic on canvas
diameter	80 cm

andrzej**wochnik**

Polska
Poland

Graduate of the Academy of Art in Szczecin (2019) — Master's degree with honors from the Serigraphy Studio of prof. Mirosław Pawłowski. He defended his bachelor's thesis with honors in the Lithography Studio of prof. Paweł Frąckiewicz. Scholarship holder of the Minister of Culture and National Heritage for outstanding achievements, scholarship holder of the City of Szczecin for artistic achievements, the President of the City of Szczecin for scientific achievements and the Rector of the Academy of Art in Szczecin for the best students. The main issues raised in his works are space and color. He presented his slingshot at over 50 collective exhibitions in Poland and abroad, including: the main exhibition of the International Print Triennial in Krakow "Immersed in Images / Zanurzeni w obrazach" at Bunkier Sztuki, at the "GO" exhibition at the Center for Contemporary Art Toruń 2018, or during 6th International Digital Prints Triennial in Gdynia in 2019. In 2018–2020, assistant to prof. Mirosław Pawłowski at the Serigraphy Studio at the Academy of Art in Szczecin. Currently he runs the first degree Serigraphy Workshop and the basics of artistic graphics.



title	**formalization of absences**
year	2019/2020
technique	serigraphy
size	70 × 100 cm

piotr**woroniec jr**

Polska
Poland

Born in 1981 in Rzeszow.
A graduate of the Institute of Fine Arts at the University of Rzeszów. Diploma in 2005 in the painting studio of prof. related dr hab. Irena Popiołek-Rodzińska. Currently a lecturer at the Painting Department of the Institute of Fine Arts. Since December 2014, he has been the President of the Association of Artists of the Rzeszów District. In 2018, he obtained a doctoral degree at the Academy of Fine Arts in Katowice. He took part in several dozen domestic and foreign exhibitions. Laureate, among others: 2010 — Grand Prix at the 10th International Autumn Art Salon "Homo Quadratus Ostroviensis", Ostrowiec Swietokrzyski; 2010 — Grand Prix in the Young Art Review "East of Art — Oriental Art"; 2008 — 1st Award of the Marshal of the Podkarpackie Province for the painting "From the Journey", BWA Rzeszów. Author of several individual exhibitions, including 2019 "The Shape of Difference" BWA Krosno, 2019 "Alt Realm" — Pragaleria Warsaw, 2018 "Voltage" BWA Rzeszow. Author of films, installations, more important exhibitions: "New illustrations" Arsenal Gallery in Bialystok, 2016, Festival of Polish Contemporary Painting in Szczecin 2010, Triennale of Small Painting Forms, Torun 2010, Quadro Art in Lodz — 2009, International Biennial of Painting and Unique Textiles in Gdynia — 2011, International Painting Triennial of the Carpathian Region "Silver Quadrangle" in Przemysl — 2009/2012/2018. Triennial of Polish Contemporary Painting "Autumn Confrontations" — in Rzeszow — 2010/2013/2019.

title	**ab Initio**
year	2020
technique	acrilic + mixed technology on canvas
size	130 × 90 cm

katarzyna**woźniak**

Polska
Poland

She was born in May 1988. In 2008, she graduated from the State Secondary School of Art in Rzeszów with a woodcarving profile. The same year she was admitted to the Sculpture Department of the Jan Matejko Academy of Fine Arts in Krakow. She defended her master's degree in 2013 in the studio of prof. Bogusz Salwiński, which enabled her further development at the third degree studies at her alma mater. In 2014, she founded the t.studio "Pracownia Ceramiczna" company in her hometown of Sanok. In 2017, she completed postgraduate studies in art education at the Faculty of Painting of the Academy of Fine Arts in Krakow.
She defended her PhD in art, in the field of fine arts and conservation of works of art at the Faculty of Art of the University of Rzeszów in May 2019. Currently, her works at the Institute of Fine Arts of the College of Humanities of the University of Rzeszow.

photo: Łukasz Kuśnierz

title	**cuncta valde bona**
year	2019
technique	glass
size	diameter 80 cm, thickness 2 cm

piotr**wójtowicz**

Polska
Poland

He was born in 1958 in Stalowa Wola. Graduate of PLSP in Jarosław. Studies at the Faculty of Painting of the Academy of Fine Arts in Krakow in the studio of prof. Jan Szancenbach and the drawing studio of prof. Zbylut Grzywacz. He obtained his diploma in 1983. He practices painting and drawing. He is the author of a dozen or so individual exhibitions organized mainly in the galleries of Podkarpacie and Małopolska. He took part in many collective exhibitions as well as environmental, national and international competitions. He collaborates with several galleries in the region as a painter, exhibition curator, and author of texts on the work of other artists. He was a four-time scholarship holder of the Ministry of Culture and Art. For 35 years he worked as a drawing and painting teacher at the Art Secondary School in Krosno (formerly PLSP in Miejsce Piastowe). Twice (1999, 2010) he received the 1st Degree Individual Award of the Director of the Center for Artistic Education for his special contribution to the development of artistic education in Poland. He lives in Krosno.

title	from the series **constellations**
year	2017
technique	own technique, plate
size	160 × 137 cm

luis**yáñez**

Meksyk
Mexico

Graphic Designer with a specialty in Illustration and Photography. He currently works in product design, game and toy design for children, children's illustration and character design. He has specialized in social poster design. In 2016 he produced and edited his social poster book.
In 2018 Speak Up Poster! International Invitational Poster Exhibition is part of the program of activities of the International Congress of Visual Communication of Ecuador Poster Biennial 2018, where he gives a conference about his work, presents and exhibits 2 collections of social posters in the cities of Quito and Ibarra.
In 2019 it obtained its most recent recognition by winning 3rd place in the social poster at the COW International Design Festival in Ukraine. In 2020 he edited and produced the first 2 Speak Up Poster! International Invitational Poster Exhibition. Active member of Worldwide Graphic Designers.
Active member of the Mexican Association of Illustrators (AMDI)
Active member of Poster Poster (Coordination of competitions)
His poster work has been selected and exhibited in different biennials, contests and poster events in the US, Japan, Hong Kong, Germany, Switzerland, Italy, Poland, Spain, France, Iran, Africa, South Korea, Finland. , Mexico, Brazil, Ukraine, Moscow, Greece, Ecuador, Venezuela, Slovakia, Peru, China, Dubai, Poland, Argentina, Turkey among other countries.

title	**art + nature**
year	2020
technique	poster
size	100 × 70 cm

andrzej**załecki**

Polska
Poland

Born in 1948. Studies at PWSSP in Poznań, diploma in workshop graphics in 1974. Activity in the disciplines of workshop graphics, drawing, illustration and painting. 60 individual exhibitions, participation in over 150 collective exhibitions in Poland and abroad. Individually or collectively abroad: France, Belgium, Italy, Spain, Bulgaria, Sweden, Norway, Finland, Netherlands, Slovenia, Slovakia, Japan, USA, Australia, Argentina, Cuba, Switzerland, Senegal, Germany, Russia, Austria, Hungary and Serbia. Full Professor.

title	**bubble**
year	2000
technique	linocut
size	70 × 100 cm

magdalena_salome**zawadzka**

Polska
Poland

Born in 1994 in Warsaw. In 2018, she graduated with dean's honors in the Studio of Concept and Intermedia Graphics under the supervision of prof. Andrzej Węcławski and dr. Mateusz Dąbrowski at the Academy of Fine Arts in Warsaw. In her work, she undertakes activities that combine science with art. She deals with drawing, painting, artistic graphics and creating installations.

title	**thallus**
year	2020
technique	natural plant based ink, earth pigments, chinese ink
size	70 × 50 cm

jakub**zdejszy**

Polska
Poland

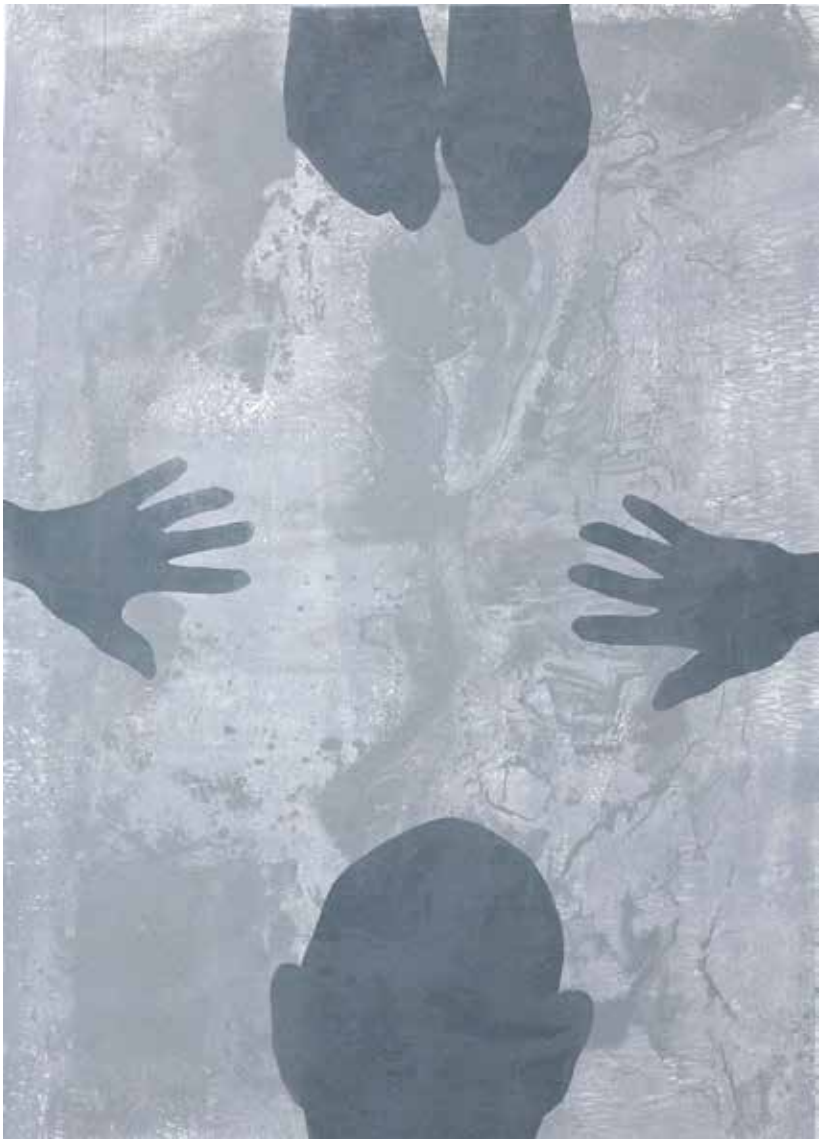
Born in 1987 in Olkusz. Visual artist, printmaker artist.
Graduate from Acadedmy of Fine Arts in Katowice. In 2013 he graduated *summa cum laude* Master degree in Arts in the field of graphic techniques. In 2019 he was conferred a doctoral degree of Arts. He is interested in graphic techniques.
More important awards:
Foreign Author Aword — The 10th International Biennial of Small Forms — Pleven 2020
2nd Prize — 11th International Biennial of Miniature Art, Galeria Gaude Mater, Czestochowa, 2020
Grand Prize — 6th NBC Meshtech Tokyo International Screen Print Biennial, Galeria Yurakucho-Asahi, Tokio, 2017

title	**triptych life**
year	2020
technique	digital print
size	50 × 150 cm

maria**zwolińska**

Polska
Poland

She was born in 1994. A graduate of the Academy of Eugeniusz Geppert Fine Arts in Wrocław majoring in Printmaking.
She is inspired by the issues of humanistic geography, sociology and psychology.
She explains her interest in social issues by belonging to communities and social structures.
She has presented her works at collective exhibitions in Poland and abroad, including: Osten Biennial of Drawing, Skopje 2018, 10th Polish Print Triennale, Katowice 2018, 20th International Print Biennial Varna 2019, The 7th Guanlan International Print Biennial China 2019, Lithography Triennial Litho-Kielce 2018/19.
She received the First Prize in the 48th edition of "The Pomeranian Graphic of the Year Competition".



title	**beginning**
year	2020
technique	lithography, algraphy
size	100 × 70 cm


THIS IS MY HOME

ART AND SCIENCE

marek**bosak**

krzysztof**dołowy**

hanna**fabczak**

agnieszka**iskra-paczkowska**

iwona**kania**

andrzej**legocki**

artur**mordka**

przemysław**paczkowski**

justyna**ruchała**

adam**szewczyk**

maciej**wnuk**

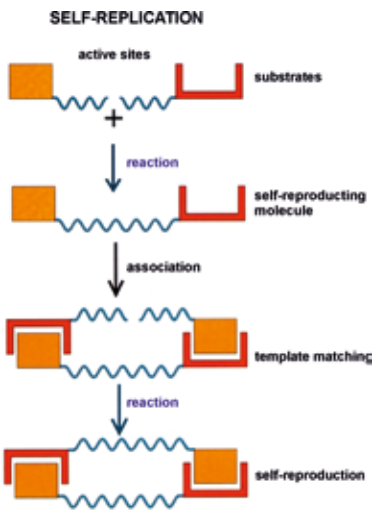
tomasz**zajkowski**

Andrzej B. Legocki
Institute of Bioorganic Chemistry, Polish Academy of Science, Poland

Scientific definitions of life

In 1871 Charles Darwin wrote to Joseph Hooker: *We could conceive in some warm little pond, with all sorts of ammonia and phosphoric salts, light, heat electricity, etc., present that a protein compound was chemically formed, ready to undergo still more complex changes.*
150 years have passed since the above Darwin's letter. During this time, science has made unimaginable progress. New fields of inquiry were opened attempting to explore the most important philosophical issues that have always fascinated people. Despite this breakthrough progress, it is still impossible to unequivocally explain the course of abiogenesis, which formed from simple chemical compounds a biological machinery of amazing complexity functioning in every living organism.
The Earth was formed as part of the Solar System from a thickening cloud of cosmic gases and dust from which protoplanets emerged. One of them became 4.54 billion years ago our Earth. The first natural systems that later transformed into living organisms probably appeared several hundred million years after the planet was formed. This transformation was not a single event, but a multi-stage evolutionary process with an astronomical dimension of time that passed through many bottlenecks along the way.
A number of possible scenarios for the emergence of life have been postulated, based on the rules of physics, chemical properties of carbon, the main element of life on Earth, and the availability of water. On the basis of these assumptions and on the basis of paleontological fossils preserved to our times, hypotheses about the earliest stages of the appearance of life on Earth were postulated. Due to the complexity and almost unlimited variety of living species, it is difficult to formulate a single definition that encompassing all the attributes of this phenomenon at once.
There is generally accepted consensus that all living organisms are recognized by several basic properties, which include:

— the ability to self-replication, (i.e. continuously copy the initial structural information),
— to convert different forms of energy and carry out metabolic pathways and have the ability to adapt to environmental conditions.



Moreover, all living organisms have a complex architecture and function according to a hierarchical organization in nature. One of the most distinctive features of life as a global phenomenon is its ability to survive and continue through the death of individuals and even the extinction of entire species. This attribute of life results from the universality of the rules of nature and the monophyletic origin of all living organisms, which as it is commonly accepted today, derive all from a common ancestor.
The main goal of biological inquiry is to recognize the complexity and diversity of the living world. Although the structure of all the basic components of every living organism is remarkably similar, nature has managed to develop an amazing variety of organisms over billions years of evolution. It makes every higher organism unique.
There have been several hypotheses about the emergence of life on Earth. The most popular concept is that life appeared on Earth spontaneously in many stages, as a result of the self-organization of organic molecules

Figure 1. Schematic representation of the self-replication of model molecules. Nucleic acids are the only type of macromolecule that self-replicates and thus enables the continuity of life.

determined by the atomic structure and reactivity of carbon. First, under the conditions of the primordial Earth in strictly reducing environment, organic molecules appeared as a result of chemical interactions between simple inorganic compounds present in volcanic fumes. After millions of years, they became the building blocks of macromolecules and structural elements of the pracells. Gradual emergence of more and more complex natural systems led in the final stages of biological evolution to formation of unlimited variety of living organisms.

Another concept of the emergence of life on Earth is the theory of panspermia based on hypothetical scenarios of exobiology. It assumed that the first primitive life forms came to us from the Universe. Although this theory cannot be completely ruled out, it is difficult to discuss with it in more detail, since it transfers the problem of the origin of life from Earth to other planets where conditions may have been completely unknown.

Simple organic compounds were also found in trace amounts in extraterrestrial objects of the Universe; in asteroids, meteorites and interstellar dust. One of the most famous is the Murchison meteorite that struck Australia in 1969. Over 70 organic compounds of extraterrestrial origin have been identified in it. Moreover, inside this meteorite the pre-solar dust grains that was 2 billion years older from the Solar System was discovered. It was then a real time capsule that witnessed the evolution of our galaxy.

However, these traces cannot be treated as indicators of present life or relics of the past life. The presence of organic compounds in the extraterrestrial space only means that somewhere in the Universe exsist conditions enabling the appearance of organic matter. It should be, however, emphasized at this point that from organic molecules to organized life leads almost infinitely long chain of events. Each element of such a chain can appear with extremely low probability, even if its appearance may have occurred in an astronomical and therefore very long time scale. Therefore, it cannot be ruled out that the occurrence of life on Earth is a phenomenon unique to the entire Milky Way galaxy, in which may be more habitable planets than there are people on our Earth. However, "habitable" does not mean "inhabited".

The third concept, different from the previous ones, is metaphysical. It assumes that the basis for the appearance of the phenomenon of life was a creative act that cannot be described by the laws of nature, which transferred the problem of the origin of life to areas beyond science.

The elucidation of the scenarios that could lead to the emergence of life on Earth was in fact a search for the emergence of the inheritance mechanism. The emergence of the mechanism of copying the initial structures was essential for the continuity of the reproductive processes. The key event was the appearance of replicons in the primordial soup i.e. molecules that facilitated self-replication processes and were able to form families of copied molecules. Their appearance was presumably the result of random interactions between the first organic molecules.

In nature, almost all biochemical reactions and most of the molecular interactions in the cells of living organisms take place with the participation of catalysts. These components, without participating directly in transformations, are able to contribute to the most favorable spatial orientation of the reacting substrates. In the course of evolution, proteins acquired the features of extremely efficient catalysts. During primordial reactions, when the proteins were not yet present, the catalytic functions could be performed by inorganic minerals produced by erosion of volcanic ash and present in the prebiotic environment.

Over the time of evolution, in the presence of the first catalysts, linear replicon polymers could also appear in the original soup. Like the initial monomers, these polymer chains maintained also the ability to self-replicate. Their coding capacity was obviously much greater than that present in single monomers. However, copying larger molecules is much more complicated due to more frequent

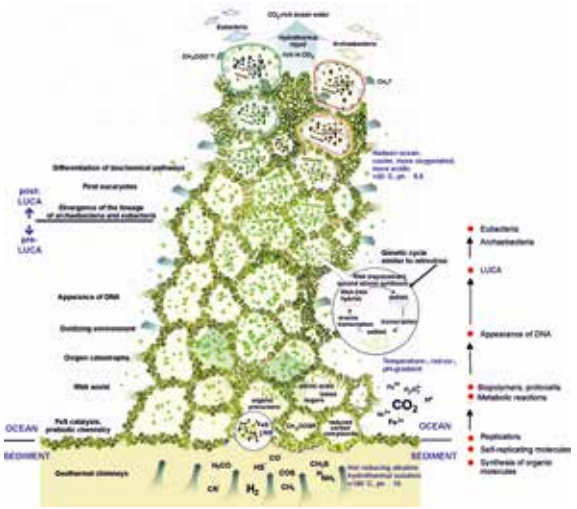


Figure 2. Simplified scenario of the evolution from the origin of early syntheses of RNA constituents to the archaebacterial and eubacterial cells in naturally occuring compartments of hydrothermal vents. Acc. Koonin, Martin 2005.

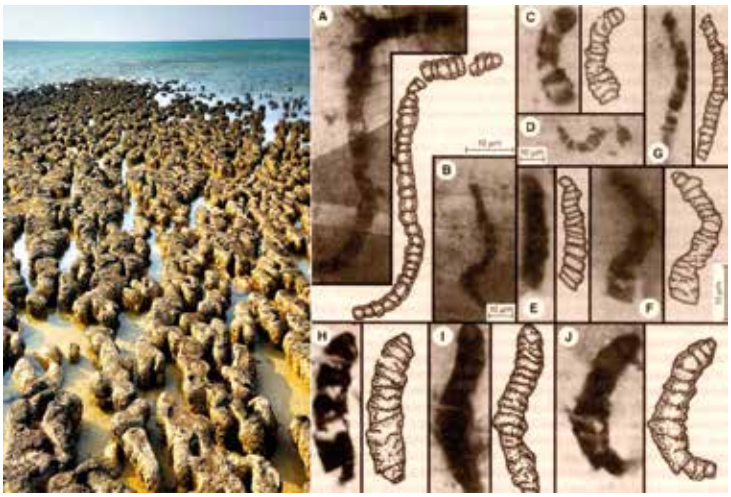


Figure 3. The oldest preserved micro-fossils on Earth. I. General view of stromatolites. II. Eleven taxa of cellularly preserved filamentous microbes as old as 3,465 billion years that have been identified in Early Archean Apex Chert Northwest Australia. Acc. Schopf J.W., 1993.

copy errors yielding mutated replication products. Some of these mutants were preserved in evolution, and thus the phenomenon of diversity has appeared in nature.
Modern simulations as well as all empirical studies show that the only class of molecules capable of forming replication systems are nucleic acids or their structural elements, nucleotides. Today we know that the first world of living organisms was the RNA world. This type of nucleic acids can act as depositors of stored hereditary information as well as the catalysts of autocatalytic transformations. Contemporary relics of the RNA world are some retroviruses that have survived to our times.
In 2017, an international team of researchers reported the discovery of fossils microorganisms in sedimentary rocks of hydrothermal vents localized in ancient ocean in Northeastern Canada. Age of these sediments estimated at 4.28 billion years. This confirmed earlier hypotheses that abiogenesis may have originated near oceanic hydrothermal holes. The petrified structures of the oldest microorganisms are now detected also in other places in the vicinity of submarine volcanoes.
The oldest terrestrial, petrified organosedimentary structures of the earliest life forms on Earth are stromatolites. These are limestone biosedimentation deposits formed from single-celled thread-like cyanobacteria on the bottom of water reservoirs. They have been found in many different places on Earth, including Greenland (dated 3.7 billion years) and Western Australia (3.48 billion years).
A slightly different problem is the question of identifying the earliest cell organisms as well to characterize the supposed structure of their genomes. In 2016, a hypothetical minimal genome of 355 genes was identified that could be present in the ancestor of all living organisms on Earth (Last Universal Common Ancestor, LUCA). Some researchers suggest that LUCA was not free-living but inorganically housed assemblage of replicated and expressed genetic elements.
When an attempt was made to define the properties of an organism that could now possess such a gene pool, it turned out that it is typical for methanogenic bacteria that colonize anaerobic hydrothermal environments. Energy for such bacteria is provided by reduction- oxidation processes generated by iron-sulfur complexes. Considering monophyletic origin of all living organisms, it can be assumed that indeed, thermophilic and hyperthermophilic bacteria might be located closest to the roots of the phylogenetic tree of life. And this strongly supports the view that on prebiotic Earth life arose and evolved in a hot, reducing hydrothermal environment.

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Life as the basic category of description and explanation of the world in selected philosophical concepts

If we consider the concept of life as a theoretical category, we will immediately notice that today it is primarily inscribed in the framework of modern biology, and that it would be difficult to overestimate its role in this field. It seems, however, that it is equally difficult to fully appreciate the role that this category played in shaping European culture — functioning outside the exact sciences, that is, functioning within the framework of twentieth-century philosophical systems. The purpose of this text is to present this role at least partially.

I will start with the reasons why this category became attractive to the philosophical reflection of the twentieth century; this, however, requires the identification of certain historical relationships between several important philosophical ideas.

Let us therefore go back for a moment to the birth of philosophy itself. This birth was a response to the need of explaining the world that had accompanied man from the earliest times. However, philosophy satisfied this need in a different way than fields much older than it, such as myth and religion. The substratum of the myth — as Ernst Cassirer put it — is the substratum of feelings (see: Cassirer, 1944, p. 81), which become the basis for ordering reality. Nature in its scientific sense, that is, as objectively existing things that are determined by general laws, does not exist (ibid., p. 76). The mythical world — wrote the author of *An Essay on Man* — is "at a much more fluid and fluctuating stage than our theoretical world of things and properties, of substances and accidents. (...) [It] is a dramatic world — a world of actions, of forces, of conflicting powers. (...) Whatever is seen or felt is surrounded by a special atmosphere — an atmosphere of joy or grief, of anguish, of excitement, of exultation or depression. Here we cannot speak of 'things' as dead or indifferent stuff" (ibid., p. 76—77). Religion also does not so much capture the world in the perspective of objectively existing laws and things, but prompts us to perceive the observed phenomena primarily as an element of the moral order, which, if voluntarily followed, ensures God's favour to man (cf. ibid. p. 106 and following).

A completely different way of taming the world was proposed by first natural philosophers. Philosophers, trying to control a certain segment of reality, no longer attempted to win over demons or to obtain the favour of the Almighty. Lovers of wisdom searched for the nature (*phisis*) or the principle (*arche*) of the world. Using modern language, they searched for objectively existing (independent of the cognising subject) laws governing the world. And although philosophy from its beginnings was perceived as an autotelic domain (cf. Aristotle, 1996, I, 2—982b), it is the knowledge of these laws that allowed its creators not only to contemplate the world as a beautiful spectacle (cf. Cicero, 1961, pp. 686—687), but also to accurately predict events and, in consequence, to control specific areas of reality (see e.g. Herodotus, 1959, p. 53; I, 74). It should be emphasised here that not only the purpose, but also the methods of philosophy differed from the methods characteristic of myth and religion. Already since Thales, philosophy used argumentation that referred to the principles of logic.

The features of philosophy indicated here were clearly explained by Heraclitus in his concept of the *Logos*, which referred to the rational laws that govern the world and exist independently of man. These rational principles were seen as a kind of "language of the world" to which we should listen and which we can express with our own words. However, the role of reason in explaining reality, reason identified with thinking consistent with the laws of logic, was most emphatically stressed by the Eleatics. The recognition of reason supported by the laws of logic as the only valuable cognitive power led Parmenides to an absurd vision of being as a homogeneous, motionless sphere. Sensory obviousness was questioned by him because it contradicted the logical consequences derived from the assumptions made earlier. A similar faith in the power of reason is also seen in the views of Zeno of Elea, who denied the possibility of movement because he decided that it was excluded by the laws of logic.

The ancient rationalism finds its continuation in the early modern period, when the category of theoretical reason again takes the place of the most important category of description and explanation of reality. Reason was absolutised already in the thought of Descartes. This philosopher identifies reason with a thinking substance (*res cogitans*) and indicates the principles of logic and mathematics as the principles of its functioning. This substantiated, logical-mathematical and at the same time absolute reason is understood here as a divine attribute in which man can participate — thanks to his substantial soul, or, in other words, thanks to a particle of rational substance present in man. This meant that human thought, respecting the principles of logic and mathematics, can formulate absolute, non-relative truths about the world around us; that we can at least to some extent look at the world from a divine perspective. Although this pleasant conviction based on the hypothesis about the omnipotence of human reason found not only its supporters and defenders, but also insightful critics, it would be difficult to deny that it constituted a dominant element of the philosophical landscape of the early modern period. However, this situation changed on the threshold of modernity. It can be said that entering modern times is related precisely to the perception of the limitations specific to the cognitive procedures developed in the early modern period, with the departure from the undivided rule of Cartesian ratio, and with the category of life entering the arena of history.

The category of life that appears in contemporary philosophical thought was supposed to be a remedy for the deficiencies of early modern rationalism. These deficiencies became apparent in the nineteenth and twentieth centuries with the development of logic and mathematics themselves, and of such sciences as biology, sociology and psychology. The emergence of non-Euclidean geometries and many-valued logics showed that the principles of classical logic and mathematics were only some of all those possible. And Kurt Gödel's demonstration that consistent first-order systems which can be carried out are incomplete, and that we cannot prove the non-contradiction of deductive systems, undermined the belief that it is possible to gain absolutely certain knowledge about every segment of reality. The difficulties of early modern reason became apparent also when attempts were made to apply its rigid categories in fields describing changeable, dynamic phenomena. The fact that humanity became aware of this difficult situation was expressed in the thought of Henri Bergson, for whom reason no longer presents the truth about reality, but deforms it in its descriptions. Bergson believed that reason cannot grasp movement and change, that it cannot grasp things as a whole, or grasp their diversity, quality and uniqueness. Therefore, reason presents as immovable what is subject to change, treating change itself as a simple rearrangement of elements. Therefore, it breaks down into parts what is complex, simplifies and quantifies it. And this is also why, in the end, it relativises all things by representing them through relations with other things (cf. Bergson 2004, pp. 142 and following; Wojnar 1985, pp. 74 and following). Although the deformations indicated here are practically useful, as thanks to them, according to Bergson, we are able to function efficiently, they prevent us from getting to know reality. They do not allow us to see — in Kant's words — "reality in itself".

The early modern ideal of reason was also questioned by Friedrich Nietzsche. Considering the origin of logic, he pointed out, like Bergson, that its source and role is practical utility, not the idea of compliance with reality. This author wrote: "What is the origin of logic in man's head? Surely it arose out of the illogical (...). The predominant disposition (...) to treat the similar as identical — an illogical disposition, for there is nothing identical as such — is what first supplied all the foundations for logic" (Nietzsche 2008, p. 112); further on, this author stated that "in order for the concept of substance to originate, which is indispensable to logic though nothing real corresponds to it in the strictest sense, it was necessary that for a long time changes in things not be seen, not be perceived; the beings who did not see things exactly had a head start over those who saw everything 'in a flux'" (ibid.).

Reason, based on the principles of logical and mathematical thought, which deforms and distorts reality in the above-mentioned concepts, which creates — in Nietzsche's words — "conceptual idols", can no longer be the category that founds the understanding of the world; it is unable to grasp its variability, fluidity, complexity and diversity. From the times of Hegel, people began to notice and emphasise change, dynamics, diversity and creativity in the reality which, in order to be understood, needed a new category that would make it possible to explain aspects which had been overlooked or ignored so far. At the threshold of the modern day, this category turned out to be the category of life.

This category was introduced to modern philosophy by the above-mentioned Friedrich Nietzsche. The philosopher links it to his concept of the will to power and makes it the central notion of his philosophy. The category of life refers here to biological content, to the struggle for survival. Describing life, Nietzsche states: "life itself is essentially a process of appropriating, injuring, overpowering the alien and the weaker, oppressing, being harsh, imposing your own form, incorporating, and at least, the very least, exploiting" (Nietzsche, 2002, p. 153). In other words, life is terrible. Each creature is forced to fight, therefore it craves strength and power. In another text, the author states: "[l]ife as a special case (...) strives after a maximal feeling of power; essentially a striving for more power; striving is nothing other than striving for power" (Nietzsche 1968, p. 368). This power, strength, is desired by "*every smallest part of a living organism*"

(ibid., p. 373). This also applies to man, who, contrary to the rich philosophical tradition, is inscribed here in the natural world. "We do not derive man from the 'spirit,' from 'divinity'," wrote Nietzsche, "we have put him back among animals" (Nietzsche 1907, p. 18). The Nietzschean man, inscribed in the world of animals, is deprived of his soul and thus deprived of that particle of the rational substance which, according to Descartes, enabled him to formulate non-relative truths about the world. Life itself, with its will to power, is now at the root of knowledge. "The strength of knowledge," wrote Nietzsche, "lies not in its degree of truth, but in its age, its embeddedness, its character as a condition of life" (Nietzsche 2008, p. 111). The truth itself in Nietzsche's terms ceases to mean an adequate description of reality; it becomes a useful error, it is a metaphor, an illusion which we are used to and whose delusion we do not remember. Basing on the category of life that makes the environment we live in an arena where we fight for survival, Nietzsche explains all aspects of the world. The ruthlessness and inevitability of the laws of nature together with our will to power opposing them determine not only our survival, but also influence the shape of the culture we create, our perception of values, and the nature of our creativity. According to Nietzsche, a low level of will to power characterises a weak, common, wretched man, a man who recognises as value only what supports his weak strength, a man whose work is always responsive, secondary — responding to the challenges of the world. Such a man creates a culture of mediocrity. His opposite is a strong, dignified, creative person in the full sense of the word, not burdened with resentment, creating his own values and culture (cf. Nietzsche 2002, p. 153 and following); man who is not only the noblest clay or the most expensive marble in need of a sculptor, but also the sculptor himself (cf. Nietzsche 2000, p. 23). He is a creator who, thanks to his will to act, can lead to the defeat of himself, to the emergence of a superman who overcomes the existing limitations. Therefore, the purpose of human activity is no longer to discover and realise one's own essence; it is not to listen to the *Logos* of the world or to submit to God's plans. Nietzsche rejects submission to anything external. "I want more than that, I am no seeker," says one of his heroes in *The Gay Science*, "I want to create for myself a sun of my own" (Nietzsche 2008, p. 180). Thus, the ideal of reflecting the world with the power of reason, taking into account the need to submit to the obtained image, is replaced here with the ideal of unrestricted creativity and individuality, an ideal that has become a permanent part of the landscape of contemporary European culture.

The category of life also plays a key role in cognition in the thought of the above-mentioned Henri Bergson. Here, however, life that underlies cognition does not exclude, but even enables an adequate approach to the world. Admittedly, reason (as I indicated earlier), according to Bergson, deforms the cognised reality in order to efficiently satisfy life needs, but it is not the only cognitive power of a human being. Man also has intuition, i.e. the ability to directly grasp reality in its entirety and changeability. Intuition is understood here as a conscious instinct, i.e. as a biological phenomenon, a kind of effect of the organism's adaptation to the needs of life. Being a product of nature, it can come to know it — in this case the subject and object of knowledge become homogeneous. Intuition takes us inside things; it is direct knowledge, independent of current needs. Thanks to this, it makes it possible to get to know the reality which constitutes a coherent whole (cf. Kołakowski 1997, p. 50). Intuition shows us that reality is infinitely diverse, changeable, and in the case of organic nature also alive, dynamic and creative. The last of the features mentioned here deserves special attention. Bergson clearly emphasises that unprompted, creative development with unlimited possibilities characterises all nature. This creativity is a contradiction of finalism and mechanicism — since they exclude genuine creativity. The philosopher does not question the fact that certain mechanisms exist in nature, but he considers them to be a sign of inhibition of real development caused by the inertia of matter, and not its highest achievement. Therefore, it is to Bergson's thought, popular in the first half of the twentieth century, that we owe the introduction of a new vision of the world into contemporary culture. It is a vision in which this world is the work of a genius artist rather than an engineer; a vision in which the uncountable and unpredictable is important, or a vision in which the world becomes mysterious again, in which subtlety and sensitivity cannot be replaced by Cartesian clarity and distinctness.

Life as a category that underlies our understanding of the world is also present in the thought of Wilhelm Dilthey. This philosopher indicates that life is the foundation on which the framework of our worldview is built, that life is its „root" (Dilthey 2019, p. 254). What does it mean? The philosopher emphasises that the life of an individual is never realised in emptiness, that we are always connected with others by various dependencies. „Some make me happy (...) others exert pressure on me," he writes (ibid., p. 254—255). We notice and feel these dependencies; they become an element of life experience that is accumulated through reflection on our situation in the world. Although the experience is to some extent individualised — although, in the words of Dilthey, „the life of each individual creates its own world out of itself" (ibid., p. 255), the essential features of this experience are common to all. We commonly experience the impermanence of our goods, the ubiquitous force of chance and the presence of death. Despite the commonality of these essential elements, the life experience of individuals takes many forms. The impermanence, transience of things, institutions and ourselves liberates in some of us the desire to use every moment (*carpe diem*), while it pushes others to build „solid framework of their existence" or to seek durability in the transcendent, metaphysical world (cf. ibid.).

This diversity, but also the changeability of life experiences, contrasts with the human efforts to build a holistic picture of life. However, it is impossible to achieve a non-contradictory image here, which is why Dilthey writes that an image of life that is „full of contradictions" emerges from the changing life experiences. „Conception, birth, development, and death are at the heart of all those things that cannot be understood" (ibid., p. 256), writes the philosopher. The contradictions which we cannot resolve are: „a general transitoriness versus our desire for something permanent; the power of nature versus the independence of our wills; the finitude of all that exists in time and space versus our ability to exceed every limit" (ibid., p. 257).

The life experience we are talking about here also has a supra-individual dimension. Single, regularly repeated experiences are passed on to the next generations. As the number of successive cases increases, such experiences become more and more relevant. Dilthey notes that the morality, customs and tradition that control us are deeply rooted in such experiences. The author stresses, however, that the certainty achieved here is significantly different from the certainty that can be achieved in science; there is no falsifiability or strict formulas because „[e]very great impression shows a human being a new side of life; the world is seen in a new light" (ibid., p. 256). These repetitive and related experiences shape our moods towards life, which are the basis for shaping the worldview, and it is within the framework set by them that we try to face the mystery of life and the world. For such a worldview to be formed, however, another process is required: "attempting to understand an incomprehensible given by means of something that is more evident. What is evident becomes a means of understanding, a basis for explaining what is incomprehensible. Science," says Dilthey, "analyses (...) religion, literature, and primitive metaphysics express the meaning and sense of the whole. That former cognises, the latter understand" (ibid., p. 258).

In the cases mentioned here, life plays the role of a central category explaining the entire human world; it now lies at the basis of our understanding of values, it determines the place of man in the world, it determines the criteria of cognition, and finally it indicates the purposes of our activities. It cannot be framed in the rigid formulas of the intellect, it cannot be explained, but it can be understood, because in this case the subject and the object are homogeneous; in this case — as Dilthey put it, „life grasps life". The concept of life indicated here permeates and shapes culture. Today, it is difficult to imagine this culture without the individualism embedded in the Nietzschean conception of life and the will to power; it would be difficult to notice its nuances and shades without Dilthey's concept of understanding, and it would be difficult today to do without the idea of intuition as understood by Bergson.

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Life from space or born in water?

Life on Earth is at least 4.5 billion years old. How it started? There are three possible answers. I. It come from divine creation; II. It came from outer space; III. it was formed spontaneously on Earth. One may find that the possibility of the life coming from space is then reduced either to answer I or III with different location of the origin of life. While the answer I is not domain of science I will analyze the possibility of life formed on Earth. To answer the question how life was started we must resolve four fundamental problems. First, how complex (organic) molecules were formed from simple abiotic substances? Second, how these molecules were concentrated and isolated from environment? Third, what was the (low) energy source for driving (abio)chemical reactions? Fourth, what was first — RNA or proteins — or maybe both?

The first question was answered by Stanley Miller in 1953[1]. He enclosed simple gases methane, ammonia, hydrogen and water in enclosed distillation apparatus which was equipped with electrodes. Between electrodes electric sparks were generated. After a week he found different amino acids from which proteins are formed. Analysis of the mixture produced by Miller conducted 50 years later showed the presence of also other substances which are found in organisms. Similar results were obtained when simple molecules were subjected to ultraviolet or X-ray radiation and also in meteorites which survived fall through earth atmosphere like the Murchison meteorite that fell in Australia in (1969).

The second question remains. Molecules formed in abiotic conditions must stay in high concentrations in order to form larger structures of proteins and nucleic acids by random interactions. Molecules in meteorites which fall into the ocean will dissolve in vast amount of water. The same is true for organic molecules formed by lightnings on earth surface and then washed by rain into ocean. Thus, there must be other place were life started.

In 1977 scientist discovered hydrothermal vents near Galapagos Islands in the depth of the ocean where there is a border between two tectonic plates. There molten magma filled with minerals and dissolved gases form superheated water filled with minerals forming black and white smokers — Figure 1. Black and white smokers are populated by many odd organisms which fed on dissolved chemicals.

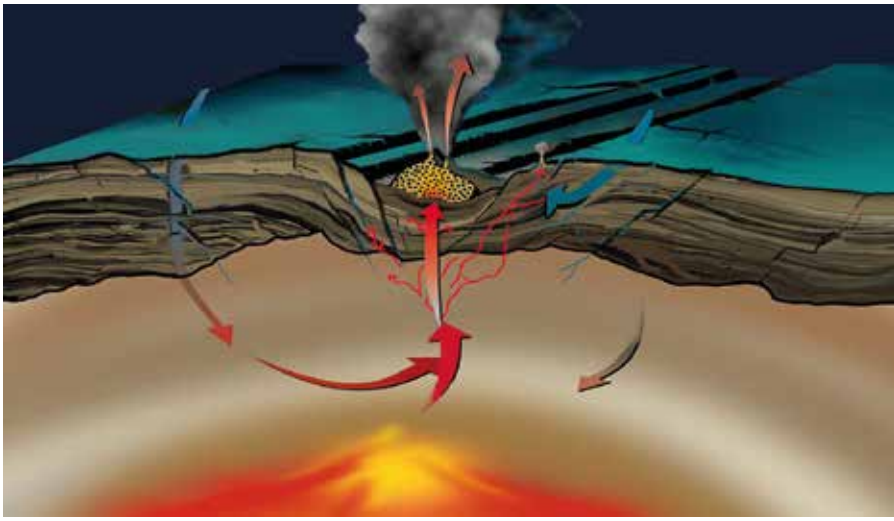

Figure 1. The mechanism of hydrothermal vent formation. Wateer oercolate down to molten magma, overheate, dissolves substances present in magma and rises through rocks and appears in the ocan floor as hot springs — hydrothermal vents realising dissolved substances in form of black or white smokers. https://joehartleypanspermiathermalvents.weebly.com/

But it is white smokers which are the likely candidate to be a place where life could have started. Smoke of white smokers is formed from chalk and other weekly soluble calcium minerals. The chalk forms a 50 meters tall chimneys above the hydrothermal vent. The chimney is made from sponge like structures. We may expect that organic molecules formed inside the earth due to extremely high temperature and very high pressure. Then these molecules adsorb on a chimney material. This is a process similar to column chromatography. Molecules formed do not disperse in an ocean but slowly form separate sets of similar molecules which can undergo random condensation.

The idea that white smokers are places were life originated have one more attractive feature. To conduct reaction of condensations the energy source is needed. At present the uniform form of energetic molecule is ATP. ATP is produced in bacteria, plants and animals. For ATP synthesis the energy stored in protons are used. On one side of ATP producing membrane there are many protons in other words a low pH value. On the other side there are very small proton concentration (high pH). Protons moving from higher concentration to lower produces energy which is then used for ATP synthesis. In animals and humans ATP is produced in mitochondria a special organelle producing ATP. While in present day mitochondria the difference in pH value is obtained by actively pumping out protein on cost of energy obtaining by burning sugars and fats. In plants the energy to move protons is obtained by absorbing light quantum. The pH difference is naturally occurring in white smokers. The white smoker fluid has pH=10 and in ancient oceans the pH=5. This pH difference could have been a stable energy source for the processes of organic syntheses[2].

And once we know were life could have started we may get involved in the problem of what was first DNA synthetized by proteins or proteins encoded by DNA. In the past scientists were looking for hypotheses in which first were proteins. At present the RNA world hypothesis is dominating i.e. that first it was RNA which also has enzyme like properties. Both hypotheses have obvious disadvantages. The other hypothesis claims coevolution of proteins and nucleic acid[3].

Summarizing, organic components of organisms can be obtained from simple molecules by applying the high energy source like electric discharges, ultraviolet light, radioactivity and high temperature and high pressure. The hydrothermal vents are likely to be an origin on life on earth because in sponge like chimneys the concentration and separation of molecules could have taken place. It is likely that naturally occurring pH difference in white smokers' chimneys was an energy source for the first condensation reactions leading to proteins and nucleic acids. Once proteins and RNA were formed they co-evolve until billion years later LUCA (Last Universal Common Ancestor) simple organism was formed.

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Beauty of microorganisms

Microscopic organisms, commonly known as microorganisms or microbes, can be found all around us, and even inside our bodies. The term "microorganisms" includes bacteria, fungi, archaea and protists, and they are among the earliest known life forms. There are many hypotheses concerning the origin of life. However, scientists agree that life arose in the aquatic environment, and that the first organisms were the prokaryotic cells with a structure similar to contemporary bacteria. Eukaryotes evolved more than two billion years ago. (Cavalier-Smith, 2010; El Albani et al., 2010). The unicellular eukaryotes, usually called protists, directly descended from bacteria, but differ from prokaryotes by having the nucleus, endomembrane, cytoskeleton, and mitochondria and constitute the evolutionary indirect link between animals and plants [Cavalier- Smith 2010] (Figure 1). Regretfully, we lack a fossil record from which we could track the evolution of the structure and function of subcellular organelles.
A major advancement in discovering unicellular organisms, was the invention of the simple microscope by Anton van Leeuwenhoek and discovery of new life forms named by him, animalcules. His discoveries came to light through correspondence with the Royal Society in London, which published his letters. In his work, sent in 1667 to the journal Philosophical Transactions of the Royal Society in London, van Leeuwenhoek wrote: "These animalcules had divers colours, some being whitish and transparent; others with green and very glittering little scales; others again were green in middle and before and behind white; others yet were ashen grey. And the motion of most of these animalcules in the water was so swift, and so various, upwards, downwards, and roundabout, that it was wonderful to see: and I judge that some of these creatures were above a thousand times smaller than the smallest ones I have ever yet seen".
The animalcules described by Anton van Leeuwenhoek most likely today could be named Protista, based on the description found in the letter to the Royal Society in which he reported " I discovered a second sort of animalcules, whose figure was an oval, provided with incredibly thin little feet, or little legs, which were moved very nimbly and wherewith they brought off incredibly quick motions". These small organisms were ciliates, which were moving using cilia. (Figure 2).

Figure 1. The generalized phylogeny of six superkingdoms. Bacteria and Archaea are both prokaryotes. All prokaryotes are single celled and lack the nuclei. There are 4 kingdoms of Eukaryotes: Animals, Plantae, Fungi, and Protista. Eukaryotes have a nucleus and other organelles (see text) and can be single celled or multicellular. The single celled Eukaryotes are called Protista.

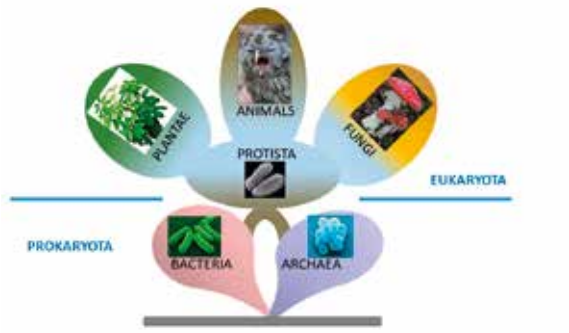
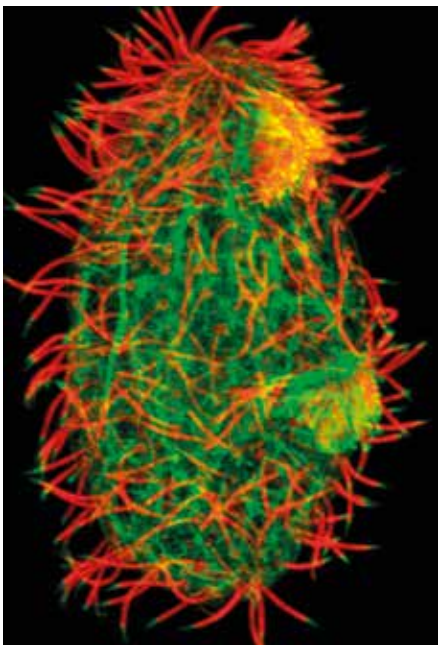


Figure 2. Fresh water ciliate *Tetrahymena termophila* (labelled microtubules in dividing cell, visible cilia — red). Confocal microscopy image by Dorota Włoga →



The term Protista was first introduced by Ernest Haeckel (1866), who divided the tree of life into three branches, kingdoms of Animalia, Plantae, and Protista, each of which he thought arose monophyletically from the primordial slime [Haeckel 1866]. His kingdom Protista was heterogeneous, including heterotrophic bacteria, diatoms, amoebae, and sponges, and his three-kingdom system did not catch on, as critics thought the assignment of the organisms to each of kingdoms was somewhat arbitrary. Only in a very loose sense, this first tree was a precursor of modern multi kingdom systems [Cavalier Smith 2010].

Current Protista is a huge kingdom, very diverse, and its taxonomy is constantly being verified. The unicellular level of organization is the only common feature for all Protista. The remaining features show considerable variation. They differ in the complexity of the cell and the method of adjustment/accommodation to the environmental conditions. Protists are equipped with special organelles that support all life functions (they enable movement, eating, breathing, emitting unnecessary products of metabolism, and reproduction). These huge and very diverse groups of the microorganisms adapted to various environments. Free-living protozoa are a permanent component of our aquatic environments. They live in both fresh, brackish, and sea waters. They are also found in groundwater, in humid environments, such as water sands, soil, peat bogs, etc. Numerous forms, as parasites of humans and animals, and cause a number of serious diseases. For example: *Giardia intestinalis/Lamblia intestinalis* (phylum Metamonada) is a flagellated parasitic microorganism that colonizes and reproduces in the small intestine, causing a diarrheal condition known as giardiasis. *Trypanosoma brucei gambiense* (phylum Euglenozoa) infection is the cause of african trypanosomiasis (also known as sleeping sickness). Several species of *Plasmodium* (phylum Apicomplexa) parasites are responsible for most malarial infections.

The body of protozoa consists of the cytoplasm and organelles including the nucleus placed in it (in ciliates from two nuclei). It is covered with a plasma membrane or, less frequently, with a rigid pellicula, and in plant-like forms — additionally with a pectin or cellulose wall. The shape of the body can be variable, determined by the properties of the cell membrane or the internal structure of the Protist; it often depends on changes in the environment in which a given protozoan resides. Many Protista also build shells of various structures. Reproduction occurs both sexually (e.g. conjugation) and asexual through division (Esteban et al.2015).

Numerous protists can move on their own. Some protists swim thanks to the movements of the flagella or related cilia (Figure.2) (e.g. Ciliate, Dinoflagellate). It is worth mentioning that the last common eukaryotic ancestor, LUCA living about 2 billion years ago, had a flagellum as a locomotor organelle (Mitchell 2017). Other Protists, for example, Rhizaria or Amoeba, move with the use of various kinds of pseudopodia. Importantly, Protist adapted various ways of feeding. Autotrophs can synthesize nutrients by photosynthesis, heterotrophs can feed by phagocytosis (surrounding food particles with the plasma of the body), or pinocytosis (absorption of fluids through the cell membrane).

Based only on light microscopy observations, it was difficult to assign these diverse microorganisms to different kingdoms. Today, the advanced analyses based on the electron microscopy and gene sequencing considerably facilitated the systematic re-organization of this kingdom (Cavalier-Smith 2010, Ruggiero et al. 2018). Currently kingdom Protista is divided into following supergroups: Amoebozoa, Excavata, Rhizaria, Chromalveolata (Adl et al. 2005). Noteworthy, there are several groups already described and presented with the finest morphological details by Haeckel in "Kunstformen der Natur" (Haeckel 1904). These include, among others, Rhizaria, which are characterized by hundreds or thousands of delicate 'plasma filaments' (pseudopodia), emanating from the mono-cellular body and protruding through innumerable fine, equally distributed pores of the central capsule. Among Rhizaria, there are several orders, including: Radiolaria (Figure 3). The beautiful collection of the Radiolaria at Radiolaria Room of the Micropolitan Museum UK available at this link http://www.microscopy-uk.org.uk/micropolitan/marine/radiolaria/index.html is very impressive. Also, the beauty of Foraminifera (Figure 4), cells with granular cytoplasmic filopodia forming a branched and complex network (reticulopodia) surrounded by a test that can be an organic, agglutinated or calcareous wall found its place in the Haeckel study. Some species with limestone carapaces surrounding the body, living in the Cretaceous era, have formed layers of limestone, used as chalk deposits.

Ernest Hackel in "Kunstformen der Natur" (Haeckel 1904) also presented the Ciliophora/Ciliata (Figure 5), which was first described by van Leevenhouk. Ciliate are the freshwater or saltwater Protista, having cilia on part or all of the surface, and two different types of nuclei (macronucleus and micronucleus). Although the ciliates typically reproduce asexually, they also exchange genetic information by the process of conjugation.

This general and short characteristic is only an introduction to the kingdom of Protista, a very numerous, diverse group of unicellular organisms, the discovery of which was possible with the invention of the microscope. Since then, Protista has aroused great interest among researchers and some of them fascinated artists.

https://www.bing.com/images/search?q=art%20of%20radiolaria&qs=n&form=QBIR&sp=-1&pq=art%20of%20radiolaria&sc=0-17&cvid=081C2746AD9043BCBA84AF599CAA4B62&first=1&scenario=ImageBasicHover

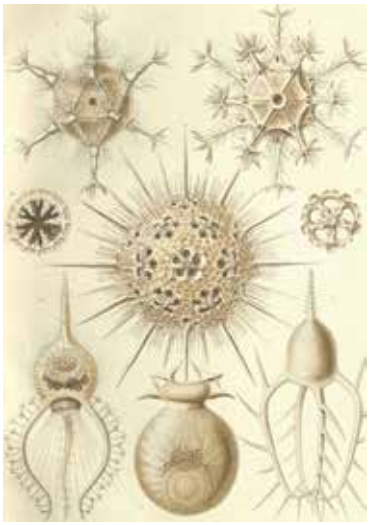


Figure 3. Platte presenting Radiolaria "Kunstformen der Natur" (Haeckel 1904)

Figure 4. Platte presenting Foraminifera, from "Kunstformen der Natur" (Haeckel 1904)

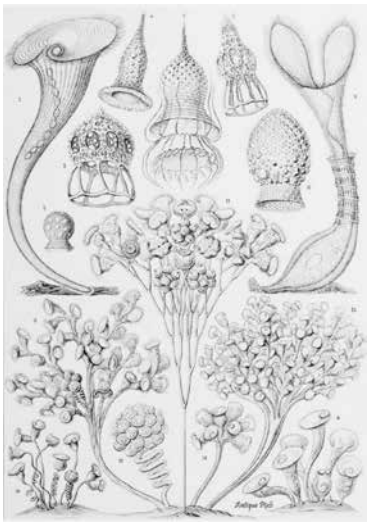


Figure 5. Platte presenting Ciliate from "Kunstformen der Natur" (Haeckel 1904)

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Action painting from the perspective of creative evolution

The concept of creativity proposed by Henri Bergson sees it as the deepest factor of reality, both in the genetic and actual sense (because it is constantly active). The characteristics of the creative process taking place on a macro scale, encompassing the whole of nature, are equally applicable to the individual scale of creative activity. The course and the rules governing them are — essentially — the same.

The creative impetus, *élan vital*, works constantly, in endless bifurcations, struggling against the resistance and inertia of matter to create ever higher forms, more perfect spiritual works. All evolution: both the development of organic matter and the transformations of species are manifestations of this creative process. A trace of this source energy is present in all individual organisms; it is a kind of general tendency that works in nature.

The centre of this movement — Bergson's God — differs from both the God of Christians and the god of philosophers, whether it is the Immovable Mover, the Absolute, or the god of Hegel who becomes present through history. It is God acting like an artist, described in terms of freedom, activity, love, effort; identical with creative activity that does not rigidly assume its results; it is open to a number of possibilities — including error, starting from scratch, changing direction. Therefore, he is neither a Demiurge, following a precisely planned scheme, nor a fully labile being, tossed by fate. Creative evolution, like any form of creativity, has nothing mechanical about it; it takes place "between" hard determinism and complete randomness.

God defined in this way is not a fully complete, constant and unchanging being, who exists like things do, but movement, "unceasing life, action, freedom" (Bergson, 1928: 262). The process he initiates also includes himself. The experience of such a state is known to man: it appears when he acts freely and creatively. God, like the artist, does not create out of nothingness, but constantly struggles with the resistance of matter, not knowing in advance the final results of his effort.

The work of this creative force is reflected in the metaphor of a shell from *Creative Evolution*: "The evolution movement would be a simple one, and we should soon have been able to determine its direction, if life had described a single course, like that of a solid ball shot from a cannon. But it proceeds rather like a shell, which suddenly bursts into fragments, which fragments, in turn, being themselves shells, burst in their turn into fragments destined to burst again, and so on for a time incommensurably long. We perceive only what is nearest to us, namely the scattered movements of the pulverised explosions" (Bergson, 1928: 103). Two series of causes, dead matter and life energy, remain in "unstable equilibrium" and condition each other.

Jackson Pollock's paintings perfectly reflect the perception of the subsoil of nature as an exploding "grenade" with all its momentum and intense energy. It is not known whether he knew Bergson's concept, but it is not significant. What is important is that his art can be interpreted from the perspective of Bergson's concept. In his works, Pollock captured the essence of the movement that permeates and creates reality: they do not represent a certain state of affairs, but a process in progress. In art, there is simultaneously this movement and duration. Paintings spread out in all directions like an explosion (*all-over*), there is no centre, no divisions or superior structure. They live on their own energy; they have an almost organic, condensed structure. In critical reflection, there are such terms as "mineral profligacy", "mud" or "chalky incrustations" (Danto, 1997: 72). The technique of dripping — pouring paint on a canvas spread out on the floor — invalidates the boundaries of the picture, creating narratives (which in itself is some form of grasping continuity) that do not record the beginning or end of the process of changes, a certain "frozen" system, but the change itself. Rejecting the stretcher, the easel or traditional painting tools in favour of action painting offers the artist maximum freedom. Walking around the canvas, "splashing" successive layers of paint, they themselves become part of this process; like Bergson's God, they initiate change and are subject to it themselves. "Nothing can go wrong... there are no accidents. The painting has a life of its own and I try to let that come through... try to stay in contact with it. It is only when I lose touch that it ends up a mess" (Thompson, 2006: 226). This centrifugal perspective naturally leads to the

method of trial and error, successive approximations in which you can control individual stages, but not the final effect. Jackson Pollock similarly described his actions: "total control is the denial of chance." To some extent, it is a return to the ancient concept of art, defined by action, not by the artifact. The difference lies in the lack of universal rules to which the artist subjects the material. Gestural painting is about negotiating rules determined by body movements, paint and gravity each time a painting is created. The shift of focus from result to process, action, is a common tendency in the practice of contemporary art; in the case of Pollock it seems that even the term "creative act" is too narrow, closing this — as Bergson would have it — open action.

"There are no things, there are only actions," writes Bergson (1928: 261); we, like the whole of what is, are constantly changing — "duration is change" (Bergson, 1988: 133). The pragmatics of life distorts our perception and thinking; we see the effects of changes, and not the continuity of the ongoing process. The human species has evolutionarily been endowed with often conflicting dispositions: instinct, intuition and intelligence. Intelligence in cognition reverses the natural order of things: it assumes the world as a discontinuous set of fixed elements for which movement is an accident. Analytical reason, thinking based on concepts, integrates and systematises our cognition of the world, but also ignores many qualitative differences: "we organise and simplify the world according to the practical meaning that its various qualities may have for us" (Kołakowski, 1997: 89). Theories that were supposed to complement the natural imperfection of sensory perception have replaced it to some extent — the perception of individuals and phenomena has become mediated by concepts, weakening the faith in one's own view of the world.

Intuitive cognition allows us to capture the continuity and unity of the process taking place in reality, to reveal things in their unique forms. The very notion of intuition has the status of a cognitively trivial category resulting from its common usage, but in philosophy it means "knowledge without arguments": cognition beyond analysis and synthesis, directly grasping the essence of things, not needing discursive support. This ability to look at the world disinterestedly is most fully expressed in art. Bergson treats art as a necessary link that replaces the — lost? impossible? — harmony between the intellect and intuition: cognition conditioned by the pragmatics of everyday life and cognition grasping the rules, but not subject to the methodology of scientific cognition. To be effective, intellect and science must distort reality, and intuitive insight must overcome the resistance of language that imposes a network of concepts on reality.

Art is thus an "epistemic complement" of our world; it exists because it offers a specific way of expression, trust in one's own perceptions — intuitive, direct, sensual. Bergson describes this ability to penetrate the apparently static nature of things in a very vivid language, as grasping "the movement of the inner life of things" (Bergson, 1988: 37) or "the moving continuity of things" (Bergson, 1928: 347). These descriptions perfectly reflect the essence of Pollock's paintings, the flickering and smoothness of lines and spots freed from forms decreed in concepts. Action painting reflects the principle of the present "as what is happening". These traces "coming-from-the-guts of painterly gesture" (Danto, 1997: 90) do not mark anything, they do not direct the recipient towards anything — they are pure energy, a kind of perpetual motion machine. This inner mobility is already evident in Pollock's early works. Action painting invalidates the superior role of the "eye" in favour of the expression of the gesture and the dynamics of the body's work. To paraphrase Leonardo da Vinci, one could say that "the hand never errs". The departure from the function of representation naturally shifts the focus from content to form. Arthur Danto put it concisely: although dripping strongly determines the creative process, it is, nevertheless, "a proof of the importance of the painting act", it makes us realise that "despite all contexts, a painting is paint, and painting is action" (Pręgowski, 2011: 228). The multiplicity of contexts that a work evokes is often regarded as its main goal, but nevertheless it shifts attention from the work itself to its interpretations, blurring the freshness of direct reception in favour of cultural scripts. "A work of art (...) must not *mean* but *be*" (Danto 1997: 71). In other words, its meaning is "being art" and selflessness that is Kantian in spirit. The inner time of the work is the "eternal now", grasping the nature of time as Plato's "moving image of eternity". As Bergson wrote, life is more than the sum of factors, matter, chemistry or physics; works of art — by analogy — are always that "something more": they are governed by the thoroughly individual phenomenon of synergy.

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Diversity of life — Inclusions of insects in fossil resins of different ages

The life of many small organisms, especially insects has been captured in amber pieces. Resins do not only kill or collect dead bodies, but also envelope trapped insects, isolating them from external influences (Rasnitsyn & Quicke, 2006). Organic inclusions are natural preparation made by nature itself — a process some tend to refer to as "scientific unique". Inclusions enable detailed morphological studies, analysis of taxonomy, sometimes even to research behavior of some species which had existed (Penney, 2010). Moreover, they give opportunity to study relations between organisms like manifestation of parasitism or documentation of interaction between prey species, including their diversity and intensity of predation (Krzemińska *et al.*, 2009). Thanks to organic inclusions, it is possible to discover the origins of various fossil groups of animals or patterns of their evolutionary development and diversity of life (Rhodes, 1966). Following Grimaldi and Engel (2005) postulations "... that evolution begets diversity, and insects are the most diverse organisms in the history of life, insects should, hence, provide profound insight into evolution...". Insects exist for probably 420 Ma, since late Silurian. The origin of many existing insect families even extend to the Cretaceous periods, ca. 120 Ma. Insects are, in recent fauna, very numerous in species, but the largest and most popular group of insects are Diptera. The insect's fossil record is diverse and extensive, both in sediments and in amber (Grimaldi & Engel, 2005).
The oldest fossil resins are deposited in Carboniferous rock layers in Illinois (USA) with their age being estimated to be ca. 320 Ma (Azar *et al.*, 2010). The oldest inclusions of animals are known from the Triassic period, and their deposits are dated on 230 — 200 Ma (Schmidt *et al.*, 2012). In one of the Triassic fossil outcrops, in the Italian Alps, the oldest inclusions of arthropods were found. These included two species of mites *Triasacarus fedelei* Lindquist & Grimaldi, 2012 and *Ampezzoa triassica* Lindquist & Grimaldi, 2012 (Eriophyoidea Nalepa, 1898 represented in recent fauna by ca. 3500 living species) (Schmidt *et al.*, 2012) and one representative of Nematocera (Diptera).
Many inclusions of animals are preserved in Cretaceous resins. Cretaceous, being one of the most important periods in Earth's history, serves as the key to understanding the origin of all recent ecosystems (Azar *et al.*, 2010). Deposits of Lebanese amber were formed in Cretaceous (Barremian) (Maksoud *et al.*, 2017). The oldest Cretaceous type of resins containing diverse biological inclusions, contemporaneous with the appearance of flowering plants, associated newly evolving ecosystems. Lebanese amber is a source of information about the initial diversification of the modern entomofauna and it documents the disappearance of some archaic insect groups. The Lebanese amber is, for these reasons, considered probably the most important among all known ambers (Azar *et al.*, 2010). There are no abundant sources of land fossils in the world corresponding to this period besides the Lebanese amber (Szwedo & Kania, 2015). Deposits of the Lebanese amber developed in a tropical or subtropical, moderate to hot and wet, dense forest. Insects remains are common in Lebanese amber and predominate among arthropods inclusions. Over 150 taxa of insects, the representatives of Archaeognatha, Blattodea, Coleoptera, Collembola, Dermaptera, Diptera, Ephemeroptera, Hemiotera, Hymenoptera, Hymenoptera, Isoptera, Lepidoptera, Mantodea, Neuroptera, Odonata, Orthoptera, Psocoptera, Thysanoptera, Thysanura or Trichoptera have been described from such resins. The most frequently occurring are Diptera followed by Hemiptera and Hymenoptera, For example. over 50% of all fossil inclusions of the Mdeyrij-Hammana outcrop are the inclusions of the representatives of flies (Azar *et al.*, 2010). We can find, amongst them, extinct species *Helius lebanensis* Kania *et al.*, 2013 (Tannourine, North Lebanon), one the oldest representatives of extant genus *Helius* Lepeletier & Serville, 1828 (Diptera: Limoniidae) that is worldwide distributed and comprises ca. 200 extant species and characterize by the occurrence of elongate rostrum (type of mouthpart), that facilitated consuming food from interior part of flowers. Inclusions in Cretaceous resins documents that the representatives of the genus *Helius* were probably adapted to a new spectrum of food, thus exemplifying a parallel evolution of plants and crane flies (Kania *et al.*, 2013). The same genus is represented by *Helius alavensis* Kania *et al.*, 2016 in Spanish amber dated on 101 — 113 Ma, Albian (Pérez de la Fuente *et al.*, 2011). Spanish outcrops, where the amber inclusions usually come from are located in Àlava (Peñacerrada I, Peñacerrada II), Vitoria-Gasteiz, Bizkaia (Bilbao), Burgos (Moraza), and also in Kantabria (El Soplao)

(Najarro *et al.*, 2010). Spanish ambers were produced in subtropical, wet forests. Although bird feathers were preserved in this kind of resins, the dominating group within inclusions from Spain are arthropods. However, the most important amber for studying terrestrial diversity, including diversity of insects, in the Cretaceous is from Myanmar (Burmese amber) (98,79±0,62 Ma (Shi *et al.*, 2012) from Kachin State, in cities Shwebo, Thayetmyo, Pakokku and Pegu province. The environment, where the Myanmar amber was produced, was probably tropical (Grimaldi *et al.*, 2002).
This fossil resin is characterized by exceptional species diversity, as well as a large number and taxonomic diversity of insects preserved in the form of inclusions. So far, representatives of over 290 families of arthropods, mainly insects, have been described on the basis of inclusions in Burmese amber. Flies are one of the most numerous in terms of number of species and specimens, as well as the best known groups of insects represented in Burmese amber (Ross, 2019). Deposits of fossil resins formed in the Eocene include eg. Baltic amber (ca. 45 Ma, Lutetian) (Szadziewski, 2017) (Figs 1, 2), Bitterfeld amber (Eocene) (Wolfe *et al.*, 2016), Ukrainian amber (Late Eocene) (Perkovsky & Rasnitsyn, 2013), as well as Oise amber (France) (ca. 53 Ma, Lutetian) (Nel & Brasero, 2010). It has been assumed that vast production of resins by plants existing then was during Middle Eocene Climatic Optimum, when the Baltic amber deposits were formed (Szwedo & Kania, 2015). The paleoentomofauna of Baltic amber is extremely diverse. Out of over 98% of animal inclusions in Baltic amber, arthropods are represented by over 500 families, over 1.500 genera and ca. 3.000 species (Hoffeins & Hoffeins, 2003). 45% of all arthropod inclusions in Eocene Baltic amber are inclusions of flies, representatives of 350 genera representing 74 families (Szadziewski *et al.*, 2018).

Figure 1. Representative of Coleoptera in Baltic amber (Eocene)

Figure 2. Representative of Diptera, the genus Helius in Baltic amber (Eocene)

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Biological being as an aesthetic object

Considering biological being as an aesthetic object, I accept the assumption that perhaps in the real world there is no creation that does not have an aesthetic side and which cannot be assigned a certain set of qualities called beauty. This is a very optimistic assumption as it suggests that the scope of beauty is actually infinite. It differs in this from moral good, which is actually proper to human acts exclusively, for only they can be good or evil, just or unjust. At the same time, in this it approaches the value of truth, because a true or false judgement can be made on everything that is.

Such an assumption, however, does not define the degree to which beauty is conferred on something, nor does it determine what kinds of beings may be assigned it. It seems that it is most easily found in simple physical formations, an example of which is the often admired structure of a crystal, as well as a work of art, as it is usually created for this value. It is a bit more difficult to capture it in biological being and mental processes. This is due not only to their greater complexity, but also to the inability to adopt a purely aesthetic attitude. After all, we feel aversion towards some biological forms and even find them ugly.

However, this difficulty has a deeper cause. The rhythm of life in the biological world and in man is in fact the same, and what is called the sphere of the spirit, which also includes scientific cognition, appeared relatively late in human history and does not constitute a deep layer of human existence. Human biology includes man in the natural world and does not allow him to be distanced from it (Gołaszewska, 1984, p. 105). Although he is an apostate, it is impossible for him to become completely detached from the body. One more thing makes us take a closer look at the assumption that a biological creation can be beautiful. What I have in mind here are possible deformations that it experiences and which are, after all, the result of specific processes. It can be assumed that also in nature there arise failed creations that can hardly be called beautiful.

When introducing the concept of beauty, I will use its classical understanding, but extend it significantly (Eco, 2005, p. 48). In all seriousness one can ask whether the creation of life understood as a process is deep, unique, homogeneous, full of tension, mysterious or even sublime, and the result of this process — the organism — is in itself coherent, consistent, ordered, full of regularities, and even elegant (Wallis, 1968, p. 244). With equal seriousness, the human body can be considered a natural masterpiece. Nevertheless, these terms are too general and must be made more specific, so one should not only indicate the rationale for aesthetic judgements about the biological being, but also specify what it is and which of its aspects are aesthetically most valuable. For the sake of clarity, I will highlight one of the possible approaches to the biological being, considering its aesthetic context.

In the philosophy of biology, the explanation of the biological being can be carried out by pointing to the constitutive properties which it is entitled to. Before discussing them and regardless of their problematic nature, it is important that the analyses operate within the classical scheme of "object — its properties", and therefore treat the biological primarily in the context of a specific substance. A biological being is then understood as an organism (an animate creature) whose main feature is metabolism or the ability to reproduce and evolve (Chodasiewicz, 2017, p. 126). This understanding combines several trends explaining the origin of life. The first of them emphasises that it should be sought in the transformation of inorganic matter that took place in the protocell, while the second is related to the reproduction and evolution of properties that allow for change through natural selection. It is also worth mentioning the third trend that highlights the formation of the protocell itself. These fundamental trends cannot, however, obscure the multiplicity of theories about the origin of life. Their review is presented by Ługowski (Ługowski, 2007).

If we consider the biological being in the context of its biogenesis, it is not important from an aesthetic point of view which of the trends more or less explains the emergence of life. What is important, however, is that they all refer to a certain principle or regularity that governs this process. This regularity can be considered in cognitive terms; it can also become the subject of aesthetic beholding for which the rational nature itself of the origin of life, the uninterrupted continuity of this process, the closeness of the association between its individual phases, and the almost infinite variety of biological forms resulting from it are important.

Moreover, the fact that this diversity is explained by a single principle indicates that unity is at the root of such rich biological variety. If it is considered one of the conditions of beauty, as it was done not only in classical aesthetics (Witkiewicz, 2002, p. 51), then the origin of life can be aesthetically evaluated. It is irrelevant to what extent the aesthetic subject is prepared to understand this unity. It is enough that he or she experiences it phenomenally in every biological creature and vaguely senses the presence of the principle that makes it possible. It is also not important what forms of this being he or she has in mind, because the manifestation of this unity is visible in each of them.

It is precisely a sensation of this unity and its sensuous appearance that then constitute the subjective basis of a positive aesthetic judgement, even if some biological creations seem clearly ugly in their appearance. In other words, the aesthetics of a biological being does not seek the reason for its value in something merely external, in the appearance given in ordinary perception. Following this path, one should assume that a multiplicity of biological forms does not meet the conditions of beauty and is hideous. This is how one can describe, for example, a crocodile, which in popular consciousness is certainly not regarded beautiful. Instead, a substrate of beauty is sought in something dynamic; more precisely, in the harmonious manifestation of what is hidden and deep — a certain biological regularity or principle — in external forms of biological being, in its appearance (Hartmann, 1953, p. 142).

This dialectic of depth and surface makes externally hideous creations true natural "works of art". If we return to the example of the crocodile, the certainty of its movement, its particular flexibility, ease and speed are the external expression of internal organisation, whose sensuous appearance is aesthetically valuable. Knowledge about this organisation supports aesthetic beholding, and even deepens it, although it is not indispensable. It only intensifies the aesthetic attitude.

By adopting this pattern of explaining the aesthetic aspect of biological being, we can find this organisation in different layers of what is natural. In more highly organised organisms, their aesthetic qualities are even more visible. Thus, a squirrel's leap from tree to tree is full of lightness and even grace. A circling bird of prey can be viewed similarly. You can also discover beauty in the world of plants, and it is no longer found in its lush colours, but again in the harmony of the sensuous appearance of the principle.

In an aesthetic relation, every biological being is considered a kind of a sensuous representation behind which there is a specific depth, a natural logos, a natural regularity. Unfortunately, man breaks out of this pattern. His hidden intentions and incomprehensible actions concerning the body disturb the organic relationship of appearance. It is subjected to procedures that are contrary to its essence, which in turn leads to ugliness. This is the result of, for example, an incomprehensible struggle with old age, which is, after all, a natural phase of the life process. The appearance of the body becomes something strange and artificial then.

Recalling intentionality understood as a deliberate action of a human being that concerns his or her body allows us to consider the problem of the aesthetic nature of the biological being in the context of its purposefulness. The teleological understanding of the world as a whole, which was dominant until the modern times, made it possible to apply the category of purpose to all beings, therefore also to biological ones. One of the arguments referred to the special organisation of relatively isolated systems that would pursue specific goals. Thus, the nervous system had its purpose; so did the respiratory system, etc. On the other hand and from a more critical perspective, individual systems are no longer assigned purposes, but functions.

The aesthetic interpretation of this phenomenon does not, however, enter into this dispute, but stops at the very fact of the dependence between individual systems, which leads to the efficient functioning of an organic being. It is this particular dexterity and its sensuous manifestations that make it possible to claim that this being is something aesthetically successful. Its unity, resulting from the multilateral dependence between the systems, is perhaps so close that it might be said that nothing can be added to it or removed from it so as not to spoil the whole. Therefore, it meets the condition of beauty formulated by the Renaissance artist Alberti (Tatarkiewicz, 1967, p. 114). Although this creator meant works of art, nothing stands in the way of relating this to works of nature.

Taking into account the special unity of a biological creation, grounded in the relationships between its individual systems, one can recall Kant's considerations. Not adhering to the orthodox Kantian interpretation of the teleological power of judgement (Kant, 1964, p. 344), it can be said that the biological being appears as purposeful in itself, although neither it nor its systems pursue any goal or exist for a purpose, but only perform certain functions. However, from an aesthetic point of view, the very expression of purposefulness is significant, as it testifies to the internal organisation of the biological being, whose external expression is aesthetically valuable.

This pattern of explaining aesthetics, based on the dialectic of the sensuous manifestation of what is hidden and deep, concerns primarily the organic being understood as a certain individual. Therefore, it assumes that only individuals can be aesthetically evaluated, which makes our considerations easier. However, referring directly to the topic of the symposium, one can ask whether the very *process* of the creation and duration of life can also be aesthetically

perceived. In this case, we are not dealing with a certain individual that can be distinguished, but with a fundamental process that continues uninterruptedly and whose explanation is the task of science.
If we take into account its continuous, long-lasting and — as stressed by Darwin — slow nature, it can be perceived as sublime. If then we understand the sublime in the sense laid out by Kant (Kant, 1964, p. 156), as what is extremely great and overwhelming, then evolution appears as a dynamic process in relation to which an individual human or a particular biological being is actually nothing. It is characteristic then that the positive feeling of the sublime is founded on the negative feeling of insignificance.
Constituting this thread, it can even be concluded that the death of a biological individual, and therefore not so much the creation of life as its perishing, as being consistent with the law of evolution, is indeed a drastic, but fully understandable manifestation of this law. To put it differently, nature is indifferent to the fate of her precious works; however, this indifference is not intended and is not an expression of a negative moral attitude. It is something natural and can be a specific aesthetic stimulus received positively, although of course it is difficult for us to agree to it.
The previous sentence announces reflections on the aesthetic attitude towards biological being, the analysis of which would be a natural extension of the issues discussed here. In summary, however, I would like to refer to the method used in the analysis of biological being as an aesthetic object. Its sources can already be found in the philosophy of Plotinus, in particular in the thesis that beauty consists in sensuous shining forth (Tatarkiewicz, 1988, p. 298). This description of beauty was adopted by Hegel (Hegel, 1964, p. 186), and then by the contemporary philosopher Hartmann (Hartmann, 2004, p. 152). It should be emphasised that the considerations on aesthetics of the latter thinker were a clear inspiration for me to take up the issue of the aesthetics of the biological being, and some of his solutions have been used in this article. In particular, the thesis that the proper substrate of beauty is the mere appearance of what is meta-physical, of a certain principle that explains the concrete. Hence, if all the regularities of biological being, its unity and internal organisation appear harmonious in the light of the senses, then it is an object of aesthetic value, even if its external form would clearly be ugly.

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The greek idea of the "beginning" (*arche*)

Many initiators and participants of the scientific revolution that took place in the 20th century admitted a fascination with Greek philosophy (B. Russell, A. Whitehead, W. Heisenberg, N. Bohr, E. Schrödinger, R. Penrose, to name a few). There were two reasons. Firstly, the desire to expose ideas and assumptions that were adopted from tradition and could hinder the development of science. But this is not the dominant motive; as the achievements of 20th-century physics prove it, science has no problem with rejecting the established patterns of thinking. And it is worth remembering that what the theory of relativity or quantum theory questioned were the frameworks of *modern* physics and philosophy. Early Greek philosophy was characterised by openness, readiness to discuss and change positions, which is an attitude distinct from the modern approach. And it is this feature that prompts many modern scholars to turn to ancient philosophy. This is the second motive of the contemporary "returning to the Greeks": the desire to find oneself in a similar intellectual situation, to recreate the ancient scientific atmosphere — in the hope that it will make it possible to deepen the understanding of contemporary problems (Schrödinger, 2017: 24). And in this spirit, I will try to discuss the Greek idea of *arche*.

The concept of *arche* (origin, principle), like *physis* (nature), *kosmos* (order) and *logos* (reason, law), is one of the oldest, most important and most specific concepts of Greek philosophy. They all illustrate the way the Greeks viewed the world; they are also a source of ideas and assumptions on which modern science is based. Let us consider, for example, the concept of nature (*physis*). All the associations that come to the mind of the modern man, all the cultural richness of this word's meanings, and all its connotations are entirely original ideas of Greek philosophers. When we talk about nature as the world of wildlife, something animated and opposed to technology; about living in harmony with nature, opposed to corruption by civilisation; about nature as qualities that are innate and cannot be eradicated; about the body's natural reactions; when we talk about nature as the common features of beings belonging to one class, e.g. nebulae, stars, black holes; but also when we talk about Nature (with a capital N) as the ruling power of the world to be obeyed, we are referring to the Hellenic heritage in our culture, a heritage that has shaped both popular views of the world and its scientific image.

John Burnet once wrote that science is "thinking about the world in the Greek way". What initiated this science, and what should also be considered the absolute beginning of philosophy, was the conviction that the world — as a whole and as a collection of individual phenomena — can be understood. The phrase *logon didonai* — to explain [something] — was a specifically Greek phrase. No other ancient culture came up with the idea that events such as solar and lunar eclipses, earthquakes and celestial movements are governed by the laws of nature, and none of these cultures even created the concept of "law of nature". The Greeks, of course, did not use it from the beginning of their history. Heraclitus, who was the first to proclaim the idea of the universal law of Nature, had to speak "vaguely", use metaphors to express this innovative idea (hence the nickname *ho skoteinos*, the dark one, given to him by the ancients).

Greek pre-philosophical representations of the beginning or birth can be found in Homer, Hesiod and the Orphics. However, the *Theogony* by Hesiod (beginning of the 7th century BC) should be considered a true precursor in the matter of interest to us. In both of his poems, Hesiod implements the idea of presenting the world as a justly ruled kingdom, a world governed by *law*: the *Theogony* presents its genesis, *Works and Days* shows the fate of man as a fellow citizen of the cosmos. And both of Hesiod's ideas — that the world in this orderly form is not eternal, that it had a beginning, and that the world is governed by law that can be hidden from the eyes of the common man — became the basic ideas of pre-Socratic philosophy. The Ionian treatises *Peri physeos* would follow the same pattern of explanation as the *Theogony*. They differ in terms of terminology.

Verse 116 of *Theogony*, commonly known in translation, says: *Ē toi men prótista Cháos génet.* "In truth at first Chaos *came to be*", and not "in the beginning *was* Chaos". This difference is important because it allows us to understand exactly what idea the Greeks introduced into their cosmogonies — following in the footsteps of Hesiod. If Chaos *came to be* (arose, appeared), it was not something eternal, some primordial state, but a primary modification, initiating

the emergence of the world known to us. "Beginning" is the absolutely first *change*, a border point at which physical reality is born: time, matter, movement, creation and perishing. And at the same time it is a border point from which *rational* knowledge of the world can begin. It can therefore be said that the Greeks introduced the concept of "initial singularity" into the canon of scientific ideas, even if the term itself is an anachronism in relation to Greek philosophy.
An interesting question is how Hesiod understood this starting point for world history — what was the Chaos that came to be in the beginning? The first meaning that may come to mind for the modern reader is disorder, the most common sense of the word "chaos" today. In antiquity, however, such an interpretation of the Hesiodic Chaos appeared late, possibly under the influence of Stoic views. In addition, the statement "the cosmos came to be out of chaos", that is "order came to be out of disorder", is not a particularly resounding idea; it expresses, at best, the logic of our thinking, so it does not lead to discovering anything new.
The interpretation presented by Aristotle seems to be equally anachronistic: chaos is a place (*chora*), empty space as a condition for the movement of bodies. Several generations of Greek philosophers from Parmenides to Plato worked to develop such a concept; it is unlikely that Hesiod could have meant it. What leads us closest to the original meaning of the concept of Chaos is the etymological research linking it with words denoting a rift. In the spirit of these studies, the emergence of Chaos is interpreted as a violent split between heaven and earth, previously combined into some impenetrable dark mass (in Hesiod: night). Chaos is the gap between heaven and earth (Uranus and Gaia) that made possible and triggered phenomena such as rain, lightning, light. At that moment, the world moved; its history began.
We are now interested in how Greek philosophy used this idea and in what direction it was developed. We hear about Thales that he was the first to talk about the principle of all things, claiming that everything was created out of water. According to the common opinion of historians of ideas, with this theorem, Thales gave rise to scientific explanation of reality. In fact, it is the oldest theorem known to us that is an attempt to understand the world without referring to tradition, authority or religion, using categories that do not go beyond the natural world; an attempt most likely supported by a justification which refers to the observed facts and ensures internal consistency.
The Greek idea of *arche* during the three centuries separating Thales from Plato and Aristotle underwent a significant evolution; the concept of the "initiating principle" found application in almost every field of knowledge. Chronologically, the first was, of course, cosmology. Ionian *physikoi* tried to indicate the original state of the world (water, *apeiron*) and the principle of its transformation (purely material, as in Anaximenes, or abstract, as in Heraclitus).
In post-Parmenidean philosophy, the search for *arche* aimed to explain the movement and change, the creation and perishing of things. Hence the concept of "elementary particles" and the forces that connect and separate them. Within this theory, the most revolutionary idea was the *vacuum* as a necessary condition for particle motion. It was introduced by Democritus (or his teacher, Leucippus), who rejected the seemingly unquestionable truth proclaimed by Parmenides that being exists and non-being is not. We observe movement in the world, say the atomists; in order to explain what we observe, we must accept something contrary to logic: non-being exists no less than being. In the fifth century BC, Greek philosophers demonstrated intellectual courage similar to that which Einstein and Heisenberg would exhibit two and a half thousand years later.
Anaximander, the author of the oldest work *On Nature*, already applied the concept of *arche* beyond the sphere of cosmological issues; namely, he asked about the origins of life on Earth. Some Greek philosophers formulated theories in this area that were surprisingly close to Darwinism: not only that the first forms of life could have been primitive aquatic organisms that came ashore and conquered it, but also theories of the evolution of living organisms through the coexistence of random mutations and natural selection. Unfortunately, the lack of observations confirming the evolution of species and the strength of Aristotle's arguments hampered the development of these concepts. But the very idea of *arche*, as I have already mentioned, moved beyond the field of natural sciences surprisingly quickly and found application in such areas of knowledge as mathematics, logic and metaphysics.
The considerations of the Pythagoreans from the 6th and 5th centuries BC certainly contributed to this. Their rather primitive beliefs and archaic religious ideas in an amazing, but at the same time fully explainable way gave rise to a new concept of *arche* as mathematically expressible laws of nature — rules of motion or qualitative features of things expressed in numerical relations. For the Pythagoreans, the principle of the cosmos was *harmonia*, the internal structure of the world that can be understood by reason. This idea inspired Plato, and, much later, the founders of modern mathematical natural science (Galileo, Newton). It also exerted a huge influence on the emerging philosophical aesthetics. The concept of harmony was the first to enable the analysis of a work of art both in terms of its artistic quality and the way in which it can be perceived by the viewer.
Finally, let us present the application of the Greek idea of *arche* in various fields of philosophy. And so, [1] in physics and biology, the search for *archai* meant an attempt to identify the ultimate material components of nature and the conditions for combining them into more organised structures. [2] In mathematics and logic, *archai* were the basic

truths that justified all the other theorems of these sciences, while at the same time they were no longer justified by any other truth. \The axioms in Euclid's geometry or the principle of non-contradiction in Aristotle's logic were of this nature. [3] In metaphysics, principles are logical conditions for the possibility of all being, which also explain its qualities (e.g. Plato's ideas or the categories of Aristotle). [4] Some philosophers argued that also in ethics there are the first "principles", i.e. the highest values, only in the light of which other things may appear to be valuable (Plato proposed here a strongly undefined Idea of Good, while Aristotle argued that in ethics there are no highest principles, and we do not learn what is morally right theoretically, but practically — as what best serves happiness). Finally, philosophy itself has [5] its "principle" and "beginning". The *arche* of philosophy, the Greeks tell us, is astonishment (= admiration). In this area in particular, it is evident that the concept of *arche* does not simply mean the beginning in time or in the historical sense. For the principle of philosophy is what makes it possible, what is the necessary condition for its existence, whether it concerns culture or a thinking individual: for philosophy to be born, man must first learn to be surprised by the world.

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Microbial masterpieces — pigment production by microbes

"Life would not long remain possible in the absence of microbes"

Louis Pasteur

Humans had always been fascinated by color, which plays important role in the acceptability of the products of many industrial segments.

Additives used to provide color to substances are called colorants and can be classified as pigments or dyes, the main difference between them is the size and solubility. While pigments are practically insoluble in the medium they incorporated, dyes dissolve during the application and lose their crystal or particulate structure in progress (Torres *et al.* 2016). Additionally, particles of dyes are smaller than pigments, which are about 1–2 μm, therefore the differences between dyes and pigments have rather physical characteristics than caused by chemical composition (Torres *et al.* 2016). Depends on microorganisms they can produce both – pigments and dyes, in the article they will be called colorants.

Nature is rich in colors such as minerals, plants, microalgae, also pigment-producing microorganisms (fungi, yeasts and bacteria) are quite common (Fig. 1.). It is possible to find an incredible number of molecules produced by microorganisms such as melanins, carotenoids, flavins, quinones, bacteriochlorophylls, and many others. Nowadays on the market are available some fermentative grade pigments, for instance: *Monascus* pigments, astaxanthin from *Xanthophyllomyces dendrorhous* or *Paracoccus carotinifaciens*, Arpink Red (or Natural Red) from *Penicillium oxalicum*, riboflavin from *Ashbya gossypii*, and β-carotene or lycopene from *Blakeslea trispora* (Dufosse 2016). Since many synthetic

pigments or bioproducts are found to have toxic, teratogenic or carcinogenic properties, the exploration of natural pigments from microbes seems to be a better option due to their biodegradability.
The main sources for natural pigments are plants or microorganisms. Nevertheless, the usage of plant pigments has many drawbacks, for instance, non-availability throughout the year and pigment stability and solubility. Bacterial and fungal colorants exhibit extensive applications and have a huge advantage over the plant pigments, as bacteria and fungi grow rapidly in low-cost media.

Role and examples of the colorants produced by microorganisms

Many microorganisms produce colorants as secondary metabolites, but not necessarily all of them (Fig. 1.). It is well-understand that most of the microbial colorants found as a variety of hues are known to act as defensive systems against UV irradiation, thereby protecting and increasing their ability to survive and adapting to the surrounding environmental conditions compared to non-pigmented microbes (Ramesh *et al*., 2019). Furthermore, pigments also act as an antimicrobial agent against other bacteria (Suresh *et al*., 2015). Interestingly, some of the pigments produced by microorganisms promote pathogenicity and virulence. For instance, virulence and pathogenicity in several species of bacteria (*Vibrio cholerae*), and fungi (*Aspergillus fumigatus*, *Cryptococcus neoformans*) for their respective animal or plant hosts appeared to be linked with melanin production (Ramesh *et al*., 2019).

PIGMENTS	MICROORGANISMS	TYPE	COLOR/APPEARANCE	REFERENCE
Astaxanthin	*Phaffia rohodozyma*	Yeast	red	Sen *et al*., 2019
	Haematococcus pluvialis	Microalgae	red	Shah *et al*., 2016
Canthaxanthin	*Monascus roseus*	Fungus	orange-pink	Vendruscolo *et al*., 2016
Lycopene β-carotene	*Blakesela trispora*	Fungus	red, yellow-orange	Sen *et al*., 2019
Monascorubramin, Rubropunctatin	*Monascus* sp.	Fungus	yellow, orange, red	de Boer, 2014
Prodigiosin	*Serratia marcescens*	Bacterium	red	Sen *et al*., 2019
Pyocyanin blue	*Pseudomonas aeruginosa*	Bacterium	green	Fouly *et al*., 2015
Riboflavin	*Ashbya gossypii*	Fungus	yellow	de Boer, 2014
	Candida famata	Yeast	yellow	Abbas and Sibirny, 2011
Staphyloxanthin	*Staphylococcus aureus*	Bacterium	golden	Sen *et al*., 2019
Torularhodin	*Rhodotorula* sp. *Rhodotorula glutinis*	Yeast	orange-red	de Boer, 2014
Violacein	*Chromobacterium*	Bacterium	purpule	Sen *et al*., 2019
Zeaxanthin	*Staphylococcus aureus*	Bacterium	Golden, yellow	Vendruscolo *et al*., 2016
	Flavobacterium spp.	Bacterium	yellow	Sen *et al*., 2019

Table 1. Examples of naturally derived colorants from microorganisms

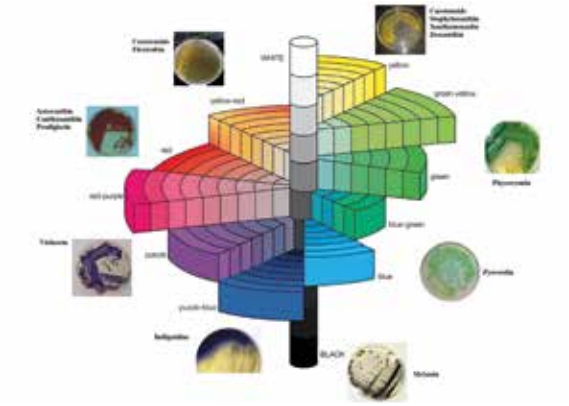

Figure 1. Munsell color system for bacterial colorants (Venil CK, 2020)

Figure 2. Microbiologist Simon Park collaborated with artist Jo Wonder to create a microbe-based replica of Sir John Everett Millais' 1851–1852 masterpiece, Ophelia (Inset). Main image courtesy of JoWonder (artist), Inset copyright Tate, London (2016) (Madhusoodanan, 2016).

Carotenoids

Carotenoids are the main natural pigments widely produced by plants and microorganisms, firstly reported by H.W.F Wackenroder. Nowadays, carotenoids signify the largest and highly diverse known group of natural pigments, and 1183 carotenoid structures are compiled from 702 source organisms by Carotenoid Database Japan (https://carotenoiddb.jp). Carotenoids are extensively produced by microorganisms and plants as natural photo-protectants. Depending on the structure, the color of carotenoids ranges from yellow to deep red (Sajjad *et al*., 2020). Among them, it could be listed: astaxanthin (red-pink colour); β-carotene (orange colour); canthaxanthin (orange-red colour), β-cryptoxantin (orange colour); lycopene (red colour), and many others.

Carotenoids are widely used in several industries, mostly they are commonly used as food colorants, feed additives, or nutritional supplements (Mussagy *et al*., 2019)

Violacein

Violacein is violet-purple bisindole, insoluble in water colorant. Violacein was for the first time was isolated from *Chromobacterium violaceum* from the Amazon River in Brazil (Durán *et al*., 1953). The role of the violacein in nature is to protect the cells from UV radiations (Sajjad *et al*., 2020). It has been reported the variety of the biological activities of violacein including antiviral, antibacterial, antiulcerogenic, anti-leishmanial, anticancer and enzyme modulation properties (Narsing Rao *et al*., 2017).

Prodigiosin

Prodigiosin is a red linear tripyrrole colorant initially reported from *Serratia marcescens*. Prodigiosin was named after its extraction from *Bacillus prodigious*, the current name of *S. marcescens* (Sajjad *et al*., 2020). Prodigiosin acts as a potential therapeutic molecule, especially as an immunosuppresser and anticancer agents, also it shows insecticidal, antifungal, antibacterial and anti-malarial activities (Narsing Rao *et al*., 2017).

Indigoidine

Indigoidine is a brilliant blue, soluble in water colorant synthesized by very few microorganisms (*Sutthiwong et al., 2014*) including *Erwinia chrysanthemi*, *Phaeobacter sp*., *Streptomyces chromofuscus* and *Vogesella indigofera* (Sajjad *et al*., 2020). Interestingly, role of indigoidine is unclear, however, it has been described that this pigment could protect against oxidative stress (Sajjad *et al*., 2020).

Scytonemin

Scytonemin is a secondary metabolite of small hydrophobic alkaloids characterized by yellowish-brown color. Scytonemin, is a nonfluorescent, lipid-soluble and exclusively produced in the extracellular matrix (sheath) of different species of *Scytonema*, *Nostoc*, *Lyngbya*, *Rivularia*, *Chlorogloeopsis*, and others (Sinha and Häder, 2008). Furthermore, scytonemin has a strong photoprotective activity which can prevent up to 90% of the incident UV radiation from entering the cell. Furthermore, scytonemin shows strong antiinflammatory and antiproliferative activities and thus can be safely used as a therapeutic agent for the management of chronic disorders of inflammation and proliferation (Sinha and Häder, 2008).

Industrial role of microbial pigments

Many industries such as food, cosmetics, pharmaceuticals and many others widely use synthetic colorants — they are cheaper, more stable and usually brighter than natural ones (Tuli *et al*., 2015). However, the use of natural colorants is relatively safe, since their nature is biodegradable, harmless and non-carcinogenic.

Interestingly, the textile industry uses approx. 1.3 million tons of synthetic dyes and dye precursors. Also, many microbial pigments were used to dye different types of fabric. Prodigiosin from *Vibrio spp.* can dye wool, nylon, acrylics and silk. By using tamarind as a mordant, pigment from *Serratia marcescens* can colour up to five types of fabric, including acrylic, polyester microfiber, polyester, silk and cotton (Narsing Rao *et al*, 2017). Moreover, as a colorant, microbial dyed textiles showed antimicrobial properties. Textile fabric dyed by prodiginines obtained from *Vibrio sp.* showed antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* (Alihosseini *et al*., 2008, Narsing Rao *et al*, 2017).

Microorganisms as true Artists

Microbes sustain life on this planet because of their myriad associations and biochemical processes. Microorganisms are found in almost every environmental niche and have various roles in nature. Furthermore, they produce large quantities of pharmacologically and biologically active compounds that can have a diverse range of activities, including colorants. Natural colorants are being extracted from microorganisms for many applications. Historically, science and art have had a strong relationship, for instance, Leonardo da Vinci created art inspired by science, and his science was inspired by art. The pigmentation of the bacteria or fungi serves as the basis of colour palette. Painting with bacteria isn't entirely novel. Sir Alexander Fleming, who discovered penicillin, began making "germ paintings" of bacteria. Since that time many artists experiments with microorganisms as sources of art inspiration, using the pigments produced by microbes or by creating agar plate art or other (Fig. 2). However, while artistic skills play an important role in microbial art it is important to remember that the true artists of these pieces are the living paints used to create them: microorganisms.

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From potassium and membranes to life and to abstract art

In this article, we introduce two biological phenomena that are important to the emergence of life. Additionally, in our opinion, these phenomena have the fundamental aesthetic context observed in abstract art. The first concept is creation of insulated compartments with the help of membranes, which leads to the division of space. The second phenomenon concerns the formation of gradients of substances and their functions in the intervals formed by membranes. Probably these two basic biological phenomena can be part of the language used in an act of artistic creation. The cells are the basic structural and functional elements of all organisms on Earth. Despite functional diversity, cells have a set of common elements. Cell membrane (or plasma membrane) is the membrane that separates the interior of the cell from the outside environment. A membrane is a selective barrier for substances, such as molecules or ions. It allows some substances to pass through, but stops others. Within the cell, all functional compartments are spatially defined by intracellular membranes. Nucleus — keeping genetic information, mitochondria — cellular power plant and reticulum – being the place of protein synthesis, are examples of intracellular compartments. These compartments are defined by specific membranes (Figure 1).

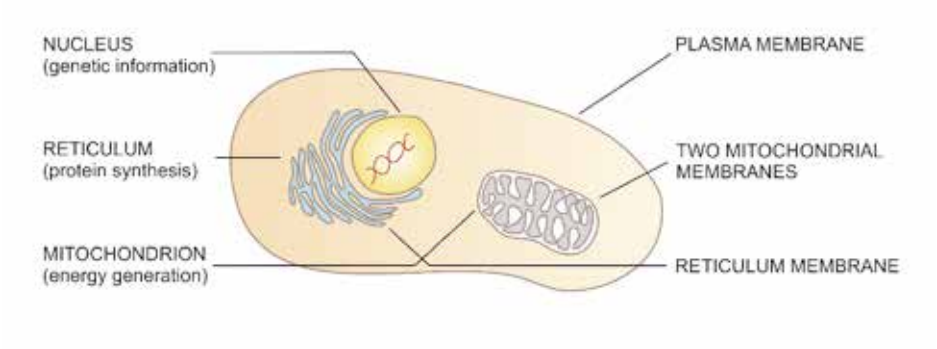

Figure 1. Structural and functional cell compartments formed by membranes: plasma membrane, nucleus (genetic information), reticulum (protein synthesis) and mitochondria playing the role of cellular power plant

Origin of life is based on creating compartments. Physicist Freeman Dyson once said: "Life began with little bags of garbage." "The bags" formed by the membranes were crucial. This kind of common structural-functional arrangement may suggest that this concept was at the very early stages of life creation. Hence, Roy Black's (University of Washington, Seattle) statement: "If you want to explain life, you have to explain the origin of cells" may strongly suggest that spatial separation of chemical processes was a fundamental starting point of life origin (Sarkar et al., 2020). How were membranes created? Probably, the first membranes were formed by amphipathic substances, such as fatty acids. These substances spontaneously (because of their physical properties) were able to form spheres (or vesicles) i.e. compartments (Figure 2). The establishment of biological membranes was at a very early stage of the formation of life on earth. Nowadays, the cell membrane consists of three classes of amphipathic lipids: phospholipids, glycolip-

ids, and sterols. Cholesterols maintain membrane fluidity at various temperatures. The amount of each depends upon the type of cell, but in the majority of cases phospholipids are the most abundant, often contributing for over 50% of all lipids in membranes.
The membrane separates some space, but there is also a need of communication of internal and external compartments. Hence, the membrane also contains membrane proteins, including integral proteins that go across the membrane serving as membrane transporters. It is worth mentioning here that on the one hand, biological membranes create separate spaces (compartments), and at the same time they are a place which, thanks to the presence of membrane proteins, receives stimuli from the outside world. What were the first ingredients of the early cells that gave rise to life on earth? It takes three main parts to build a simple cell: RNA to store information, proteins to catalyze the biochemical reactions, and the membrane to keep RNA and proteins together (Figure 3).

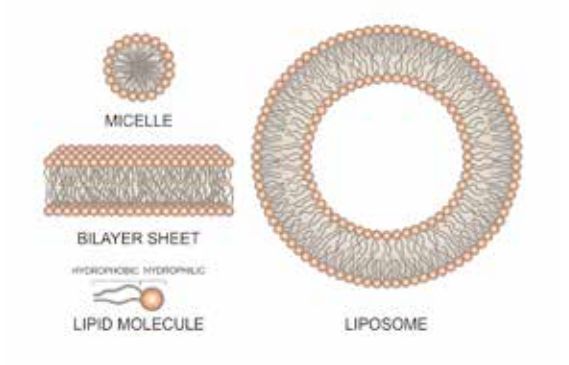

Figure 2. Formation of membranes by amphipathic substances i.e. lipid molecule possessing hydrophobic and hydrophilic part of molecule. Three types of membranes structures: micelle, bilayer sheet and liposome.

Membrane proteins, amphipathic transmembrane proteins, are the important functional elements of all known cells. These proteins are important for the cell, because they are responsible for various biological activities. Due to membrane proteins, the cell membrane controls the movement of substances in and out of cells and intracellular organelles such as mitochondria. In addition, cell membranes are involved in a variety of cellular processes for instance cell signaling. Examples of integral proteins include ion channels (for example potassium channels). Ion channels allow inorganic ions such as sodium, potassium, calcium, or chloride to diffuse down their electrochemical gradient across the lipid bilayer through pores across the membrane.
Let's introduce a second concept of this paper: ion gradients. An electrochemical gradient is a gradient usually for the ions that can move across the membrane. The gradient consists of two parts, the chemical gradient, or difference in solute concentration across a membrane, and the electrical gradient, or difference in charge across a membrane. The number of positively charged ions outside the cell is usually greater than the number of positively charged ions in the cell interior. This results in a relatively negative charge on the inside of the membrane, and a positive charge on the outside. This difference in charges causes a voltage to exist across the membrane i.e. membrane potential. Membrane potential is for example very important for the conduction of electrical impulses along nerve cells. Interestingly, the role of potassium cations (K^+) is unique, despite being less abundant than sodium cations (Na^+) in sea water (Danchin & Nikel, 2019). This observation could be explained by different properties of potassium and sodium cations. But there is also opinion that life originated in a potassium-rich environment, making K^+ presence just a leftover of evolution (Danchin & Nikel, 2019).
Channels selective for K^+ are also present in intracellular membranes including mitochondrial membranes (Wrzosek et al., 2020). The following K^+ channels have been described in the inner mitochondrial membrane: ATP-regulated potassium channel, calcium-activated potassium channel and the voltage-gated Kv1.3 potassium channel. The primary functional roles of these channels include regulation of mitochondrial respiration, and the alteration of membrane potential (Rotko et al., 2020). Additionally, they modulate the mitochondrial matrix volume and the synthesis of reactive oxygen species by mitochondria. Mitochondrial potassium channels are believed to contribute to cytoprotection, cell death and lifespan (Gururaja Rao et al., 2019).
Summarizing, in this short paper we focused on two selected concepts possibly being important on early stages of origin of life. Namely, compartment formation by membranes and existence of ions gradients as driving force for propel of biochemical processes.

Are these fundamental biological phenomena represented in the visual arts, i.e. in painting? It seems to be so! We can point out at least two artists whose works seem to refer to these fundamental phenomena. Firstly, the works of Wojciech Fangor (1922–2015) refer to the phenomenon of space division, i.e. the creation of compartments. Secondly, Mark Rothko (1903–1970) a representative of color field painting, in his works visualizes, in our opinion, chemical gradients. Thus, it can be concluded that some abstract painting actually depicts the fundamental biological processes that underlie the emergence of life.

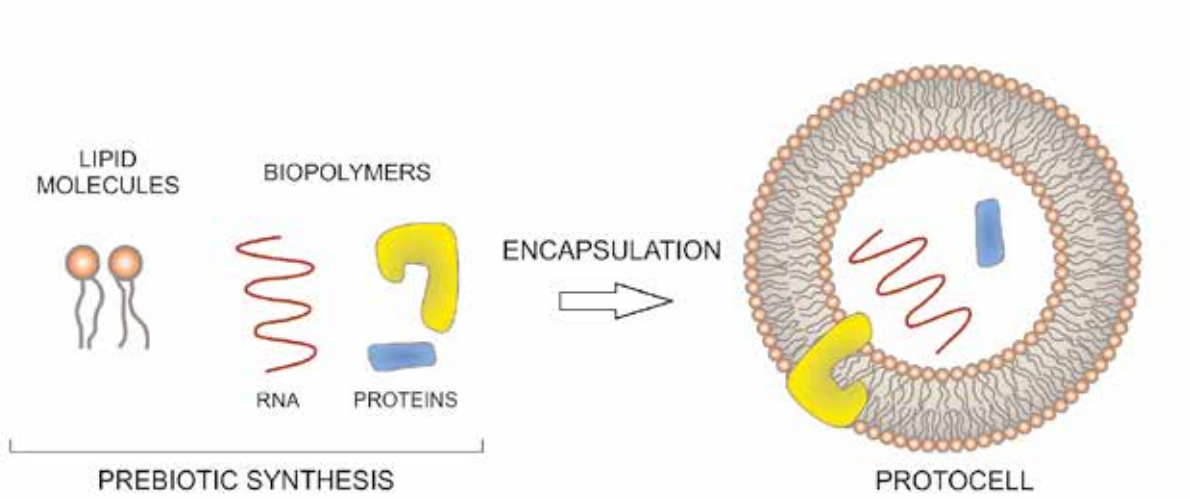

Figure 3. Scheme describing probable protocell formation process — encapsulation. Lipid molecules as elements forming membrane, RNA as information carrier and proteins catalyzing the biochemical processes

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Molecular biology as a source of art inspiration

Science has been the object of human interest since prehistoric times, being at once a source of inspiration and a form of expression. The development of science and related technologies have no doubt had an impact on the world of culture, including the media, literature, music and the fine arts (Iaccarino, 2003). The increasing use of tools, methods, and knowledge previously reserved for the sciences is the result of a natural drive towards deepening knowledge on the complexity of the functioning of the human organism as well as learning about the relationship it has with its environment, including at an elementary level. At the same time, learning about these relationships in relation to the functioning of complex biological systems allows us to look at the development of human culture in terms of complex biophysical and biochemical relationships that are at once the basis for human actions and decisions and their consequences (Whiten *et al*., 2017).

Figure 1. -*Omics* — human embryo inside circular genome, digital collage, author: Maciej Wnuk, 2020

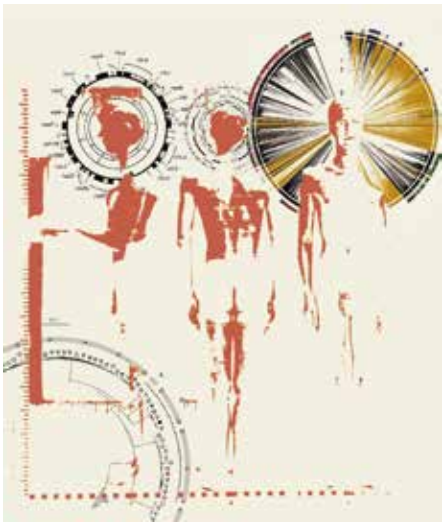

Figure 2. *Angels*. The young man under medical examination during army recruiting. The dendrogram (mSphere Mar 2017, 2 (2) e00359-16), digital collage, author: Maciej Wnuk, 2020

It is, then, obvious that the development of technologies for imaging objects and analysis of biological material has an invaluable input into the creative process, as knowledge gathered thanks to these has an effect on the way we have come to perceive the modern world. Scientific data presented in pictorial form, or as streams of characters or numbers, can be used not only to build models and prototypes. One ought to remember that the development of artistic techniques is determined, among other things, by access to new types of resources that can be a source of exceptional, unconventional possibilities of creative expression (Fig. 1,2). Objects of research can also be an inspiration to artists and designers in terms of colour, shape, and unique geometric and spatial solutions.

Molecular biology is one of the faster-developing branches of science with immensely great potential and a strong influence on culture. It is concerned with the organisation and functioning of organisms at a molecular level. The phenomenon of molecular biology involves the development of increasingly sophisticated experimental techniques in molecular biology with broad, interdisciplinary applications; ever-increasing flow of technical innovations and scientific discoveries within the scientific community; and the development of special software and constantly updated databases for, respectively, analysing and storing data on genotypes, gene expression levels, cytogenetic profiles and other molecular characteristics (Vitale, 2017).

Use of the tools of molecular biology has changed the way scientific experiments are approached, allowing for revolutionary discoveries not only within the field of molecular biology itself but also in biochemistry, biophysics, biotechnology, cellular biology, and genetics. The development of NGS technology and DNA recombination technology in particular has enabled the collection of a new type of data, both quantitatively and qualitatively, that allows for visualisation at molecular level of a complex network of interrelationships within a single cell, an organism, a population, or even between species. The tools of molecular biology make it possible to at once simplify the relationships observed and record a large amount of metadata in a maximally compressed fashion (Vitale, 2017).

An example of such meta analysis of received data using molecular biology is genomics, since it is concerned with the study of entire genomes and the analysis of the functioning of the sequences they contain (Navarro *et al*., 2019).

Genomics surfaced in the 1980s as a new branch of science that combined biological sciences with mathematics and information technology; it is inseparably related to the use of bioinformatics. Genomics can be divided into, among others: structural genomics, which concerns itself with studying the nucleotide sequence of the genome; functional genomics, which has as its goal defining the relationships and interactions occurring within the genome; and comparative genomics, thanks to which we can trace the history of evolution on Earth. The abovementioned types of genomics are only examples, since techniques for en masse analysis of biological material are not reduced to nucleic acids, and the methodical approach has revolutionised the scale of data acquired and our perception of the world for good.

Currently research consisting in meta analysis of acquired data with the use of large-scale techniques and quantifying pools of biological molecules that translate into the structure, function and dynamics of an organism or organisms is informally referred to as omics. However, depending on the object of research, we use the terms: epigenomics (study of epigenetic modifications of chromatin), transcriptomics (research on RNA transcripts), proteomics (analysis of protein profiles), metabolomics (analysis of metabolites) etc. (Graw et al., 2020).

In turn, the complex interactions between these different levels of organisation of biological structures and their interaction with the environment are the subject of so-called systems biology (Chuang *et al*., 2010).

The techniques of molecular biology and genetic engineering also led to the creation of a new fast-developing scientific approach — synthetic biology. Research conducted as part of synthetic biology projects and creates artificial biological systems modelled on natural ones. Unlike classical genetic engineering, synthetic biology puts a lot of emphasis on rationally designing new systems and intense use of mathematical modelling techniques in order to predict the behaviour of the system and the optimisation of its action.

Given the vast world of molecular biology and mutual interactions between different -omics, it is unsurprising that artists increasingly reach for data from these fields. The form of molecules is especially interesting for artists. The structure of molecules is a source of inspiration both for applied and liberal arts as a kind of donor of shapes, contours, drawings, and outlines. For example, the structure of the DNA helix inspires painters to the same extent as it does sculptors or architects.

Nucleic acids can also be a direct material or medium for an artistic work, and the techniques of molecular biology can in themselves be a form of artistic expression. Here, one must mention Paul Vanouse and Solon Morse's installation work entitled 'The America Project'. The project consisted in the isolation of participants' DNA extracted from the oral epithelium and the use of PCR and restriction enzymes to produce DNA bits of varying sizes.

The obtained DNA fragments were then separated in agarose gel electrophoresis and, at the final stage, stained with Ethidium Bromide and visualised using a transilluminator. Using this technique, DNA separation was obtained in the form of an American flag and Crown pattern. The artist also produced a number of works in the Latent Figure Protocol series (more at www.paulvanouse.com/lfp.html) using bacterial plasmids digested with restriction enzymes. Another interesting work by Paul Vanouse was an installation entitled the Relative Velocity Inscription Device that made real-time video recordings of the DNA electrophoresis of four family members (father, mother, sister and brother). Vanouse postulated that his goal was to "build "a race about 'race' " in which (as theorist Bill Egginton adds) "thebody has been erased" (Vanouse, 2018).

DNA and the possibilities of its analysis with the use of molecular biology are also at the centre of the work of another artist, Heather Dewey-Hagborg. Her project entitled 'Stranger Visions' concerned creating a series of portraits of the

inhabitants of Brooklyn, NYC, on the basis of their DNA, which she retrieved from abandoned objects such as hair, cigarettes and chewing gum (more at https://deweyhagborg.com/projects/stranger-visions).

It ought to be pointed out, however, that both the works of Paul Vanouse and Heather Dewey-Hagborg are perceived on the one hand as an affirmation of the possibilities of modern molecular technologies, on the other — as forms of artistic manifestos that illustrate the deepening loss of anonymity and personal freedom in society, and the reduction of human Being to DNA sequence.

A very interesting example of the mutual inspiration and intermingling of the worlds of art and science is the 'DNA origami' technology, which is currently undergoing intensive development. In this technique, scientists use DNA as a material to construct spatial 2D and 3D nanostructures of various shapes, which can be used as drug nanocarriers or nanorobots.

Molecules-proteins (peptides) as spatial structures are in turn the object of interest of Julian Voss-Andreae. Inspired by I, II, III and IV-row structures of proteins (e.g. based on the PBD database), the artist creates sculptures and spatial installations. His best known sculptures include the work 'Birth of an Idea', depicting a potassium channel protein, the sculpture 'Angel of the West' inspired by the structure of the antibody, a bronze sculpture entitled 'Conditional siRNA for City of Hope', or an extremely original work entitled 'Heart of Steel', depicting the structure of haemoglobin. A feature of the latter sculpture was the fact that with time, the installation was covered in rust, which was intended to emphasise the fact that haemoglobin contains an iron atom.

Bioinformatic tools and the use of metadata (DNA, RNA sequences and amino acid peptides) deposited in databases such as NCBI and others have great potential in the creation of artistic works and the expression of artistic content. The works of Martin Krzywinski, who has specialised in visualising complex networks of genetic interactions using 'Circle' diagrams, are one such example. For this purpose, Krzywinski developed the open source tool 'Circos', which organises tabular data in a circular layout with unique aesthetic characteristics. Among his best known works are: 'The Human Genome vs. the Animal Kingdom', 'Genomes Across Species', 'Reimagining Genomes', and 'The Visualization of Pi' (more at http://mkweb.bcgsc.ca/)

The possibilities presented by molecular biology related to transgenesis have also served as inspiration and were the basis of transgenic art, defined by Eduardo Kac as 'a new art form based on the use of genetic engineering techniques to transfer synthetic genes to an organism or to transfer natural genetic material from one species into another, to create unique living beings'. His most famous and controversial work is the 'GFP Bunny', a rabbit with an inserted GFP gene, which resulted in it glowing green when exposed to a certain wavelength of light (more at www.ekac.org/gfpbunny.html).

To summarise, the examples presented above are only a selection of the evidence of artists' use of molecular biology as a material, medium, or means of expression. It should be emphasized that the use of molecular biology, especially in the field of metadata processing by means of bioinformatics programs, creates completely new and almost unlimited possibilities of expression of artistic visions.

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Theories about the origin of life

In 1920 two researchers J. B. S. Haldane and Aleksandr Oparin, envisioned that complex organic compounds formed from simpler inorganic precursors. This theory was called abiogenesis. But this idea had no scientific support until Stanley Miller and Harold Urey conducted their famous experiment in which they simulated the conditions on early Earth by mixing water vapor, hydrogen, methane, and ammonia. They passed these gases through glass tubes treating them with electric discharges. After some time they observed the formation of complex organic compounds such as amino acids — that are the basic building blocks of proteins. Their experiment in various variants is still carried out today in many laboratories. Recently, using a similar approach, scientists were able to show production of nucleotides — the basic building blocks of DNA and RNA (Ferus et al. 2017). The most important in the Miller-Urey experiment is the discovery that from simple compounds, one can easily create matter that is the basis of life. Yet even the simplest bacterium alive today is extremely complex, and it is difficult to imagine that it could arise in such a simple experiment as Miller and Urey devised. There must have been intermediate steps in life's history that did not survive until today. Because all life on Earth is related to each other, traces of what the first organisms might have looked like could have survived in organisms that live today.
We don't know how exactly life began, mostly because the geological record of that period is lost, but we have many hints as to what could have happened. To give the reader an overview of some popular concepts, in this article, I will ask a series of fundamental questions: When did life begin? What is life? What was first: DNA or proteins? Where did life begin?

When did life begin?
Certainly, life on Earth could not have started before the Earth itself formed 4 billion 456 million years ago. Soon after our planet was formed, it collided with another planet about the size of Mars (Bottke et al. 2015). This event melted the crust and led to the formation of the Moon. When the Earth's crust cooled again, there might have already been water on its surface (Mojzsis et al. 2001), not for long though, because over the next several hundred million years, hundreds of massive meteors fell on Earth. This period was called the great bombardment. As a result of the collisions, the hypothetical oceans evaporated, and the Earth's crust melted again. At that time, the Earth just wasn't a good place to live, at least until bombardment stopped about 4 billion years ago — this is the earliest possible time for life to begin on our planet.
Fossils and chemical evidence show that microorganisms already existed on Earth about 3.5 billion years ago (Shopf et al. 2007). This means that inanimate matter became living matter at about this time. There is also a controversial evidence that life on Earth was already present 4.1 billion years ago (Bell et al. 2015). Figure 1 is a transmission X-ray image of 4.1 billion-year-old zircon with graphite embedded in it. This graphite has a carbon isotope typical of living organisms, but it is not strong evidence for life. Microfossils such as shown in Figure 2 are stronger evidence (Shopf et al. 2007). This figure also gives us the idea that if we could go back in time to look for the first organisms, it might be problematic to recognize them. This brings us to the next unanswered question — what is life?

What is life?
Origin of what are we trying to understand? Surprisingly the answer to this question is not trivial even to biologists. Fortunately, understanding life's definition is not necessary to study its origin — an idea explained by Nobel laureate Jack Szostak in one of his publications (Szostak 2012). Perhaps the whole difficulty in answering this question, is due to the fact that we formulate it incorrectly. Perhaps life is not something that living organisms have, but rather something that living organisms do. Maybe instead of asking if something is alive, we should ask how much it is alive.

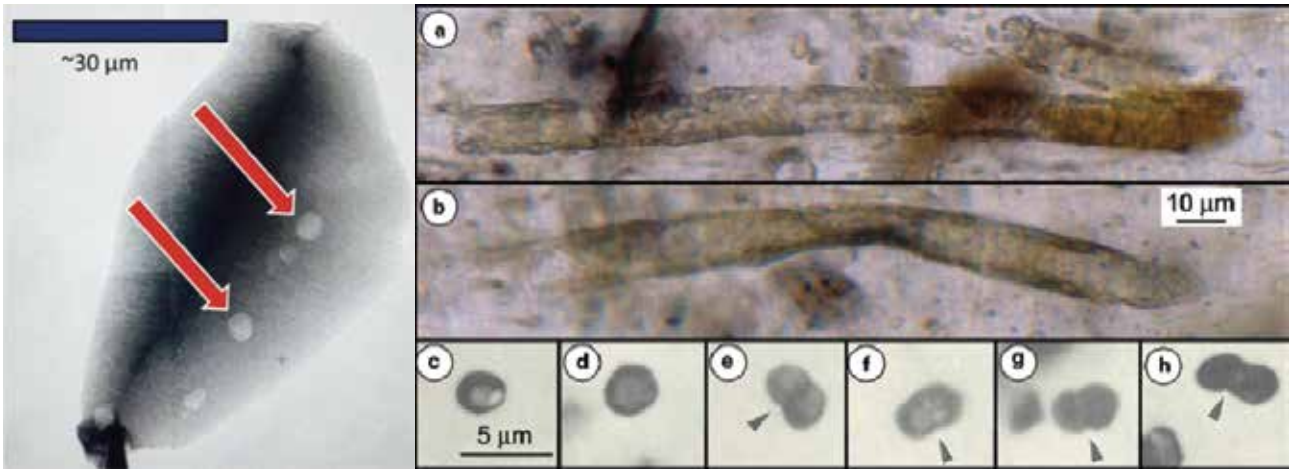

Figure 1. Transmission X-ray image of zircon with graphite indicated. Image form Bell et al. 2015. Schopf et al. 2007

Figure 2. Representative Archean microfossils in petrographic thin sections: (a and b) Broad prokaryotic (oscillatoriacean cyanobacterium-like) tubular sheaths (Siphonophycus transvaalense) from the ~2516Ma Gamohaan Formation of South Africa; scale shown in (b). (c–h) Solitary or paired (denoted by arrows) microbial coccoidal unicells. Image form Schopf et al. 2007

In 1944 physicist Erwin Schrödinger looked at what living organisms do and noted that according to the second law of thermodynamics, the universe tends to increase its entropy. Energy and matter tend to dissipate and simplify and yet, inside a living cell, everything is hugely complex and highly ordered. Schrödinger defined life as: counteracting entropy or maintaining disequilibrium.

In his view living organisms are little closed chemical systems that work to maintain order, but this definition ignores one important feature of living organisms: living organisms evolve.

It is widely agreed that the first living organism must have had information stored in some way. Instructions on how to build its individual components. These molecules are presumed to be polymers capable of building bigger structures out of smaller components. Modern cells use polymers for a variety of functions including information storage (e.g., DNA, RNA), or structural (e.g., actin, tubulin). The process of forming a polymer occurs also outside the cells. For example, RNA chains polymerize on mineral surfaces (Pearce et al. 2002). The RNA chain is formed from building blocks found in the environment. Because the resulting chains differ from each other they interact differently with the environment. For example some will be more effective at obtaining their building material than others and therefore exhaust the resources of subunits faster — limiting the growth of competing chains of polymers. This process is very similar to biological evolution by natural selection but is happening in a purely chemical context. It seems that for life to develop — evolve — and even originate, natural selection had to exist from the very beginning. In chemistry this process is called chemical evolution. It seems reasonable to conclude that life is a product of evolution. Life probably began when molecules began to copy and evolve through natural selection. Life can thus be defined as a self-sustaining chemical system capable of Darwinian evolution (Deamer and Fleischaker 1994). This working definition has its flaws but using it, allows us to describe what should characterize living organisms, either on early Earth or on other planets or moons.

In summary life should counteract entropy. To do this, it should create a closed system (for example be made of cells). It should have some kind of molecule capable of carrying information. Information on how to build its components. And this information should be able to evolve through natural selection.

What was first: the DNA or Proteins?

When we look at living organisms, no matter where they are on the phylogenetic tree of life, most cellular machinery is made of proteins. Our cells, like all known organisms on our planet, to produce proteins, must copy genes from deoxyribonucleic acid (DNA) to ribonucleic acid (RNA) and use RNA as a template for producing proteins. This universal mechanism is called the "central dogma of molecular biology". There is a hidden paradox in this dogma — the sort of problem of what came first — the chicken or the egg? DNA needs proteins to replicate itself. Cells use DNA to make protein. Fortunately, when considering the origins of life, we can solve this paradox quite easily. The solution is to replace both DNA and proteins with RNA. RNA is a molecule related to DNA. It contains the same 4 letters of the genetic code, with the difference that thymine is replaced with chemically similar compound uracil. Instead of 2 strands and a helix, RNA usually has only one strand. RNA is unique because, in addition to its ability to carry information, it can also fold into complex shapes — similarly to proteins. As protein enzymes catalyze various chemical reactions, RNA enzymes — called ribozymes can also function as molecular machines.

A popular theory of the origins of life is the so-called „RNA world hypothesis" — a world where RNA performed both informational and catalytic functions. For the theory to be true, even if the RNA world is long gone, we should still be able to produce ribozymes synthetically. Indeed, artificial ribozymes that can copy their own sequence can be produced in laboratories (Paul and Joyce 2002). Copying is not 100% accurate, but errors are the basis of variability and natural selection. Another strong argument in favor of the RNA world hypothesis is that the ribosome (the molecular machine used to make proteins) is mostly made of RNA. RNA constitutes its oldest central part. Also, nucleotides, which are the RNA components, are found as part of many different molecules that the cell uses in metabolic processes, i.e., adenosine triphosphate (ATP), coenzyme A, or vitamina B12. Thus, the RNA world hypothesis has the potential to solve the chicken or egg question: RNA can store biological information, it can carry out enzymatic reactions, and it can evolve.

Where did life begin?

This question can be reduced to whether life arose on Earth or beyond it? Some studies suggest that microorganisms could survive in the vacuum of space and travel between planets (Nicholson 2009). The theory that life could have been delivered to our planet is called Panspermia. However, the Panspermia theory does not answer how life began but instead pushes it somewhere else. Therefore, in this article, I will assume that life arose here on Earth.

The universe is full of organic matter compounds that are delivered to the surface of Earth with meteorites or sub-mm grains (Kebukawa et al. 2017). This should come as no surprise when we realize that carbon is the fourth most abundant element in the universe. Life's building blocks are widely available, but where exactly did life originate on Earth? Probably, somewhere where energy was present. The energy source for the first biochemical process could be the radiation from the Sun, the geothermal process, or electric discharge. We don't know which one provided the energy for the first living systems, but maybe the clues needed to answer this question can be found in our own cells? We know that all life on Earth uses ATP to store energy. To produce ATP, cells accumulate hydrogen on one side of the membrane and enable the unidirectional flow of hydrogen atoms. They use this directional flow to generate a high energy bond in ATP utilizing a protein called ATP synthase. Maybe first, cells also used a hydrogen gradient to accumulate energy? Hydrothermal vents are an abundant source of hydrogen, and one of the places considered as the cradle of life. These underwater chimneys are additionally covered with microscopic pockets that could serve as molds for the first cells. So, where did life begin? The answer is that we do not know, but let's assume for now that the first cell formed on the surface of a hydrothermal vent. Hypothetically, the energy released from the vent provided conditions for the first ribozymes to evolve. But the path to life as we know it remains very long. This primitive life had to replace information storage in RNA with DNA. Instead of using ribozymes, it had to start using proteins and it had to develop efficient ways of storing energy. The first life that acquired these features is referred to as the first universal common ancestor (FUCA) (Prosdocimi et al. 2019). Likely there were many organisms similar to FUCA but one of them eventually become the last universal common ancestor (LUCA) that originated the three domains of life: Bacteria, Archaea, and Eukarya (Woese 1998).

Although the origin of life theories have many missing parts, they are based on the processes we discovered or reproduced. In conclusion, it seems that life happens and will continue happening as long as the right conditions exist, on Earth or elsewhere.

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Mikołajki
2017


2017


Mikołajki
2017


Mikołajki
2017

ART AND SCIENCE

Obrazowanie biologiczne: inspiracje niewidzialnym światem?

Mikołajki
2017

PAN Warszawa
2017

University of Rzeszów
2018

University of Warmia and Mazury
Olsztyn, 2017

2 ART AND SCIENCE

Sztuka Bioróżnorodności / Art of Biodiversity

Boska Dolina
Dylągówka 2018

PAS Warsaw
2018

Boska Dolina
Dylągówka 2018

Boska Dolina
Dylągówka 2018

PAS Warsaw
2018

PAS Warsaw
2018

PAS Warszawa
2018

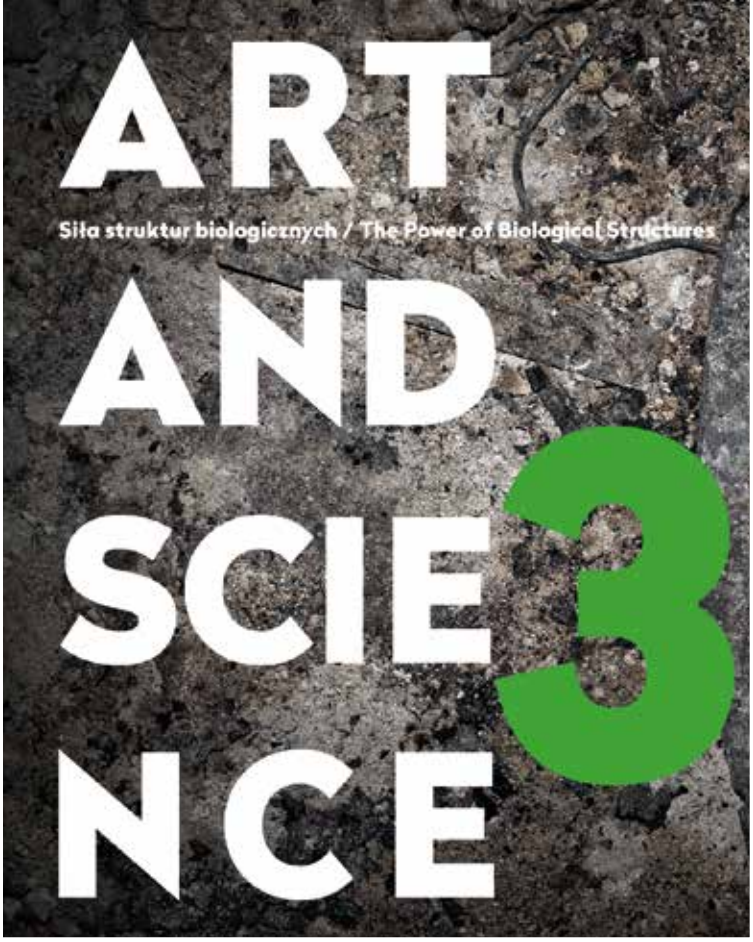
City Gallery Rzeszów
2018


Przeworsk
2019
MIASTO
ZEWORSK


Przeworsk
2019


2019


Przeworsk
2019

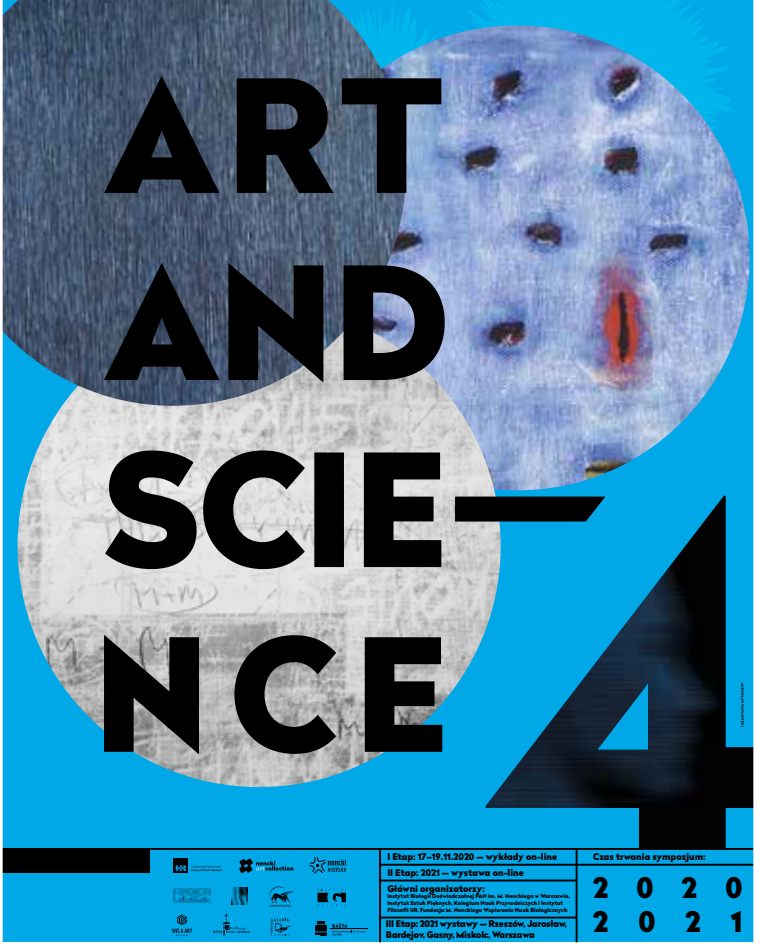


UMCS Lublin
2019

Rzeszów
2019

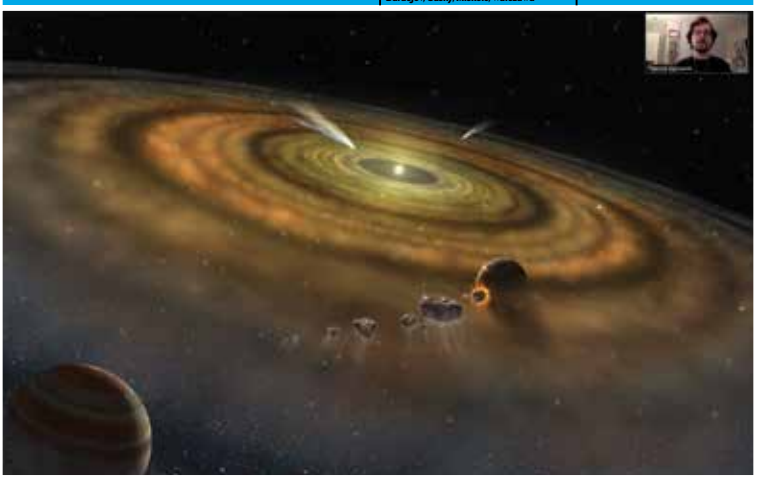
PAS Warsaw
2019

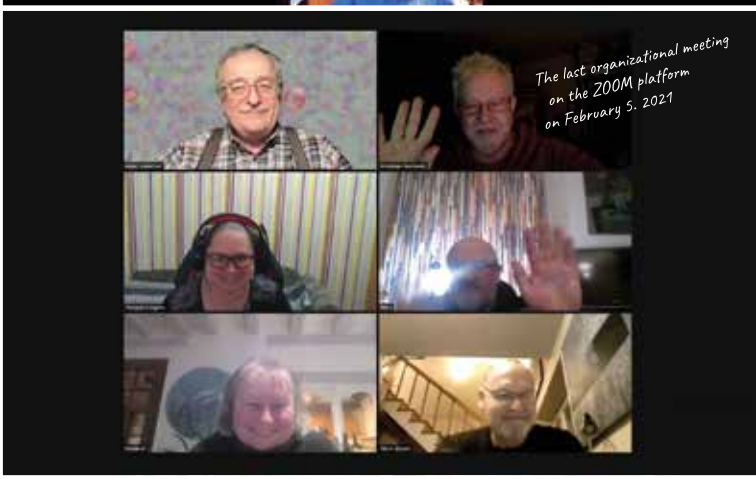
University of Rzeszów
2020

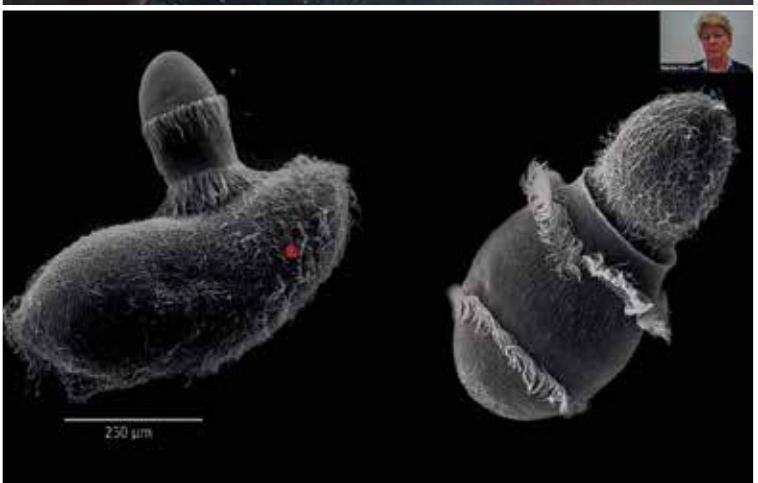

ART
AND
SCIE—
NCE
4
i Etap: 17–19.11.2020 – wykłady on-line
ii Etap: 2021 – wystawa on-line
Główni organizatorzy:
Instytut Biologii Doświadczalnej im. M. Nenckiego w Warszawie,
Instytut Sztuki Polskiej PAN, Kolegium Nauk Przyrodniczych i Instytut Filozofii UR, Fundacja M. Mendelego Wspierania Nauk Biologicznych
III Etap: 2021 wystawy – Rzeszów, Jarosław, Bardejov, Gasny, Miskolc, Warszawa
Czas trwania sympozjum:
2020
2021


ZOOM Meetings, 2020/2021
Bernadeta


2020
2021




The last organizational meeting
on the ZOOM platform
on February 5. 2021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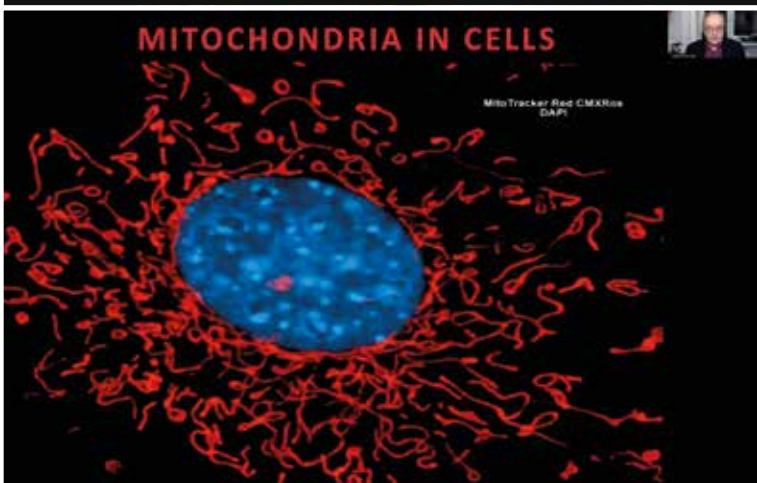
MITOCHONDRIA IN CELLS
MitoTracker Red CMXRos
DAPI

SYMPOSIUM / POST-CONFERENCE EXHIBITIONS

Organizers:
Adam Szewczyk — Nencki Institute of Experimental Biology, Polish Academy of Sciences
Hanna Fabczak — Nencki Foundation for Supporting Biological Sciences
Mirosław Pawłowski — Institute of Fine Arts of the University of Rzeszów
Agnieszka Iskra-Paczkowska — Institute of Philosophy of the University of Rzeszów
Marek A. Olszyński — Institute of Fine Arts of the University of Rzeszów
Antoni Nikiel — Institute of Fine Arts of the University of Rzeszów
Maciej Wnuk — Institute of Biotechnology of the University of Rzeszów

ART AND SCIE 4 — NCE

Partners of the 4th Art & Science project "The Art of the Origin of Life" 2020/2021:
Polish Biochemical Society, Nencki Art Collection; BWA Gallery — Rzeszów; Herman Ottó Museum — Miskolc Gallery, Hungary; Bašta — Cultural-community center, Bardejov, Slovakia; U Attavantich Gallery and Rynek 6 Gallery — Center of Culture and Art — Jarosław; Wela Ary Gallery, France.

The first part of the 4th Art & Science project "The Art of the Origin of Life" — November 17–19, 2020 — Symposium on-line on the ZOOM WEBINAR platform and live streaming on Facebook:
The lecturers were scientists from the Institute of Bioorganic Chemistry of the PAS in Poznań, the Institute of Biology and Biotechnology, the Institute of Philosophy of the University of Rzeszów, Warsaw University of Life Sciences, the Nencki Institute of Experimental Biology PAS from Warsaw and NASA in the USA. The lectures are available at https://www.youtube.com/channel/UCFOx8g9r2cj60bcrmjLLccg

The second part of the 4th Art & Science project "The Art of the Origin of Life" — locations and dates of exhibitions in 2021:
1. **23.04–23.05.2021** — BWA Gallery, Rzeszów
2. **4–30.06.2021** — Two places of exhibitions in Jarosław City:
   — U Attavantich Gallery — The Center for Culture and Promotion in Jarosław
   — Rynek 6 Gallery — The Jarosław Center of Culture and Art
3. **17–31.08.2021** — Bašta — Cultural-community center, Bardejov, Slovakia (closing on the last day of the exhibition)
4. **4–26.09.2021** — Herman Ottó Museum — Miskolc Gallery, Hungary
   September 2–4, art workshops for Hungarian artists, conducted jointly by artists from the Institute of Arts and scientists-biologists from University of Rzeszow. During this time, there will also be organized street art events in the city center and an open-air exhibition of posters by foreign graphic designers participating in the 4th Art & Science.
5. **1–31.12.2021** — Warsaw, Nencki Art Collection Gallery — exhibition (opening and closing)
6. **7–29.08.2021** — International exhibition "Art & Life" accompanying 4th Art & Science project — Wela Art Gallery, Gasny, France. Curators: Elisabeth Wierzbicka, Patrycja Longawa, Mirosław Pawłowski and Marek A. Olszyński.

Project, setting and visual promotion coordinators as well as curators and exhibition organizers:
Adam Szewczyk — Nencki Institute of Experimental Biology, Polish Academy of Sciences; Hanna Fabczak — president of the Nencki Foundation for Supporting Biological Sciences; Bernadeta Korczewska — curator of the Attavanti Gallery in Jaroslaw; Kamila Bednarska — Institute of Fine Arts of the University of Rzeszów; Magdalena Uchman — Institute of Fine Arts of the University of Rzeszów; Anna Kamycka — Institute of Fine Arts of the University of Rzeszów; Marek Pokrywka — Institute of Fine Arts of the University of Rzeszów; Piotr Woroniec Jr. — Institute of Fine Arts of the University of Rzeszów; Ábel Kónya — deputy manager of Herman Ottó Museum, head of member institution Miskolc Gallery, Hungary; Peter Javorík — Bašta — Cultural-community center, Slovakia; Patrycja Longawa — curator of the exhibition in Slovakia, coordinator and organizer of the international presentation of poster artists for the 4th Art & Science project; Piotr Rędziniak — BWA Gallery, Rzeszow.

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