REFLECTIONS ON DISASTROUS CHALLENGES TO HUMANITY

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Abstract

At the dawn of civilization, people were powerless facing natural disasters. Nevertheless, some of them created unforgettable pictorial images on cave walls, sending us a strong message of preserving the world's beauty. Later, civilizations explored the world discovering powerful laws of nature and observing phenomena of different scales (e.g., the atomic structure of the matter, dualistic quantum effects, and systematic studies of the Universe). Unfortunately, many discoveries were exclusively used for military advances and geopolitical ambitions. These cataclysms were documented in literature and expressed in powerful art images (e.g., "Guernica" by Pablo Picasso). In 1945, atomic bombs entirely evaporated two Japanese cities revealing the monster power of nuclear weapon. For the first time, the mankind stood at the crossroad trying to make a moral choice between a bloody military confrontation of nations and their technological cooperation in preventing catastrophic disasters. Some astrophysical phenomena that might drastically affect the Earth "prosperous" future have not been widely discussed: the vulnerable dynamic that might transform the Sun to a giant star (with a radius comparable with the Mercury's orbit); and a possible collision of the Solar System with a neighboring galaxy. Like in ancient times, humanity is currently powerless in meeting these challenges, although the first mutual steps in space exploration have been made. Will this spirit of collaboration prevail, or shall we continue glorifying warfare and dominance of some technologically advanced nations in this fragile world? – Hopefully, the answer to this moral question will be found by humanities.

***Keywords**: Moral Choice, Astrophysical Phenomena, Disasters, Powerlessness, Prevailed Collaboration*

Introduction

In the Earth history, numerous life-threatening events had different reasons and time scales. Catastrophes that threaten our world were briefly analyzed by Isaac Asimov in "A Choice of Catastrophes" (1979). His classification of catastrophes starts with astrophysical-scale events (models of the expanding and contracting universe, dynamics of galaxies, and black holes). New discoveries in nuclear physics (The Higgs Boson 2023) at the European Organization for Nuclear Research and deep-space studies with the James Webb Space Telescope enriched our knowledge of the cosmic-scale processes.

Isaac Asimov identified the second group of catastrophes that will occur at the scale of the Sun dynamics (e.g., stages of a Red Giant and a White Dwarf and collisions with a neighboring galaxy or mini-black holes). New data was summarized in (NASA's Parker Solar Probe 2020; Ravisetti 2022). Asimov pointed that the events of this group should not be considered as an inevitable catastrophe for the humanity since "… the expansion and subsequent contraction of the sun will come so far in the future that by then human beings will surely have developed the technological means to escape" (Asimov 1979, 115).

Collisions with extraterrestrial objects (comets and asteroids) expose the third group of catastrophes (Asimov 1979). Tremendous efforts were made by scientists to catalogize these objects (French 1998) and identify those of them that could collide with the Earth (National Near-Earth Object Preparedness Strategy and Action Plan 2018). During the Earth history (for 4.5 billion years) the planet was hit by asteroids at least 190 times (French 1998), including three largest asteroid impacts that wreaked havoc across the planet: 1)

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The Vredfort crater (diameter of 160 km) in South Africa created by impact of the asteroid with the diameter of 10-15 km about 2 billion years ago; 2) The Chixulub crater (180 km in diameter) in Mexico created by collision with an asteroid of the 12-km diameter (known as the "dinosaur killer") about 66 million years ago, and 3) The Sudbury Basin in Canada contains remnants of the asteroid (diameter of 9-14 km) that hit the Earth over 1.8 billion years ago. Scholars estimate that asteroids with a diameter above 1 km can cause a global catastrophe that could obliterate most life forms, trigger massive tectonic shifts, earthquakes, and cause an ice age. NASA "discovered and cataloged all [25,000] near-Earth asteroids large enough [at least 140 meters] to cause significant global damage" (National Near-Earth Object Preparedness Strategy and Action Plan 2018, 9) and stated that responding to hazards requires international cooperation.

The catastrophes of the fourth class (Asimov 1979) occur due to the competition of life among species (Stars Insider 2023), evolution of microorganisms, and the spreading of diseases, like the COVID-19 pandemic (2024). The military conflicts (Hall 2005; Copley 2020; Trifunović and Kazanský 2021) would also destroy human life.

The depletion of natural resources, pollution, fast population growth, degradation of educational systems, and uncontrollable dominance of computer intelligence could be classified as the fifth-class catastrophes that would "destroy civilization and condemn humanity to a primitive life" (Asimov 1979, 14).

The major goal of this article is to analyze responses of human civilizations on various catastrophic events and find a basis for future generations in continuing the human presence in the universe.

Numerous paintings (Gallup, Gruitrooy, and Weisberg 1998), books (e.g., "War and Peace" by Leo Tolstoy; The Hemingway Stories), movies ("Contact" (1997); "The Silence of Doctor Ivens" (1973)), and life stories of philosophers, scholars, artists, composers, historians, writers, and humanists (Socrates, Giordano Bruno, Nicolaus Copernicus, Jean-Jacques Rousseau, Immanuel Kant, Albert Einstein, Sergei Korolev, Carl Sagan, and Isaac Asimov) inspired me to discuss these natural, technological, social, and moral challenges.

Scientific contributions of colleagues and former students also played a role in my space-exploration efforts. The website of Robert Vanderbei, Professor from Princeton University, (Vanderbei n.d.) includes numerous pictures of planets, constellations, and galaxies made with telescopes installed in his home driveway. The story of Kevin Gill, a former student, inspired generations of our computer science majors. Working on his final capstone project, Kevin developed the Living Mars images (Gill 2012, 2013). Kevin's videoclips were reviewed by NASA specialists, and later he joined their team at the Jet Propulsion Laboratory (JPL) and created computer-generated images of thermo-nuclear explosions on the Sun and produced the close views of Saturn, winning a NASA JPL's Emmy Award (Marrone 2018).

This paper is organized as follows. The author starts with an overview of human reflections on the world and soul tunes, including ancient cave paintings, artistic reactions on devastating natural disasters, and messages to parishes and leaders of moral societies. This section continues with summaries of art works dedicated to the God and classical music arrangements that address the meaning of life.

The next part covers ancient models of mystic universe and some dogmatic religious statements that put obstacles in the development of universe models based on scientific data. This section overviews modern technologies of universe explorations with the James Webb Space Telescope, the NASA Heliophysics Program, Voyager 1 and 2 flights across the Solar system, Cassini spacecraft mission, and Mars Exploration rovers and orbiters.

These observations and data allowed formulate (in the next section) concepts of universe evolution, the Sun's future timeline, and challenges to life on the Earth, including catastrophic volcanic activities, mass extinctions, and devastating infections.

The following section addresses the self-destructive behavior of human civilizations during WWI and WWII, and in military conflicts for power dominating and barbarically appropriating natural resources. Unprecedented arms sales ("*business as usual*") become immoral, diverting resources from resolving vital

problems that humanity is facing. This section concludes with the warning of mankind's dangerous "suicidal mission" in nuclear wars.

The last section includes discussions on searching common goals for humanity. Some global mutual scientific and technological projects are described including the CMS Experiment at the CERN Large Hadron Collider (2023), the International Space Station Mission (2024), and the Internet (Tanenbaum 2003).

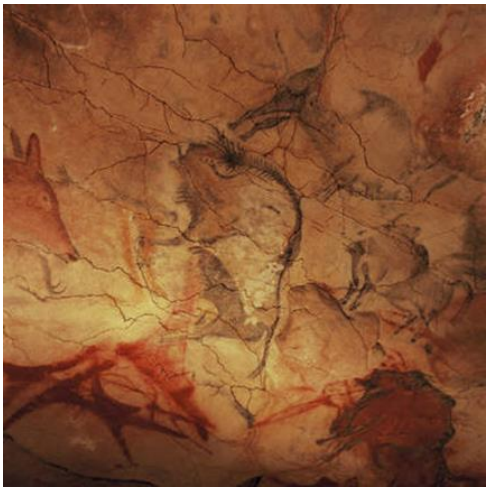
The paper ends with the concluding remarks and recommendations on shaping a new mission for humanities to mobilize society for meeting challenges of astrophysical and planetarian scales that require international collaborative efforts. The glorification of warfare and dominance of some technologically advanced nations in this fragile world must vanish, and the moral spiritual prerogative of collaboration should prevail.

1. Reflections on the World Around Us

Discovering the World's Beauty

At the dawn of civilization, people were powerless facing natural disasters. Nevertheless, some of them created unforgettable pictorial images on cave walls, sending us a strong message of embracing and preserving the world's beauty. The Cro-Magnon paintings with "prehistoric depictions of animals, symbols, and human beings on the cave walls" (Gallup, Gruitrooy, and Weisberg 1998, 11) have been attributed to the Paleolithic period (40,000–8,000 BC). They were found in caves at Lascaux in the Dordogne region of France and at Altamira in northern Spain (see Fig. 1 below).

a) Paintings in the cave of Lascaux, Dordogne region, France. Lascaux Centre International d'art pariétal © Dan Courtice. *Source*: The Lascaux Cave. International Centre of Cave Art. (2023). https://www.lascaux-dordogne.com/en/lascaux-cave



b) Paleolithic Cave Art, Altamira, Northern Spain © UNESCO, Author: Yvon Fruneau. *Source*: Cave of Altamira and Paleolithic Cave Art of Northern Spain. (2023). UNESCO World Heritage Centre. https://whc.unesco.org/en/list/310/gallery/

Figure 1: Paintings in Paleolithic Caves.

Facing Natural Disasters

In the history of civilizations, people were powerless facing natural disasters. Archeological sites (Hall 2005, 6-295), religious and historical artifacts (Nappo 1998), and pieces of arts express people's fear. The powerful images of terrors are expressed in paintings of famous artists (Gallup, Gruitrooy, and Weisberg 1998), including Edvard Munch's "The Scream" (1893) (see Fig. 2a below), which "has been widely interpreted as representing the universal anxiety of modern humanity" (Eggum and Munch (ed.) 1984, 10). Karl Bryullov's painting "The Last Day of Pompeii" (1827–1833) (see Fig. 2b below) depicts the moment when "…

hundreds of citizens of Pompeii stop in awe and fear, witnessing one of the most legendary natural disasters in human history: the volcanic eruption of Mount Vesuvius" (The Culture Trip Ltd n.d.).

a) Edvard Munch. The Scream. 1893. National Gallery, Oslo, Norway. *Source*: The Scream. (2023). Wikipedia. https://en.wikipedia.org/wiki/The_Scream

b) Karl Bryullov. The Last Day of Pompeii. (1827–1833). The State Russian Museum, Saint Petersburg, Russia. *Source*: History of a Painting: 'Last Day of Pompeii' by Karl Bryullov. (2023). The Culture Trip Ltd. https://theculturetrip.com/europe/russia/articles/history-of-a-painting-last-day-of-pompeii-by-karl-bryullov/

Figure 2: Images of people who were powerless facing natural disasters.

Unsolved Puzzles of the Past

Ancient civilizations (Britannica 2020), (Hall 2005, 6-295) created sanctuary sites that puzzle us. The history of these monuments reveals deep knowledge in astronomy, natural sciences, the complexity of engineering solutions, ceremonial traditions, and strong moral orientations.

The famous prehistoric megalithic structure *Stonehenge* developed on Salisbury Plain in Wiltshire, England, was originally (around 3,000 BC) built as a timber structure and functioned as a cremation cemetery probably for the burial of members of prominent families (Haughton 2010). Later, around 2,550 BC., the structure was refashioned into a stone monument of eighty pillars arranged in two concentric circles. These bluestones, weighing about 4 tons each, and a 16.4-foot-long greenish sandstone slab were probably transported from south-west Wales to Salisbury Plain over a 185-mile route (Haughton 2010). The northeastern entrance to the enclosure was precisely aligned with the midsummer sunrise and midwinter sunset.

Artifacts of ancient civilizations were discovered in Peru. The Norte Chico civilization flourished along the Pacific coast as early as 3,000 BC. Other civilizations (the Moche, Chavin, Chimú, and Nazca) would follow, leaving behind mysteries. Sacsayhuaman, an ancient walled complex near Cusco, was a fortress built from stones weighing over 100 tons, demonstrating the Incas' skills to transport and place them. Moray, an ancient Inca ruin, consists of several circular terraces that descend into the ground, each having its microclimate and being used for agricultural experimentation studying the effects of different climates on crops. The Nazca Lines But, a series of ancient geoglyphs in Nazca Desert, remains a puzzle left by the Nazca people, who inhabited the region from 200 BC to 700 AD. The large drawings depict animals, plants, and geometric designs. As Leasca (2024) stated, they "were created, possibly, for religious or astronomical purposes".

The World Religions

Main Religious Messages

In the recorded human history (Hall 2005, 6-295), there is no culture which has not practiced some form of religion (Nagle 2013) that revealed itself as "an organized system of beliefs and practices revolving around, or leading to, a transcendent spiritual experience" (Mark 2018, 1). All religions concerned themselves "with the spiritual aspect of the human condition, … the creation of the world, a human being's place in the world, life after death, eternity, and how to escape from suffering in this world or in the next" (Mark 2018, 1).

As Jeffrey Brodd mentioned in his book "*World Religions: A Voyage of Discovery*" (2015), "… Religion begins with mystery. Being human inevitably prompts deep questions about our existence: Where did we come from? Where are we going? Why are we here? … What is the nature of this world? … By responding to the questions, religion provides a way of living and dying meaningfully amid the mystery." (Brodd 2015, 11)

First Religious Evidence, Biblical Manuscripts, and Gospels of the New Testament

The earliest Egyptian myths were recorded around 4,000 BC, and the first written evidence of religion in the world was found on Sumerian tablets around 3,500 BC. The Rig Veda manuscript (1500 BC – 1100 BC) mentions the god Rudra (Shiva) and goddess Tara (among others), establishing the basic tenets of Hinduism. (Religion in the Ancient World: Timeline 2024)

The Ketef Hinnom silver scrolls (2024) exhibited in the Israel Museum are the oldest surviving texts from the Hebrew Bible, dated to 600 BC (Wilford 2004).

Exhibited in the John Rylands Library in Manchester, England, the Rylands Greek papyrus 457 ($\mathfrak{P}^{52}$) (Roberts 1936) dated of 125–175 AD contains fragments from the St. John Gospel 18:31-33 and 37-38. The "Book of Kells" (2024) (c. 800 AD) contains four Gospels of the New Testament assembled in 340 colorful folios and 680 pages (Brown 1980). It is exhibited in the Trinity College Library in Dublin.

According to believes, the Qur'an was revealed in stages to the Prophet Muhammad by God in Arabic over 23 years. "Some Qur'anic [textual] fragments have been dated as far back as the eighth, and possibly even the seventh, century. The oldest existing copy of the full text is from the ninth century". (The Qur'an 2011)

The Babylonian Talmud was compiled around 600 AD. In 712-807 AD, collections of oral myths (The Kojiki, The Nihon Shoki, and The Kogoshui) were written forming the basis of the Shinto religion. (Religion in the Ancient World: Timeline 2024)

The "Golden Rule"

All sacred manuscripts contain messages that inspire people to follow the best humanistic traditions and rules. Norman Rockwell expressed one of these rules in his painting "Golden Rule" (see Fig. 3 below) as the story illustration for The Saturday Evening Post (April 1, 1961), (Marker 1989, 104). A group of people of different religions, races and ethnicity served as the backdrop for the inscription "Do Unto Other as You Would Have Them Do Unto You" on this painting. In 1985, a large mosaic of Rockwell's "Golden Rule" was presented to the United Nations as a gift on behalf of the United States by then First Lady Nancy Reagan.

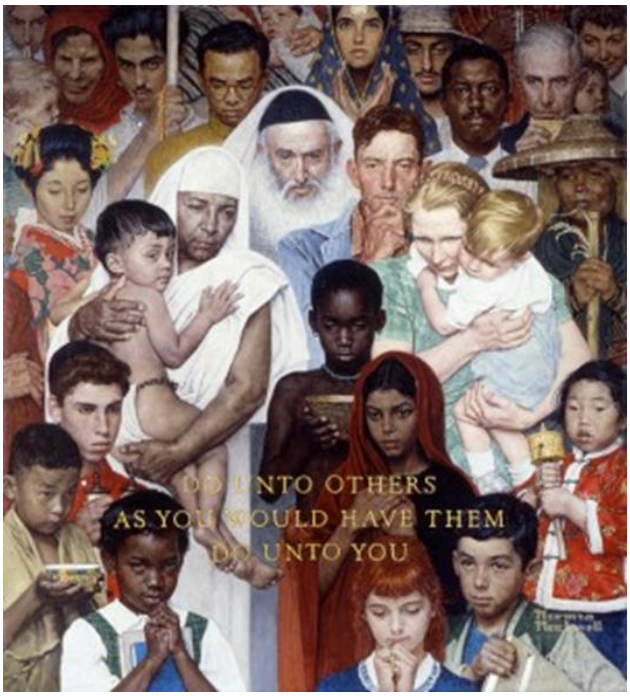


Figure 3: Norman Rockwell (1894-1978), Golden Rule, 1961. Oil on canvas, 44 1/2" x 39 1/2". Story illustration for The Saturday Evening Post, April 1, 1961. Norman Rockwell Museum Collections. ©SEPS: Curtis Licensing, Indianapolis, IN. *Source*: Rockwell's "Golden Rule". Norman Rockwell Museum. Blog Post – February 5, 2014. https://www.nrm.org/2014/02/golden_rule/

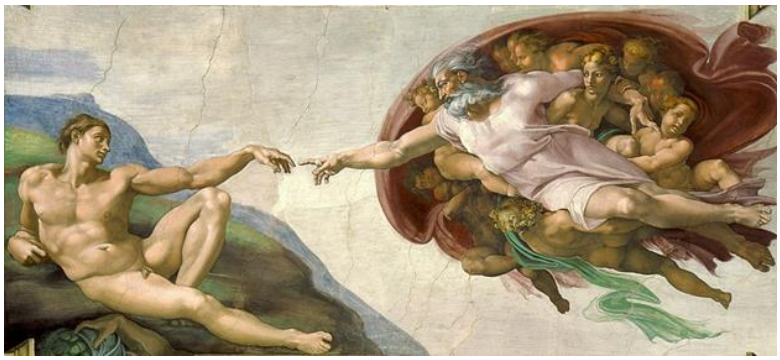
Personal Travel Reflections

Personal experience was always important in people's spiritual lives. The author visited many sacred places around the world (in Israel, Palestine, Greece, Vatican, Italy, France, Spain, Great Britain, Ukraine, Russia, Germany, Japan, and other counties) including The Western (Wailing) Wall, The Church of the Holy Sepulcher, Via Dolorosa, and The Dome of the Rock in Jerusalem; Rachel's Tomb and The Church of Nativity in Bethlehem; The ancient Synagogue in Capernaum and Masada in Israel; Parthenon at Acropolis and Hephaisteion at Ancient Agora in Athens; Temples of Hera and Zeus in Olympia, and monasteries of Varlaam, St. Stephen, and Rousanou at Meteora in Greece; The Basilica of St. Peter and The Sistine Chapel in Vatican; Pantheon in Rome; Forum in Ancient Pompeii; The Cathedral Santa Maria del Fiore, The Basilica di Santa Croce, and The Basilica di Santa Lorenzo in Florence. The treasures in Eastern Europe are also remarkable, including the Saint Sophia Cathedral in Kyiv, Saint Isaac's Cathedral in St. Petersburg, and Cathedrals of the Archangel and the Annunciation in Moscow. (Riabov 2008; 2018; 2024)

Japanese heritage sites (especially, Kyoto) excite us with cultural discoveries and philosophical puzzles (Rowthorn and Florence 2001; Riabov 2023). In the Ryoanji Temple's Stone Garden, there are fifteen different stones, but an observer could see only fourteen stones from any direction. Stone gardens – gifts of Japanese people to Americans – adorn Portland and Boston (Riabov 2010).

Art Works Dedicated to The God

Following Judeo-Christian traditions, artists and sculptors dedicated their works of arts to the God. Here we mention only a few giants, whose works have inspired generations of people and deeply touched their souls. The Italian sculptor, painter, architect, and poet Michelangelo Buonarroti (1475–1564) is at the Olympia summit. His fresco *The Creation of Adam* (c. 1511-–1512 AD) (see Fig. 4a below) adorns the ceiling of the Sistine Chapel in Vatican.

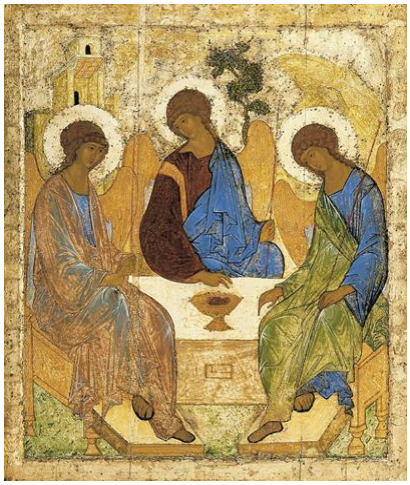


a) Michelangelo. The Creation of Adam. Fresco. c. 1511-12. Sistine Chapel, Vatican, Rome. *Source*: Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Michelangelo_Creation_of_Adam_%28cropped%29.jpg

b) Raphael. Madonna of the Meadow. c. 1505. Oil on wood. Kunsthistorisches Museum, Vienna. *Source*: Wikipedia. https://en.wikipedia.org/wiki/Madonna_del_Prato_(Raphael)

c) Ivan Kramskoi. *Christ in the Desert*. 1872. Oil on canvas. The State Tretyakov Gallery. Moscow, Russia. *Source*: Wikipedia. https://en.wikipedia.org/wiki/Christ_in_the_Desert

d) Michelangelo. The Deposition (The Florentine Pietà). Marble. c. 1547. Museo dell'Opera del Duomo. Florence, Italy. *Source*: Wikipedia. https://en.wikipedia.org/wiki/The_Deposition_(Michelangelo)



e) Andrei Rublev. The Trinity. Tempera. 1411 or 1425–1427 AD. Temporally displayed at Moscow's Cathedral of Christ the Savior. *Source*: Wikipedia. https://en.wikipedia.org/wiki/Trinity_(Andrei_Rublev)

Figure 4: Art Works Dedicated to The God.

Michelangelo's marble sculpture *The Deposition* (*The Florentine Pietà*, c. 1547–1555) (see Fig. 4d) rests in Museo dell' Opera del Duomo in Florence. According to Vasari, "Michelangelo began to work on the sculpture around the age of 72. Without commission, he worked tirelessly into the night with just a single candle to illuminate his work. He worked on this sculpture to amuse his mind …" (Hibbard 1974, 282).

The Madonna del Prato (1506) is an oil-on-board painting by Raphael held in the Kunsthistorisches Museum in Vienna (see Fig. 4b). "The scene represents the figures of the Virgin Mary, the infant Jesus, and an infant John the Baptist shown in a calm grassy meadow…. Mary is wearing a gold-bordered blue mantle set against a red dress. The blue symbolizes the church and the red Christ's death, with the Madonna touching hands with Jesus the uniting of Mother Church with Christ's sacrifice." (Madonna del Prato 2024)

The Trinity, the most famous Russian icon, was created by Russian painter Andrei Rublev in 1411 or 1425–1427 AD. *The Trinity* (see Fig. 4e) depicts three angels who visited Abraham at the Oak of Mamre (Genesis 18:1–8). "The painting is full of symbolism …. At the time of Rublev, the Holy Trinity was the embodiment of spiritual unity, peace, harmony, mutual love, and humility." (Trinity 2024)

The theme of Christ's temptation is reflected in Ivan Kramskoi's oil-on-canvas painting *Christ in the Desert* (1872) exhibited at The State Tretyakov Gallery in Moscow (see Fig. 4c). "The painting emphasizes Jesus's human constituent of hypostatic union and features a mind in struggle instead of action." (Christ in the Desert 2024)

Music Addresses the Meaning of Life

In the history of the Western civilization, many composers dedicated their music to the God trying to reveal the bright and dark corners of the human soul. Johann Sebastian Bach (1685-1750), a German composer and musician, is known for his organ works (*the Schubler Chorales* and *the Toccata and Fugue in D minor*) and chorales (*the St. Matthew Passion* and *the Mass in B minor*). The passion for life and the devotion of a human to the spiritual leader were immersed in our souls during Bach's organ masses in the Köln Cathedral and the Notre-Dame de Paris Cathedral.

Franz Joseph Haydn (1732-1809), an Austrian composer, was called "Father of the Symphony and String Quartets" for his contributions to musical forms. His *The Creation* and *The Seasons* address the meaning of life and the purpose of humankind.

The music works of a great German composer and pianist Ludwig van Beethoven (1770-1827) mark the music transition from the Classical period to the Romantic era. E. T. A. Hoffmann, a composer and a contributor to the *Allgemeine musikalische Zeitung*, wrote that the music of Beethoven's *Fifth Symphony* "sets in motion terror, fear, horror, pain, and awakens the infinite yearning that is the essence of romanticism" (Cassedy 2010). In the last years of his life, Beethoven composed *Missa solemnis* and *Symphony No. 9*. These works "are characterized by their intellectual depth, their formal innovations, and their intense, highly personal expression" (Ludwig van Beethoven 2024).

Pyotr Ilyich Tchaikovsky (1840-1893), a Russian composer of the Romantic Music period, wrote the most popular concert and theatrical music, including the ballets *Swan Lake* and *The Nutcracker*, the *1812 Overture*, *First Piano Concerto*, *Violin Concerto*, the *Romeo and Juliet* overture-fantasy, several symphonies, and the opera *Eugene Onegin* (Pyotr Ilyich Tchaikovsky 2024). Tchaikovsky's symphonies, ballet, and operas "belong to not just Russia but also the world at large" (Taruskin 1992).

The *Symphony No. 6 in B minor*, Op. 74 (known as the *Pathétique Symphony*) is Tchaikovsky's final symphony. The composer led the first performance of the symphony in Saint Petersburg on [O.S.] 16 October 1893, nine days before his death. David Brown, an English musicologist, suggests that "the symphony deals with the power of Fate in life and death" (Brown 1992, 445).

Sergei Vasilyevich Rachmaninoff (1873-1943) is considered one of the finest pianists of his day and, as a composer, one of the last great representatives of Romanticism (Norris 2001). Rachmaninoff composed

three symphonies and the most popular song (arranged for orchestra), the wordless *Vocalise*. He also wrote two cappella choral works—the *Liturgy of St. John Chrysostom* and the *All-Night Vigil*. It was the fifth movement of *All-Night Vigil* that the composer requested to have sung at his funeral. (Martyn 1990)

2. Exploring Mystic Universe

First Models of the Universe

Since ancient times, humans have been curious about the universe, its origin, and structure. Ptolemy (Claudius Ptolemaeus) (100–168 AD) was an Egyptian astronomer, mathematician and geographer who believed that the Earth was in the center of the universe. He refined ideas of Greek philosophers and astronomers (Eudoxus and Aristotle), who believed that if the heavens are divine, and the gods created man, then the universe must be geocentric (NASA. n.d.).

Fourteen centuries later, Nicolaus Copernicus (1473-1543), a Polish mathematician, physicist, and artist, became the first astronomer, who posited the idea of a heliocentric solar system, in which planetary objects orbit the sun (Zhang and Kuchi 2023). The final version of his theory, *De Revolutionibus Orbium Coelestium Libri Vi*, was printed in 1543, the last year of his life (Westman 2023). His theory had important consequences for discoveries by Galileo, Kepler, Descartes, and Newton.

Exploring Universe with Modern Technologies

a) “Cosmic Cliffs” at the edge of a star-forming region NGC 3324 in the Carina Nebula, 7,600 light-years away.

b) Prelude to Supernova.

c) A spiral galaxy Messier 74 like our Milky Way.

d) The Eagle Nebula M16 "Pillars of Creation“.

Figure 5: Images of the Universe received by the James Webb Space Telescope. *Source*: The James Webb Space Telescope. NASA Goddard Space Flight Center. Last Updated: June 1, 2023. https://jwst.nasa.gov/

Infrared technology is used at The James Webb Space Telescope (JWST) (2023) for studying phases of cosmic history—from the Solar system to the most distant observable galaxies in the early universe formed over 13.5 billion years ago. It was launched from ESA's spaceport in French Guiana on Dec. 25, 2021.

The JWST discoveries include the image of "Cosmic Cliffs" at the edge of a star-forming region NGC 3324 in the Carina Nebula (see Fig. 5a), 7,600 light-years away; infrared images of the exoplanet HIP 65426b; The Eagle Nebula M16 "Pillars of Creation" (Fig. 5d); a spiral galaxy Messier-74 that looks like our Milky Way (Fig. 5c); prelude to supernova (Fig. 5b), and rings around Uranus (NASA Photos n.d.).

The NASA Heliophysics program explores various aspects of the Sun-Earth system. The fourth solar flyby of the Parker Solar Probe in 2020 found new data in Sun activities, including the structure of the Sun magnetic field. The images revealed fundamental differences between an active Sun and a quiet Sun and confirmed the existence of the 25-Year Solar Cycle (NASA Press Release 2020).

The Voyager 1 and 2 probes flight across the Solar system for more than 45 years (Guenot 2022). Originally, probes were designed to visit Jupiter and Saturn. They delivered detail images of Saturn's rings (August 23, 1981), Jupiter, and two of its moons, Thebe and Metis. Nowadays, both probes continue their journey outside the Solar system.

NASA's Cassini spacecraft explored Saturn and its icy moons for 13 years (NASA's Cassini Spacecraft Mission Overview n.d.). Cassini's images revealed hydrogen gas that is pouring from the hot seafloor into the ocean on Enceladus, Saturn's moon. This phenomenon might indicate the energy source for life there.

The Mars Exploration program was revived with the launch of the Pathfinder Rover in 1997 (NASA's Mars Exploration Program n.d.). NASA's Mars 2020 Perseverance Rover (2021) continued searching for life on Mars. NASA's MAVEN Orbiter (n.d.) systematically measures the Martian atmosphere, helping understand climate change there.

The Universe Evolution

Astrophysicists, who studied the Universe dynamics (Peebles, Schramm, Turner, and Kron 1994; Muro 2022), predicted various inevitable events in the long perspectives of global evolution (Trosper 2018). Geological studies indicate that the oldest rock on Earth was formed about four billion years ago. The age of the current universe is counted from the estimated time of the "Big Bang" event that likely happened 13.8 billion years ago (History of the Universe 2022; Muro 2022). So, the new major cosmological events in the future might have the scale of a billion-trillion years or more. Various expected cosmological events (gravitational disturbances outside the Solar system, supernova explosions, Universe's rapid expansion, evolution of galaxies and stars, etc.) were described in (Timeline of the Far Future n.d.).

Obviously, mankind could not "prevent" such events, but should accumulate knowledge about the Universe dynamics and continue developing technological skills that would help humanity survive longer.

3. Challenges to Life on The Earth

The Future Timeline of the Sun and the Earth

At present, our sun is in its life prime. The star is 4.57 billion years old, productively fusing hydrogen into helium (Ravisetti 2022).

During the next 1-8 billion (B) years, major changes will occur in the Solar System: in 1B – the star becomes too hot for life on Earth's surface; 2B – Earth's oceans have evaporated; 3.5B – Milky Way and Andromeda galaxies may collide, and the Sun increases its emitted power by 40%; 6.5-7.5B – the star become a Red giant with the radius of Mercury's current orbit, emitting 2,700 times more power than now (Earth will be swallowed up by the Sun, but life on Titan might flourish); and 8B years from now – the hydrogen supply will fizzle out, and the Sun will cool, dim, and turn into a White dwarf. (Ravisetti 2022)

The major predictable events in the Earth evolution (sea level rise, seasonal changes, super-volcanic eruptions, glacial-period returns, collisions with asteroids, natural and Holocene extinctions, biological evolutions, etc.) for next 250 million years were summaries in (Timeline of the Far Future. n.d.).

Destructive Volcanoes

Mass extinctions of species in the Earth history were associated with catastrophic volcanic eruptions (Raup and Sepkoski 1984). Volcanologists identified nine large areas affected by eruptions: Emeishan traps, Siberian traps, Central Atlantic Igneous Province, Karoo and Ferrar provinces, Trape Province of Paraná Etendeka, Rajmahal Trappa, Traps of the Deccan Plateau, North Atlantic Igneous Province, and Columbia River Basalt Group (TASS Project 2023). The Permian mass extinction (on the border of Paleozoic and Mesozoic eras, 251 million years ago) was the largest in the history of the Earth, when 96% of marine organisms, about 75% of terrestrial vertebrates, and 83% of insect species became extinct. Likely, it was a result of the eruption of the Siberian traps (Ritchie 2022).

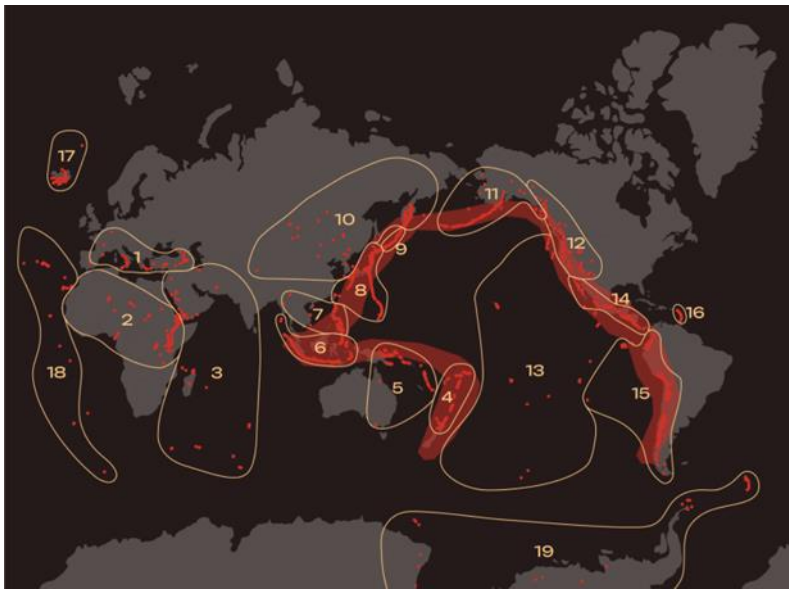


Figure 6: Volcanic Regions of The World. *Sources*: Can Volcanoes Destroy Life on the Planet? TASS News Agency, March 30, 2023. https://spec.tass.ru/vulkan/; Global Volcanism Program, 2023. [Database] Volcanoes of the World (v. 5.0.4; 17 Apr 2023). Distributed by Smithsonian Institution, compiled by Venzke, E. https://doi.org/10.5479/si.GVP.VOTW5-2022.5.0.

a) Grand Prismatic Spring in Yellow-stone National Park (USA)

b) Eyjafjallajökull volcano eruption (Iceland), 2010

c) Eruption of Mount Etna (Sicily, Italy), 2022

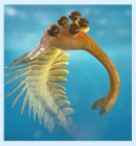
Figure 7: Three famous volcanoes. *Source*: Can Volcanoes Destroy Life on the Planet? TASS News Agency, March 30, 2023. https://spec.tass.ru/vulkan/

Volcanic activities in 19 regions (see Fig. 6) were catalogized by the Smithsonian Institution (2013) that runs the Global Volcanism Program (2023). Its database "Volcanoes of the World" includes information about eruptions of 1328 volcanoes (including those shown in Fig. 7) that occurred for the last ten thousand years (TASS

Project 2023). The major volcanic activities are concentrated in 11 regions of the ring around the Pacific Ocean (see Fig. 6). The Grand Prismatic Spring in Yellowstone National Park (USA) (see Fig. 7a) is the Earth largest giant "slipping" volcano. Volcanic threats and fatalities were analyzed by Brown, Jenkins, Sparks et al. (2017).

Historical Mass Extinction Events on Earth

Table 1: Historical Mass Extinction Events on Earth

Images	Extinction Event Name & Period	Organisms Involved	What happened?	Possible Reasons of Catastrophes
	The Oxygen Catastrophe, about 2,300 M years ago, Paleo-proterozoic era	Culprit, one of Earth's earliest prokaryotic organisms (*cyanobacteria*) that photosynthesize and release oxygen.	The planet's atmosphere had just 0.03% of today's oxygen levels	The oxygen levels started to rise, driving much of Earth's life to extinction.
	End-Botomian mass extinctions about 513 to 509 million years ago, during the Cambrian Period	Organisms made the transition from unicellular to multicellular, including hard-shelled animals (e.g., trilobites).	This mass extinction wiped about 83% of these organisms from Earth.	The reasons: sea-level change, marine anoxia, carbon isotope excursions, and eruptions of large igneous provinces.
	The Ordovician–Silurian extinction occurred between 450 and 440 million years ago	One of the largest extinction events on Earth. Trilobites, graptolites, bryozoans, brachiopods, conodonts were wiped out.	The extinction of 85% of all marine species on Earth. Rise of volcanism.	Cooling and widespread glaciation, followed by warming and low oxygen levels.
	Lau/Kozlowskii extinction, during the Silurian period, 420 million years ago	Some species, such as graptolite, saw a reduction as high as 70%.	The extinction of 23% of all marine animals.	Deoxygenation of the ocean and the proliferation of sulfidic ocean conditions.
	Late Devonian extinction (8-10 events lasted 2-4 and 20-25 Ms).	It affected mostly marine life.	The extinction of 70-80% of all animal species.	Low levels of oxygen in the oceans.
	Carboniferous rainforest collapse, around 307 M years ago	It had a huge impact on Earth's flora and overall landscape.	"Coal forests" were wiped out.	Likely, climate change and rise of volcanic activities.
	The Permian–Triassic extinction, 251.9 million years ago.	77-96% of all invertebrate marine species were wiped out, as well as numerous insect species.	On land, 70% of all vertebrate species went extinct.	No evidence that it was preceded by an atmospheric or oceanic change.
	The Triassic–Jurassic events, about 201 million years ago.	34% of marine genera and up to 20% of marine families went extinct.	76% of marine and terrestrial species were wiped out.	Climate change, ocean acidification, increase in CO2 in atmosphere (linked to volcanism).
	The Cretaceous–Paleogene event, around 65 million years ago.	About 75% of all life on Earth went extinct. Large animals (e.g., dinosaurs) were unable to survive.	A prolonged period of cold and darkness, "impact winter".	It was caused by an asteroid impact at Yucatán Peninsula in Mexico.
	Eocene–Oligocene event, around 33.9 million years ago.	About 66% of all species in Europe and Asia went extinct.	The climate was likely affected by Earth's cooling.	Less CO2 in the atmosphere and changes in ocean circulation.
	The Pliocene–Pleistocene event occurred 2.6 million years ago.	36% of marine genera became extinct. Giant marine fauna (megalodon, giant shark) disappeared.	Particles from a supernova (exploding star) entered Earth.	Mutations and cancers that affected mostly larger animals.
	The Holocene (Anthropocene) undergoing extinction	The species extinction rate being between 100 to 1,000 times higher than it would naturally occur.	477 vertebrates have gone extinct since 1900.	This extinction event caused by human activity.

Source: The history of mass extinction events on Earth. Stars Insider. April 29, 2023, https://www.msn.com/en-us/travel/news/the-history-of-mass-extinction-events-on-earth/

Scientists identified at least 12 mass extinction events in the history of Earth, starting from the Oxygen Catastrophe that occurred about 2.3B years ago (Paleo-Proterozoic era). The historical timeline of these events, possible reasons for catastrophes, and the list of affected organisms are presented in Table 1 (Stars Insider 2023).

The data related to the last four extinction events (from 66M years ago to present) indicates that 75% of all life on Earth and giant marine fauna disappeared. During the Holocene extinction period caused by human activity, 477 vertebrates went extinct since 1900.

The Most Devastating Infections

The Earth biosphere is also affected by spreading the devastating infections. Fungal infections catastrophically damaged plants and animals (Ivanov, Ukladov, and Golubeva 2021). Beetles that infect trees with the fungus *Grosmania clavigera* destroyed 16.3 million hectares of forest in Canada (Kuzaev 2022). Scientists estimated the damage from tree diseases: by 2020 dead trees could absorb 230-580 million tons of carbon dioxide from the air, but this is a small portion of 34.9 billion tons emitted into the atmosphere in 2021 (Liu, Deng, Davis et al. 2022).

Table 2: The most devastating infections

Images	Infection name	Time Period	Brief Description	Major Effects
 Infected potato. Phytophthora infestans. Wikipedia [54]	The fungus *Phytophthora infestans* [55]	In the mid-19th century, potatoes infected with fungus *Phytophthora infestans* arrived in Europe either from Peru or Mexico.	Similar fungal infections affected crops of rice, wheat, corn, and soybeans. The worldwide loss would be enough for 4.3 billion people.	The crops failed time after time. The Irish had a particularly hard time: a terrible famine broke out on the island. One in eight residents died between 1841 and 1851, and the same number emigrated.
 Banana plantation in Costa Rica affected by Panama disease, 1919 © The Library of Congress	The fungus *Fusarium oxysporum* [53]	It was first documented in Australia in 1876. The causative agent (TR4) was only identified in 1994.	The disease causes *Gros Michel* banana plants to rot from the inside.	Fungus spread in Central America, where it caused one of the largest ***epiphytoties*** (plant pandemic) called *Panamanian*. it also devastated *Cavendish* banana plantations in Taiwan, Southeast Asia, Africa, and Australia in the 1960s.
 © Marek R. Swadzba/ Shutterstock/Fotodom	The fungus *Chytridiomycosis* [53]	Nowadays	*Chytridiomycosis* has already wiped out dozens of amphibian species.	It drastically affects the reproductive behavior of orange toads. It threatens hundreds of other species.
 © Nick Greaves/ Shutterstock/Fotodom	The fungus *Cryphonectria parasitica (Chestnut blight)* [53]	The diseased tree was first noticed at the New York Zoo in 1904. By 1940, 3.5 billion chestnut trees had died.	The fungus has likely entered with seedlings from Japan.	The Chestnut blight has changed the face of the US East Coast. (In Asia, trees coexisted with the pathogen for centuries).
 © Marvin Moriarty/USFW/ Public Domain/Wikimedia	*Pseudogymnoascus destructans* (White nose syndrome) [53]	It was found on bats in a cave in New York State in 2006.	A fungal coating was found on the muzzles, ears, and wings of bats.	Affect species with weakened immune systems. During hibernation in bats, the body temperature drops and processes in the body slow down. In total, millions of bats died.

Source: Kuzaev, Marat. (2022). The most devastating infection is spreading right now. But few have heard of her. TASS New Agency, September 19, 2022. https://nauka.tass.ru/nauka/15751575

Descriptions of the most devastating infections (the fungus *Phytophthora infestans*, *Fusarium oxysporum*, *Chytridiomycosis*, *Cryphonectria parasitica* (known as *Chestnut blight*), and the fungal coating *Pseudogymnoascus destructans* (known as *White nose syndrome*)) and their effects on crops, plant and animal reproduction, and species with weakened immune systems are summarized in (Kuzaev 2022).

4. Self-Destructive Behavior of Human Civilizations

Two World Wars in 20th Century

World War I began in 1914 and lasted until 1918. During the conflict, the Central Powers (Germany, Austria-Hungary, Bulgaria, and the Ottoman Empire) fought against the Allied Powers (Great Britain, France, Russia, Italy, Romania, Canada, Japan, and the United States). More than 16 million people—soldiers and civilians—were dead. The Battle of Verdun (2016) was the bloodiest conflict of WWI. Casualties numbered about 400,000 for the French and 350,000 for the Germans. (World War I 2023).

A French lieutenant wrote in his diary (May 23, 1916): "*Humanity is mad. It must be mad to do what it is doing. What a massacre! What scenes of horror and carnage! I cannot find words to translate my impressions. Hell cannot be so terrible. Men are mad!*" (Horne 2007, 236).

The 40,000,000–50,000,000 deaths incurred in World War II (1939-1945) make it the bloodiest historical conflict (Hughes and Royde-Smith 2023). Cruelty of Nazis, negligence of basic human rights, and massive repressions were witnessed and condemned by nations. Only in Auschwitz (see Fig. 8), a complex of 40 concentration and extermination camps operated by Nazi Germany in occupied Poland, 1.1 million people were murdered, including 960,000 Jews, 74,000 Poles, 21,000 Romani, and 15,000 Soviet prisoners of war (Auschwitz Concentration Camp 2023).

Figure 8: Auschwitz II-Birkenau gatehouse; the train track led directly to the gas chambers. *Source*: Auschwitz concentration camp. Wikipedia. https://en.wikipedia.org/wiki/Auschwitz_concentration_camp

Military archives, chronicles from battlefields, museum exhibitions, people's dairies, novels, poetry, and family oral stories preserve memories not only about millions of dead or injured victims of these devastating wars, but also about the highest spiritual strength of soldiers and civilians, who resisted military aggressions and sacrificed themselves bringing closer the victory days.

The Nazi siege of Leningrad (for almost 900 days in 1941-1943), when "the city was cut off from the rest of the world, was one of the most gruesome episodes of the World War II. Nearly three million people it; just under half of them died, starving, or freezing to death…" (Salisbury 2003). But the city survived. The Radio House played a major role in raising the spirits of inhabitants. Olga Berggolts, Anna Ahmatova, and Vladimir Volzhenin read their poems; Ivan Lapshonkov sang arias from Rimsky-Korsakov's *Snow Maiden*; Aleksandr Yankevich, being gravely ill, read Makarenko's "Pedagogical Poem". On January 8, 1942, the radio fell silent across the city due to the loss of transmission power. People from city ends appeared at Radio House, appealing for restoration of radio broadcast (Salisbury 2003, 461).

Karl Eliasberg, director of the Radio Committee, made it possible to revive concerts. "The first concert given April 5, 1942, was not long. The artists were too weak for a full presentation. They played Glazunov's *Triumphal Overture*, excerpts from *Swan Lake* and concluded with the Overture to *Ruslan and Ludmila*." (Salisbury 2003, 512).

Leningrad was the native city for Dmitri Shostakovich, who worked on symphonic projects there. The premiere of Shostakovich's *Seventh, the Leningrad Symphony*, was given in 1942, expressing "its broad sweep of anger, agony and military panoply" (Salisbury 2003, 284).

In 1961, Yevgeny Yevtushenko, a young Siberian poet, wrote *Babii Yar* poem (Yevtushenko 1993), which denounced the Nazi mass murder of tens of thousands of Jews in Ukraine during WWII. This is one of five Yevtushenko's poems on which Dmitri Shostakovich based his *Thirteenth Symphony* (subtitled *Babii Yar*) that was premiered in 1962.

Fights Continued for Global Power and Natural Resources

Even after two destructive world wars, fights between "global powers" continued involving smaller nations in bloody conflicts:

- Korean War (1950-1953): U.S. forces deployed in Korea exceeded 300,000 in 1953; over 36,600 U.S. military were killed (Grimmett 2004).
- The Vietnam War (1955-1975) was a bloody conflict in Vietnam, Laos, and Cambodia. The United States had 543,000 military personnel in 1969 (Grimmett 2004). The war exacted an enormous human cost: about 3 million Vietnamese soldiers and civilians were killed; 310,000 Cambodians, 62,000 Laotians, and 58,220 U.S. service members died in the Vietnam War (2024).
- The Soviet-Afghan War (1979-1989) was a major conflict of the Cold War. The Democratic Republic of Afghanistan, the Soviet Union and allied paramilitary groups fought against the Afghan mujahideen and their allied fighters (including al-Qaeda) supported by Pakistan, the United States, the United Kingdom, China, Iran, and some Arab states. The war resulted in the deaths of approximately 3,000,000 Afghans, while millions more fled from the country as refugees (Soviet–Afghan War 2024).
- The Gulf War (1990–1991) was an armed conflict between Iraq and a 42-country coalition (950,000 soldiers) led by the United States, which began with the bombing campaign against Iraqi army and ended with the liberation of Kuwait (Englehart 1991). The military and civilian casualties were estimated as following (Daponte 1993; Salvage 2002, 2): the total number of Iraqi deaths was 206,000, including 120,000 military deaths, 35,000 civilian deaths in civil war, and 30,000 refugee deaths. Depleted uranium munitions were massively used on the battlefield (Depleted Uranium n.d.). The public relations campaign targeted public and Congressional support and included several fake news stories, like the "incubator testimony" (MacArthur 1992).
- The Bosnia War (1992–1995) resulted in the internal partition of Bosnia and Herzegovina (the former multi-ethnic part of Yugoslavia) and over 101,000 dead, mainly Bosniaks. (Bosnia War n.d.)
- The bombing of Serbia (1999). NATO launched its campaign without the UN's approval, stating that it was a humanitarian intervention (NATO bombing of Yugoslavia n.d.). 10,317 civilians were killed and 848,000 were expelled from Kosovo (Judah 2009). The NATO bombing damaged bridges, factories, hospitals, schools, cultural monuments, businesses, and military installations. About 10 tons of depleted uranium was dropped across Yugoslavia (Miljević, Marković, Todorović, et. al 2001).
- The Iraq War (2003–2011) began with the invasion of Iraq by the U.S.-led coalition that overthrew the Ba'athist government of Saddam Hussein. The conflict continued for the next decade as an insurgency emerged to oppose the coalition forces (Iraq War n.d.). The invasion occurred as a response on the September 11 attacks by Al-Qaeda terrorist groups in the United States. The United Nations resolution in support of the invasion was based on the false claims of the U.S. Government that "… Iraq had a weapons of mass destruction (WMD) program and that Saddam Hussein was supporting al-Qaeda" (Iraq War n.d.). However, in 2004, the 9/11 Commission concluded that there was no evidence of any relationship between Saddam's regime and al-Qaeda. No WMD stockpiles or active WMD program were ever found in Iraq (Iraq War n.d.). The PLOS Medicine Study (2011) estimated 460,000 excess deaths (Hagopian, Flaxman, Takaro, et al. 2013). The Pew Global Attitudes Survey Project (2006) reports that majorities in 14 countries "believed the world was safer before the Iraq War".
- The war in Afghanistan (2001–2021) was the direct response to the September 11 attacks and became the longest war in the U.S. military history. It began with an invasion of Afghanistan by an international military coalition led by the United States that declared the war on terror against al-Qaeda's leader Osama bin Laden. The coalition (51 countries) became gradually involved in the war

against the Taliban insurgency (War in Afghanistan n.d.). In total, 176,206 were killed during this war, including 46,319 civilians ("Human Cost of Post-9/11 Wars" 2023). The conflict ended (without any "glorification") with the 2021 Taliban offensive, which overthrew the Islamic Republic and re-established the Islamic Emirate (War in Afghanistan n.d.).

- The Syrian Civil War started in March 2011 when Syria's government, led by Pres. Bashar al-Assad, faced an unprecedented challenge to its authority in pro-democracy violent protests erupted throughout the country. The Syrian government extensively used police, military, and paramilitary forces to suppress demonstrations. By 2012, the conflict between government forces and opposition militias expanded into a civil war. Dramatic events in Syria and neighboring countries are reviewed in (Britannica 2024). Many countries gradually became involved in this war. In 2013, leaders of al-Qaeda declared that their forces would combat as the Islamic State in Iraq and Syria [ISIS]. The issues of chemical weaponry use, religious confrontations, freedoms, human dignity, civilian casualties, and massive migration were tried to being resolved by using extensive military forces by all conflict sites. Till March 2023, 268,816 were killed, including 138,947 civilians ("Human Cost of Post-9/11 Wars" 2023).
- The Russian-Ukrainian conflict was started in February 2022. The conflict roots were vaguely discussed by politicians and in multimedia. Some themes dominate the discussions: 1.) "Western" countries and their allies consider themselves as winners in the Cold War after the collapse of the USSR in 1991, and they are "dreaming" of the collapse of modern Russia, considering Ukraine as the best place for West–Russia confrontation; 2.) Strong historical, cultural, economic, and people-to-people relations between Russians and Ukrainians (from eastern and central parts) were compromised; 3.) Ukrainians strive to join the European Union; 4.) Westen-oriented Ukrainian politicians consider the country membership in the fast-expanding NATO as a factor of its national security (ignoring mutual security of some regional nations); 5.) The confrontation was flued by a nationalistic movement, Russophobia, and neo-Nazi organizations from Western Ukraine regions; 6.) Silence about some critical events ("Maidan" crisis in February 2014; overwhelmed public support in the 2014 referendum on the Crimea independence; the deadly arson of a protesters' camp in Odessa in May 2014, and bloody punitive operations against people in Donetsk and Lugansk regions since 2014). The violations of moral norms by military were documented, but not condemned by the international community, e.g., bombardments of the Zaporizhzhia Nuclear Power Plant; drone and artillery attacks on houses, hospitals, food markets, bridges, dikes, power plants, and energy supply infrastructure; and terroristic acts against politicians, journalists, and people with "different opinions". Prohibited cluster bombs (supplied to the Ukrainian army by NATO) used in attacks on civilian targets. Depleted uranium munitions are ready for use on the battlefield. Despite controversial propagandistic statements of politicians on deaths and wounded combatants, the casualties are counted in hundreds of thousands. Financial support of Ukrainian government in military operations and weaponry supply by the United States, NATO, European countries, and their allies is measured in hundreds of billions of dollars, in addition to unprecedented sanctions against Russian companies, financial institutions, and people. Millions of refugees migrated to European countries and other states. But, instead of peace-treaty negotiations, the conflict bloodiness, economic chaos, and the danger of a new world war and a nuclear disaster grows every day.

Pursuing the goal of strategical dominance, the Pentagon manage 5,000 U.S. military bases, including 600 bases overseas (Vine 2012).

All military conflicts were symbolized by images of humiliation and extreme violence. The photograph "The Terror of War" ("Napalm girl") (see Fig. 9) made by Nick Ut, an Associated Press correspondent in South Vietnam in 1972, inspired millions of people around the globe to protest the use of napalm bombs against civilians (Phan Thi Kim Phuc 2023). The image of Cpl. Graner and Spc. Sabrina Harman, who posed

for a picture behind nude Muslim detainees of Abu Ghraib prison in Iraq (reported by news channels in 2003) (see Fig. 10), caused world-wide protests against brutality and humiliation brought by military during the Iraq war (Abu Ghraib Torture and Prisoner Abuse 2023).

Figure 9: "The Terror of War" ("Napalm girl"). Nick Ut/AP/June 8, 1972, South Vietnam. *Source*: Phan Thi Kim Phuc. Wikipedia. https://en.wikipedia.org/wiki/Phan_Thi_Kim_Phuc

Figure 10: Cpl. Graner and Spc. Sabrina Harman pose for a picture behind nude detainees. Abu Ghraib prison, Iraq. 7 Nov. 2003. *Source*: Abu Ghraib torture and prisoner abuse. Wikipedia. https://en.wikipedia.org/wiki/Abu_Ghraib_torture_and_prisoner_abuse

Arms Sales – "Business as Usual"

Data collected by Stockholm International Peace Research Institute (SIPRI) revealed the arms sales of the top 100 arms-producing and military-service companies for $531 billion in 2020 (Marksteiner, Béraud-Sudreau, Tian et al. 2021). (For comparison, the total arms sales of these companies were about $300 billion in 2002). The 41 US companies accounted for 54% ($285 billion) of sales in 2020. In addition, the 26 European companies accounted for 21% ($109 billion), China – 13% ($66.8 billion), and Russia – 5% ($26.4 billion). (SIPRI Arms Industry Database 2021).

Preparing for a Suicidal Mission: Nuclear Wars

Since 1945, the terror-bombing of civilians became an accepted method of making war using atom bombs (Hall 2005, 736). The first atomic bomb (sarcastically named "Little Boy") was dropped on Hiroshima on August 6, 1945. 70,000 inhabitants were killed (see Fig. 11). The second atomic bomb was dropped on Nagasaki on August 9, 1945. The aerial photographs (see Fig. 12) show that the entire city was annihilated. (Atomic Bombings of Hiroshima and Nagasaki 2024)

a) Pyrocumulonimbus cloud over Hiroshima, Aug. 6, 1945

b) The Hiroshima Genbaku Dome after the bombing

c) 22-year-old victim being treated at the Hiroshima Red Cross Hospital.

Figure 11: Hiroshima after the atomic bombing (Aug. 6, 1945). *Source*: Wikipedia. https://en.wikipedia.org/wiki/Atomic_bombings_of_Hiroshima_and_Nagasaki

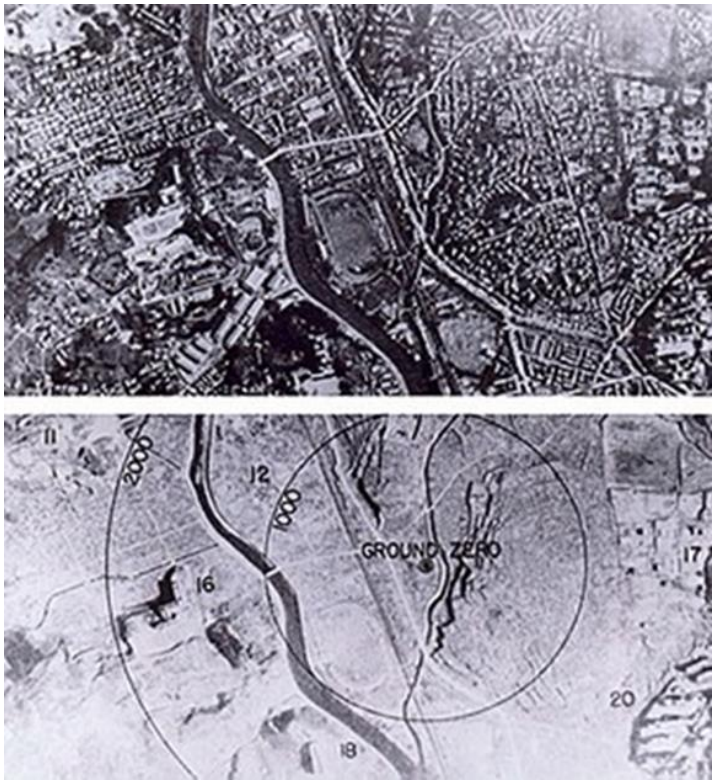


Figure 12: Nagasaki before and after the bombing (Aug. 9, 1945), after the fires had burned out. *Source*: Wikipedia. https://en.wikipedia.org/wiki/Atomic_bombings_of_Hiroshima_and_Nagasaki

The era of nuclear arms race began.

Nuclear States and Their Capacities

From 1945 to present, eight states have publicly announced successful tests of nuclear weapons (SIPRI Yearbook 2020). Five of them (the United States, Russia, the United Kingdom, France, and China) are considered to be nuclear-weapon states (NWS) under the terms of the 1970 Treaty on the Non-Proliferation of Nuclear Weapons (NPT). Other three states (India, Pakistan, and North Korea) possess nuclear weapons, but were not parties to the Treaty. According to (ACA Fact Sheets & Briefs 2023), Israel has nuclear weapons, but does not acknowledge it (List of states with nuclear weapons 2024). More than 3,740 nuclear warheads are currently deployed by these nine states. The data on their nuclear capacities is reviewed in (SIPRI Yearbook 2020; ACA Fact Sheets & Briefs 2023; Kristensen, Korda, Johns et al. 2023).

Threats of Using Nuclear Weapons and Attacks on Nuclear Plants

The world was polarized by creating two confronting military blocks, the North Atlantic Treaty Organization (NATO, created in 1949) of western states and the Warsaw Pact (1955) between countries ruled by socialist and communist governments. During the Cold War period (1945-1991), several plans of preventive nuclear attacks on Soviet military installations, large cities, and strategical infrastructures were considered (Nuclear History of the United States 2023). A list of targets entitled "Atomic Weapons Requirements Study for 1959" was produced by U.S. Strategic Air Command in 1956 and released in December 2015 by the U.S. National Archives and Records Administration. The list includes the number and targets in the USSR, Eastern Europe, and China. Scott Shane (2015) wrote in The New York Times: “It lists many targets for “systematic destruction” in major cities, including 179 in Moscow, 145 in Leningrad, and 91 in East Berlin.”

The military confrontation between the United States and the USSR reached the climax during the 1962 Cuban Missile Crisis. On October 22, 1962, President John F. Kennedy instituted a "quarantine" on the shipment of Soviet medium-range ballistic missiles to Cuba. He also warned that the launching of missiles from Cuba against nations in the Western Hemisphere would bring U.S. nuclear retaliation on the Soviet Union. The world was at the brink of nuclear disaster and its extinction. A negotiated settlement was achieved in a few days. (Grimmett 2004)

By the late 1960s, the number of intercontinental ballistic missiles and warheads was so high on both sides that both counties could destroy completely the infrastructure and a large proportion of the adversary population. According to a study by Xia, Robock, Scherrer et al. (2022), a full-scale nuclear war between the U.S. and Russia would kill 360 million people directly, with a further 5 billion people dying from starvation. More than 2 billion people would die from a smaller-scale nuclear war between India and Pakistan (Diaz-Maurin 2022; Cohen 2022). An outright winner would not be pronounced.

The era of tactical nuclear weaponry and proxy wars has begun (Nuclear Warfare 2024). Nuclear bunker buster bombs were designed to destroy hardened, underground military bunkers. The B61 bombs were used during the 2001 U.S. invasion of Afghanistan and the 2003 Coalition Forces invasion of Iraq. (Nuclear Banker Buster 2024)

In military conflicts, barbarian tactics were used, without any consideration for the environment (Young 2021). Normal functioning of the kidney, brain, liver, and heart can be affected by exposure to depleted uranium (DU) (Craft, Abu-Qare, Flaherty, et al. 2004). Nevertheless, the U.S. and NATO militaries used DU penetrator rounds in the Gulf War (1991), the Bosnia War (1992-1995), bombing of Serbia (1999), invasion of Iraq (2003), and airstrikes on ISIS in Syria in 2015 (Depleted Uranium n.d.). Around 1,000 to 2,000 tons of depleted uranium were used in the Second Gulf War in 2003 (Young 2021). In September 2023, the United States and the United Kingdom sent controversial depleted uranium munitions to Ukraine.

During the on-going Russian-Ukrainian conflict, the Zaporizhzhia Nuclear Power Plant (ZNPP), Europe's largest, has become the center of a nuclear safety crisis (2023). The sixth nuclear reactor of the Russian-controlled Zaporizhzhia NPP was recently damaged following drone attacks. After the breach of the Nova Kakhovka dam in June 2023, all ZNPP reactors were put into “cold shutdown” status. Another 1986 Chernobyl-style disaster was avoided.

5. In Search of Common Goals for The Humanity

Working Together on Global Mutual Projects

The Particle Physics Projects at CERN

New discoveries in nuclear physics (The Higgs Boson 2023) became the results of multinational collaboration of scholars and engineers at the European Organization for Nuclear Research (CERN) (2023). Their efforts accompanied with deep-space studies by the James Webb Space Telescope (2023) enriched our knowledge of the cosmic-scale processes (Timeline of the Far Future n.d.).

Figure 13: The Large Hadron Collider (LHC). (Image by Anna Pantelia/CERN). *Source*: The Large Hadron Collider, CERN. https://www.home.cern/science/accelerators/large-hadron-collider

CERN is an intergovernmental organization of 23 member states that operates the world largest particle physics laboratory, The Large Hadron Collider (LHC) (2023) (see Fig. 13). The LHC/CMS Experiment captured the event (recorded in 2012) that shows the decay of the SM Higgs boson to a pair of photons (The Higgs Boson 2023) confirming the existence of the Higgs field that fills the entire Universe and gives mass to all elementary particles. Peter Higgs and François Englert were awarded the 2013 Nobel Prize in Physics for their theoretical predictions.

The International Space Station (ISS) Mission

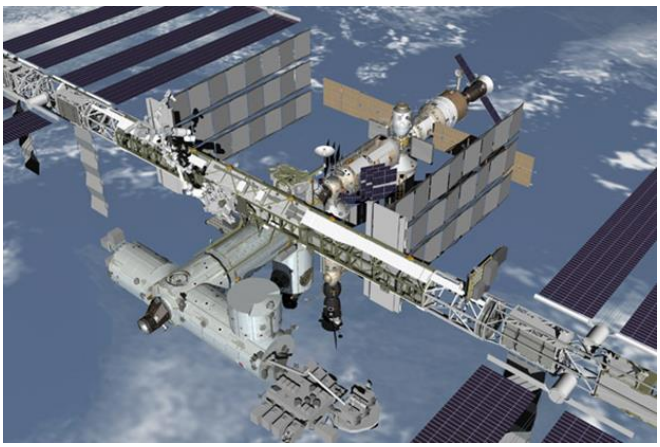


Figure 14: The International Space Station (ISS). *Source*: The International Space Station Mission. Boeing Corp. http://www.boeing.com/defense-space/space/spacestation/gallery/

The International Space Station project (see Fig. 14) involves 100,000 people in space agencies and at 500 facilities in the U.S. and 15 countries. Boeing's engineers wrote: "The International Space Station's role as a scientific laboratory and test bed for deep-space technology is crucial to humanity's ability to improve life on Earth while pursuing opportunities in space" (The International Space Station Mission 2024).

The Internet

The modern Internet is a vast collection of networks that provide common services to users (Maufer 1999). "It is an unusual system that it was not planned by anyone and is not controlled by anyone" (Tanenbaum 2003, 42). The "bumpy" history of the Internet is described in John Naughton's (2000) book.

The story began in the late 1950s. At the height of the Cold War, the U.S. Department of Defense wanted a command-and-control network that could survive nuclear strikes. In the 1960s, Paul Baran proposed an idea to use digital packet-switching technology, which was realized in the ARPANET project. Later, the TCP/IP model (Cerf and Kahn 1974) was invented to handle communication over internetworks. In the 1980s, the National Science Foundation funded 20 regional networks that allowed users at thousands of universities, research labs, libraries, and museums to access supercomputers, share data, and collaborate on research projects. (Tanenbaum 2003, 46)

During the 1990s, research networks were built in many countries. The new World Wide Web application invented by CERN physicist Timothy John Berners-Lee (2024) brought millions of nonacademic users to the Internet for exchanging images, video recordings, and accessing maps, library catalogs, webpages, and books.

Unfortunately, the Internet is vulnerable to hacker attacks that can harm individual users and infrastructures (Bidgoli 2006). In addition, modern smartphone applications and multimedium platforms have been inappropriately used in public-opinion manipulations, pirating private data, and spying on governments and people. Nowadays, these "methods" have become "elements" of proxy wars, fake news, and political confrontations.

6. Concluding Remarks: Mission for the Humanities

Challenges of cosmological and planetarian scales require paramount efforts of humankind in long perspective. Will this spirit of collaboration prevail, or shall we continue glorifying warfare and dominance of some "technologically advanced" nations in this fragile world? – Hopefully, the answer to this moral question will be found by the Humanities.

Since ancient times, scientists have collected data on various astronomical, geological, atmospheric phenomena, and natural and social catastrophes. This tradition is continued by research centers, including CERN, NASA, and national astrophysical laboratories and space agencies. Data on natural disasters is collected in the specialized databases (e.g., the Volcanic Fatalities Database) and analyzed by research institutions, including the Smithsonian's Global Volcanism Program (2023). This information is freely available to the public.

Unfortunately, only a few databases promote free access to scholarly publications (e.g., ResearchGate (2024), the ACM Digital Library (2024), and Academia.edu (2024)). Only a few organizations provide reliable information on weaponry, arms sales, and nuclear arsenals (SIPRI Yearbook 2020). Estimations of casualties in military conflicts can be found in books (Hall 2005), case study reports, and research papers, but the accent is mostly made on the statistic accuracy, rather than on destructions, post-war effects on environment and survivors' health, and degradation of moral principles.

Several unique research projects (The Higgs Boson (2023); The James Webb Space Telescope (2023); and The International Space Station Mission (2024)) were run by nations, demonstrating the power of technological collaboration in reaching the common goals for humankind. The Internet and multimedium electronic platforms become available to billions of people around the globe for communication and group activities (Tanenbaum 2003). Unfortunately, some smartphone applications and multimedium platforms are inappropriately used in public-opinion manipulations, private data retrievals, spying on people, forcing political confrontations, and becoming "elements" of proxy wars.

Many international organizations have contributed to preventing natural and humanitarian disasters and fighting pandemics, diseases, and hunger (e.g., The World Health Organization (n.d.) and Doctors Without Borders (n.d.)). Some other projects are worthy to note, e.g., the Svalbard Global Seed Vault (n.d.) facility that holds long-term and sustainable seed collections from around the world, and the U.N. Educational, Scientific and Cultural Organization (UNESCO n.d.) that plays a vital role in preserving cultural heritage of civilizations with the mission "to foster mutual understanding and respect for our planet, and … work to strengthen the intellectual and moral solidarity of humankind and bring out the best in our shared humanity" (UNESCO n.d., "Our Vision").

The author shared his own views on technological, social, and moral aspects of global challenges to humankind.

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