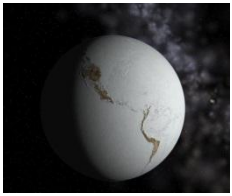
D.V.Mun, V.V.Popeta, O.S.Rusanova

PREVENTING MAN-MADE DISASTERS

Book 3
The Future: Risks, Threats, Challenges



vs

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М90

Cover picture on left: A hypothetical view of how Earth could look after the onset of a "nuclear winter". Source: 1) https://commons.wikimedia.org/wiki/File:Fictional_Snowball_Earth_1_Neethis.jpg; 2) https://www.hellodd.com/news/articleView.html?idxno=71577. Author: Neethis

Cover picture on right: Cover photograph of the book by Dmitry Mun and Vladislav Popeta, "The Logic of Man-Made Disasters: The past, the present, and the future." 2020, LAP Lambert Academic Publishing, Isbn: 978-620-2-66685-5 https://newatlas.com/rise-of-algae-snowball-earth-animal-evolution/50934/?itm_source=newatlas&itm_medium=article-body

Reviewer:
V.A.Tsvetkova, Dr. of Technical Sciences, Professor, Academician of the Russian Academy of Natural History, Chief Researcher of the Library for Natural Science of the Russian Academy of Sciences

D.V.Mun

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In the third book of the trilogy "Preventing Man-made Disasters," which by virtue of its importance and relevance is being published ahead of the second part of the cycle, "Managing Human Factor Risks," the authors analyze recent breakthroughs in scientific and technical progress and predict their impact on the economic, political, social and environmental aspects of human life. The book also contains a summary of the global risks, threats and challenges currently facing society as a whole and each and every human being, and suggests ways of overcoming the unfavorable circumstances now emerging.

For specialists and the general public.

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Dedicated to the memory of the victims of man-made disasters and rescue workers…

From the authors

The authors are sincerely grateful to Anna Dmitrievna Ermakova (Anna-Maria Petra), Valentina Alexeevna Tsvetkova, Roman Petrovich Lapin, Salavat Galimdzhanovich Mingaleev, Viktor Vladimirovich Vereschagin, Alexey Germanovich Dudarev, Alexander Sergeevich Kotosonov, Konstantin Nikolaevich Kostyuk and everyone else who has given their support and assistance during the writing of the Life Safety Library book cycle.

Fig.1 Screenshot from Charlie Chaplin film "The Gold Rush", 1925 r. Photo from open sources

> …There always has been, is and will be risk in the development of civilization. And we will have to get used to thinking about the need to live under its burden. But this means just one thing: mankind must learn to reduce this risk as far as possible.
>
> *N.N.Moiseev, Academician of the Russian Academy of Sciences*

Prolog: The world on the brink…

Esteemed readers of the "Preventing Man-made Disasters" cycle,

We have purposely decided to change the previously announced sequence of the books and publish Book 3, "The Future: Threats, Risks, Challenges," before Book 2, "Managing Human Factor Risks: Theory and Practice." We took this decision for one simple reason: the future has already arrived. It is evolving and happening not on some distant horizon, but right here and now. It is no longer merely knocking at the door – it is tearing our doors off their hinges and bursting into our daily lives.

In Book 2 of the cycle, which we plan to publish in 2023-2024, we continue our forensic analysis of high-profile accidents and disasters from human history and bring together a selection of practice cases, advice and recommendations on working with man-made risks, or human factor risks. Experience has shown that the dreaded "human factor" is not only capable of destruction but can also save, create and prevent both man-made and natural disasters.

But to begin with, a word of warning: risks which even yesterday looked like something from the distant future have already become an emphatic part of life today; and the threats posed by advanced technologies and discoveries made by human genius for the good of mankind could, if abused, lead mankind toward total annihilation. The reason is that breakthrough technologies are being deployed without a second thought for past experience and the elemental principles of common sense, which are focused primarily on safety rather than on getting rich quick.

Historical experience shows us that first, people make breakthrough discoveries and develop new technologies such as fire, the printing press, the automobile, nuclear chain reactions, nanotechnol-

ogies and so on, and only later do they create the means to ensure safety and protection against the side effects of those technologies.

Roughly 1 million years ago, our ancient ancestors started using fire in their daily lives. Having been of immeasurable benefit to mankind from time immemorial, fire when out of control has also caused enormous damage, burning down thousands of towns and killing millions of people.

And it was only a few centuries ago that people began forming professional fire crews (in Russia, the fire service is thought to have been founded on 30 April 1649), and only very recently, at the turn of the 20th century, that the first fire extinguishers were invented and made widely available.

Next, in the early 20th century, mankind invented the automobile and put it into mass production. In the competitive race for profit, manufacturers very quickly learned to "squeeze" sixty or more kilometers per hour from the engines, resulting in daredevil driving with inevitable accidents and millions of casualties. And only a few decades later, after numerous road accidents all over the world, did people finally invent the simple and effective three-point safety belt which now saves millions of human lives every day.

Fig.2 An automobile collides with a streetlamp, 1929, USA.
Photo: Leslie Jones

https://web.archive.org/web/20121111004240/http://www.vintag.es/2012/05/vintage-photos-of-car-crashes.html

For reference: From 1910 to 2019 the global automobile fleet grew from 2 million to 1 billion vehicles. On average, over 1.2 million people around the world die every year in road accidents and a further 20-50 million are injured.

In recent years, as civilization hurtles (at top speed) from the present day into an unknown, undefined and very hazy future, this headlong movement is often led not by people with risk-orientated thinking

concerned primarily about the safety of goods and technologies, but by people obsessed with making a quick buck who persuade us that "everything has been checked and is absolutely safe" while selling hastily concocted products that have not gone through the necessary testing procedures. This has been the case with a huge number of breakthrough discoveries: cocaine used to be sold in pharmacies as a cough medicine; lobotomies were considered an effective way of curing hyperactivity in children and headaches in women; radioactive candles were used to treat infertility; fantastically expensive nano creams and stem cell injections were touted as a universal means of rejuvenation…The list is endless.

Today, technologies such as artificial intelligence, gene and social engineering are already in free circulation – technologies so serious that if used by incompetent, greedy or psychologically damaged people could bring quick and irreversible destruction on the whole of mankind.

We, as the authors of this book, consider it our main purpose to issue a warning about the coming threats, risks and challenges.

Forewarned is forearmed. The future climatic, economic, political and social changes on our planet are irreversible and so huge that they will affect literally each and every one of us in the very near future. And to adapt as well as possible to these changes, each of us must begin right now making whatever contribution we can to preserving the fragile equilibrium in which our world still exists. For the sake of life on Earth…

Fig.3. A locomotive takes a wrong turn… Los Angeles, USA, 25.01.1948
http://www.rrpicturearchives.net/locopicture.aspx?id=84591

A message to readers from Salavat Galimdzhanovich Mingaleev, President of the Russian Union of Rescuers

Dear readers,

You are holding in your hands the latest book in the series "Preventing Man-made Disasters." As you will already have noticed, the authors have decided to change the sequence of publication by issuing Book 3, "The Future: Risks, Threats, Challenges," before Book 2, "Managing Human Factor Risks." I would like to stress that this (third) book is particularly topical right now, in today's world, as it not only explores the threats and risks arising from the human factor on the scale of entire countries but also seeks to warn us about future dangers.

At the same time, in this book the authors make the vital point that the dreaded "human factor" is the main cause of both man-made and natural disasters. People are dying, material assets are being destroyed, and damage is being done to the environment, but the punishment, conclusions and analyses of the causes of these disasters again and again fail to highlight those who are really to blame. In a number of cases, history unfortunately does not record their names. It is to therefor to the credit of the authors of this cycle that they have found the courage, so lacking in today's world, to describe events and facts for what they are. It is, after all, no secret that the level of human factor risks in Russia is much higher than in Western countries, primarily because of the high level of irresponsible behavior and negligence of managers on the ground.

The poor quality of information we use, the scientific inaccuracy of analyses, studies and forecasts, "fakes" and "deepfakes" pose the greatest danger to our country at this time, during the Special Military Operation to denazify and demilitarize Ukraine.

As the authors have repeatedly stated, attention to safety in Russia lags two or even three steps behind the development of technology. As a result, we are constantly playing catch-up but are always late. Yes, we are constantly learning, but for the moment at least, we are learning from our own mistakes rather than from other people's.

This book should be mandatory reading for government officials, as well as all patriots, rescue workers and the saviors of the country who are currently defending the Motherland with weapons in their hands.

S.G.Mingaleev
President of the Russian Union of Rescuers,
Merited Rescuer of the Russian Federation,
Full State Counsellor of the RF, 3rd Class

A message to readers from Viktor Vladimirovich Vereschagin, President of the Russian Risk Management Society

Dear readers,

You hold in your hands the latest book in the series "Preventing Man-made Disasters." It is about the risks, threats and challenges we face today and will face in the future. The financial and economic crisis in Russia and the world, which is unfolding as we watch, the exacerbation of the geopolitical situation against the backdrop of the Covid-19 pandemic, and the unprecedented sanctions adopted against Russia by the "collective West" have thrown up new questions and challenges to theory and practice in various areas of our lives, including risk management and the role of the human factor.

It is this "factor", or to be more precise, the behavior of each of us individually which will, to a large extent, determine whether we can preserve the Earth for future generations, prevent a man-made environmental disaster, and minimize the numerous associated risks. The authors, amongst them Dmitry Mun, an active member of the Russian Risk Management Society, provide an in-depth and detailed analysis of real events and emergencies that have occurred in our country and around the world, and invite governments, the public, and each of us individually to "pull ourselves together" and seek ways of addressing these problems quickly and responsibly.

I am confident that this book will help all of us to reflect once again on mankind's responsibility towards nature and the environment, to learn to effectively manage the numerous risks in this area, and to rethink our attitude towards what is going on in the world today. The book "The Future: Risks, Threats, Challenges" will without doubt be of significance and interest to a wide circle of readers, from private individuals to specialists in emergency situations and risk management, company executives and shareholders, public activists and the leaders of Russia's legislative and executive bodies.

Yours sincerely,

V.V.Vereschagin, Candidate of Historical Science,
President of the Russian Risk Management Society,
Chairman of Rosstandart TK 010

PART 1
From spam to fakes: unperceived risks of the fourth IT revolution

> The internet is fraught with great dangers and in this sense is no different from nuclear physics, electrodynamics or gene engineering.
>
> *Boris Strugatsky, fantasy writer*

In the beginning was the word…

Dear readers,

As you read these lines, you are probably holding a tablet or a smartphone in your hands. It is virtually impossible to imagine life today without these devices. Smartphones, PCs and tablets with their associated information transmission systems – how can one even leave home without them? And using this group of devices, without even leaving our homes, we can live, work, make a career, study, entertain ourselves, boost our social status, order food, get medical assistance delivered directly to our door, and so on…

Just over ten years ago, all of this was virtually impossible. All the benefits of informatization and digitalization, which until very recently seemed like far-off realities, have suddenly arrived here and now.

Our radically changing lifestyles and social behavior are the result of wholesale deployment of the achievements of the information revolution - the fourth such revolution in the history of human civilization. And few today recall what life was life before, what methods of creating, storing and transmitting information had been invented by mankind and were predominant before the start of the third Millenium. But in the past, in the very beginning, was the word…

Fig.4. Mammoth Hunt,
Detail from a painting in the hall of the State History Museum.
Artist: Viktor Mikhaylovich Vasentsov, 1883–1885
Open sources photograph

Fig.5. Mammoth. Cave drawing by unknown artist. Late Paleolithic, 12-11th centuries BC. Rouffignac cave, France
https://commons.wikimedia.org/wiki/File:Grotte_de_Rouff_mammut.jpg

To be more precise, our distant ancestors transmitted vitally important information using sounds. At first, these were just indistinct sounds which nevertheless contained elements of music: rhythm, timbre and even primitive melodies. This is how people used to share their emotions. Anthropological research has shown that the first hominins began to develop a vocal apparatus and, consequently, articulated speech approximately 2 million years ago. Those sounds gradually turned into words, as words are essential in order to formulate and transmit thoughts to others as precisely as possible. Words gradually turned into language and became speech. Language as a method of encoding and transmitting information was the evolutionary outcome of people's need for survival, interaction and collective adaptation to a constantly changing and hostile environment.

It is through speech that people have from time immemorial perceived and transformed the world around them, forming and transmitting knowledge and experience to the next generation. The great Russian scientist Igor Pavlov noted that the only distinctive feature of human thinking is vocal activity.

People began to preserve information and hand it down through the centuries and generations, initially in the form of pictures before replacing pictures with symbols. And it is from these artefacts – works of art by ancient people - that we can derive at least a distant understanding of how they existed.

It was much later, approximately in the 4th-5th centuries BC, that people invented pictographic writing (based on intuitively intelligible images), which then evolved into hieroglyphic, syllabic and finally alphabetic writing.

Fig.6 A "newspaper stone". Prehistoric petroglyphs, Utah, USA. Author: Jim from Calgary, Canada

https://commons.wikimedia.org/wiki/File:Newspaper_Rock_closeup.jpg

Fig. 7. Cuneiform writing – one of the known systems of pictographic writing, 3,500 BC. Author: José-Manuel Benito 2006

https://commons.wikimedia.org/wiki/File:Tableta_con_trillo.png

The first information revolution

Writing, as the ability to accumulate data on external media, was a genuine breakthrough for human civilization. Researchers refer to the emergence of the most primitive writing as the start of the first information revolution. Whereas previously, verbal lore had been preserved only in the human memory and passed on through the millennia from person to person, often disappearing upon the death of its carrier or becoming seriously distorted, from this time onwards the recording of knowledge was stabilized and became independent of the producer of the knowledge. Thus, wisdom gained through life experience and "costly mistakes" began to accumulate in special places (libraries) amongst special people who occupied a vital place in the social hierarchy, becoming priests, elders, vizirs, librarians, counsellors, philosophers, mentors, theologians etc. The first books began to appear and played a vital role in man's cultural upbringing and ancestral memory.

Fig.8 A clay tablet describing the story of the global flood, library of King Ashurbanipal, Assyria, 7th century BC. Source/Photographer Fæ. 2010 год, British Museum

https://ru.wikipedia.org/wiki/Библиотека_Ашшурбанипала#/media/Файл:Library_of_Ashurbani-pal_The_Flood_Tablet.jpg

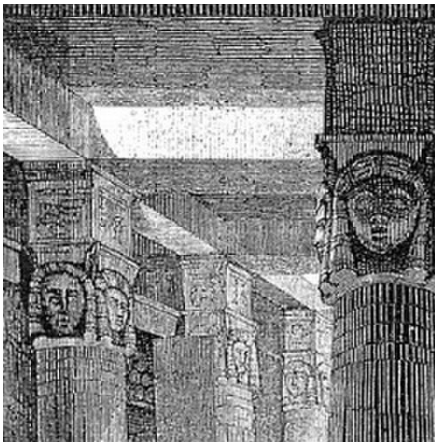

Fig.9 The lost library of Alexandria was the biggest collection of knowledge in the ancient world. Engraving by O. von Corven, 19th century. From open sources

https://ru.wikipedia.org/wiki/Александрийская_библиотека#/media/Файл:Ancient-libraryalex.jpg

The second information revolution

It was only in the 15th century, following the invention of book printing, that the second information revolution began. You may wonder why that invention by Johann Gutenberg is regarded as a revolution. After all, books existed before Gutenberg, on clay boards, in the form of papyrus, parchment documents, records on turtle shells and the shoulder bones of cattle, items made of birch bark etc. However, the subsequent spread of information from the "selected few" to the masses destroyed the monopoly of knowledge held by the narrow circle of "scientists" that had existed for millennia. And this revolution radically changed society by creating additional opportunities for broad swathes of the population to simultaneously experience cultural objects.

It should be noted that each breakthrough technology came with its own major downsides. And the first of these downsides was the expansion of access to information to society at large thanks to the printing of books. For example, the most popular book after the Bible amongst the medieval public was a tract entitled "Hammer of Witch-

es." In civilized and tolerant Germany alone, "Hammer of Witches" was reprinted 15 times!

The repercussions of this period of European history have been repeatedly studied and the findings are widely accessible to researchers. Having invented book printing, Europe immersed itself for a century and a half in a process which future generations would call "witch hunting": obscurantism, misogyny, and the persecution of scientists, the educated, dissidents, undesirables, ideological and political opponents. There is no need to remind anyone today that in those "dark times" Christian Europe, at the mercy of the "tyranny of the Inquisition," significantly slowed its own socio-economic development and almost succumbed to the onslaught of the Ottoman Empire, having lost more than half of its territory by the end of the 6th century.

Fig.10 The Gutenberg printing press, 15th century, Author: Gruszecki, 2010 r.

https://commons.wikimedia.org/wiki/File:Printing_machine_of_Johanes_Gutenbrg1.jpg

Fig.11 Cover of the seventh edition of the book (Cologne, 1520), kept in Sydney University, and an illustration from it. Photograph for open sources.

https://commons.wikimedia.org/wiki/File:Malleus_maleficarum,_Köln_1520,_Titelseite.jpg

The third information revolution

Today we are able to draw conclusions about how society is impacted by the spread of negative information. Europe succeeded in overcoming the downsides of the second information revolution and, together with the rest of the world, rapidly moved on to the third information revolution (in the late 19th and early 20th centuries). This information breakthrough was based on scientific discoveries leading to the invention of radio, telegraph, telephone and television. Henceforth, information could be received by millions of potential consumers almost immediately after its production. This was the beginning of the era of the mass media – vertical media capable of accumulating and transmitting in previously unheard-of quantities not only textual but also audio and, eventually, audiovisual information to enormous audiences of people at great distances both from one another and from the source of the information.

Fig.12 Morse telegraph, 1854.
Photographer: Georg Pik
https://commons.wikimedia.org/wiki/File:Vladimir_Zworykin_and_historic_TV_tubes.jpg

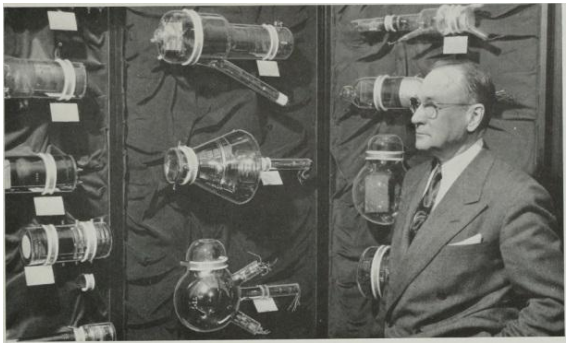

Fig.13 Television pioneer V.K.Zvorykin and some of the historical transmitting television tubes that he developed, USA. 1954 r. Photographer unknown.
https://commons.wikimedia.org/wiki/File:Kotlasskiy_kraevedcheskiy_musey_(031).JPG

The fourth information revolution

The fourth information revolution, traditionally referred to as the information technology (IT) revolution - IT being the totality of tech-

nical means for electronic information processing and communication – began with personal computers and telephone cables, evolved from the early 1970s into modern smartphones and the World Wide Web, or internet, and continues to this day.

Fig.14 Evolution of the mobile phone from the 1980s to the iPhone 14 in 2022

https://commons.wikimedia.org/wiki/File:Telecar-cd.jpg

https://commons.wikimedia.org/wiki/File:Cellular_phones_National_Museum_of_Scotland_15.JPG

https://commons.wikimedia.org/wiki/File:IPhone_14_-_2.jpg

Briefly reviewing its key achievements, one could say that the fourth information revolution is a great victory for progress. After all, for the first time in the history of mankind, a technological basis has been created not only for providing individuals with instant and unimpeded access to all the knowledge accumulated by man, and not only for overcoming any distance and minimizing information transmission times, but also – pay attention here! – for the first time ever, any inhabitant of the planet with the appropriate gadget and access to the World Wide Web now has the opportunity to be heard. Whereas in the past, people were merely passive consumers of information supplied by the vertical mass media with virtually no feedback, nowadays each and every individual has the ability both to consume information and to store, generate, create and transmit it to their fellow beings.

Internet technologies have become firmly and universally established in our daily lives. And they have rapidly and easily displaced earlier technologies from their key role in human civilization. For comparison, it took 38 years from its invention before 50 million people were using radio, 13 years for television and just 4 years for the internet…When the internet was born in 1969, there were no more than 300,000 computers in the whole world, but at the beginning of the 2000s there were already over 100 million, and by the middle of 2015 there were 3.3 billion internet users - a number which has continued to grow ever since.

Let us now take a look at how most people use the truly unlimited information capabilities they have at their fingertips. This is where we begin analyzing and assessing the negative side effects which inevitably accompany any breakthrough technology.

Information explosion

The first thing that happened after users began connecting en masse to the World Wide Web was a multi-fold growth in information volumes, which became known as the "information explosion" – a term that was introduced into everyday conversation by the Soviet and Russian scientist A.D.Ursul. Already back in those, what seem to us now, very distant years there was exponential growth in the volume of information on paper media, especially scientific publications. But the real "information explosion" came in 2021 with the appearance in people's daily lives of smartphones and communication devices combining a miniature personal computer with a mobile telephone.

The evidence is clear. In the 300,000 years prior to 2002, mankind had produced and accumulated on all types of external media a total of $18 \cdot 10^{18}$ bytes (18 Exabytes) of information. When the fourth information revolution came along, the same volume of information was being produced in just TWO years.[1] In other words, with the help of smartphones, mankind has, in effect, produced as much data in two years as had been accumulated in the whole of human history theretofore…

[1] Lyman P., Varian H. R. How much information? Release of the University of California. Oct. 27, 2003

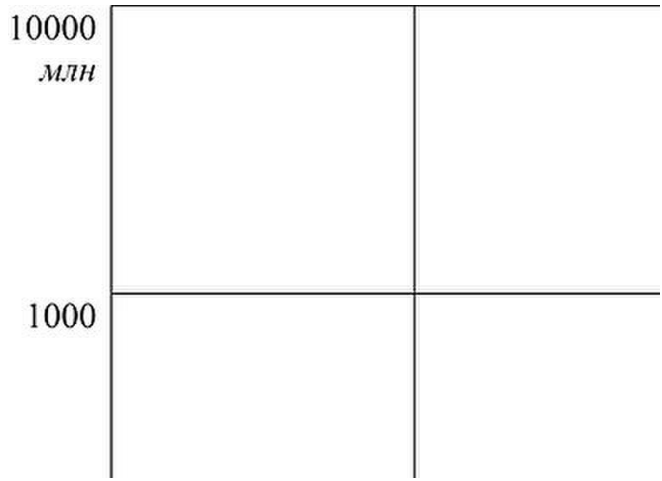

Fig.15 Distribution within the H. sapiens population of new, distinctive functional-behavioral features in the form of useful intellectual skills of interaction: *a* — Earth's population 7 billion; *b* — literacy; *c* — reading-printing — accessibility to all literate persons; *d* — receipt of radio and television information (number of receivers); *e* — information communication via telephone, computer, internet (number of telephones, computers, internet users). Author: A.L.Eremin, 2005 г.
https://commons.wikimedia.org/wiki/File:Fig_3a.jpg

Since then, i.e. since 2003, statistics show that the volume of digital information has doubled every 18 months. In a study carried out in 2010, DELL EMC predicted that in exactly ten years' time - in 2020 - the "digital universe" would grow to 40 Zettabytes (10×21), in other words, by 50 times compared to 2010. If you imagine that there are 700,500,000,000,000,000,000 grains of sand on all the beaches on Earth, the volume of information in 40 Zettabytes is 57 times larger than all that sand. And according to DELL EMC's latest prediction, the volume of information created in the internet will reach 175 Zettabytes[2] by 2050.

[2] https://www.forbes.com/sites/tomcoughlin/2018/11/27/175-zettabytes-by-2025/#b5fe21054597

Fig.16 Prediction of growth in the volume of global data by year

Source: https://ex.ru/?blog_post=%D0%BE-%D0%BA%D0%BE%D0%BD%D1%82%D0%B5%D0%BA%D1%81%D1%82%D0%B5-%D1%86%D0%B8%D1%84%D1%80%D0%BE%D0%B2%D0%B8%D0%B7%D0%B0%D1%86%D0%B8%D0%B8

How does mankind manage to generate such a huge quantity of information? In fact, it's all very simple. First, electronic-digital means of creation, storage and transmission of information allow users to easily, quickly and with no great effort copy, multiply and retransmit incoming data. Second, the gadgets required for someone to take part in the constant expansion of the "digital universe" have now become cheap and universally available. Third, unlimited growth in digital data is enabled by the availability to any ordinary mobile phone and internet user of channels of incoming and outgoing information (the telephone itself, email, messengers), systems for instantaneous targeted exchanges of messages, social media, video hosting sites etc. etc.

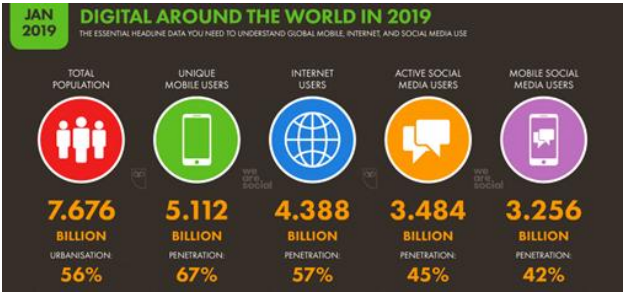

Fig.17 Number of IT users in the world in 2019

Source: *https://datareportal.com/reports/digital-2019-global-digital-overview*

Today, virtually anyone with a smartphone, internet access and social media accounts who knows how to use them is capable not only of consuming but also of generating, amending, creating and disseminating information in unlimited quantities. And ordinary internet users have lost no time in taking advantage of this opportunity. The digital information universe has been engulfed by an unstoppable tsunami of videos, photos, selfies, posts, blogs, reports and other types of information from individual internet users. In addition, 51% of all traffic is generated by bots created by people rather than by real individuals and websites.

Today's IT revolution can be summed up by the following statistics: as at January 2019, there were 5.1 billion mobile phones, 4.3 billion internet users and 3.2 billion active social media users out of the 7.6 billion people alive. And all of these numbers continue to grow exponentially.

Spam / information noise

Information noise, or spam, is the biggest impediment to human intellectual activity today. The uncontrolled spread of inaccurate and unverifiable information (including fake news, which we will examine in detail in later chapters) is beginning to undermine the very foundations of society: mutual trust, trust in government institutions, reputation and authority, presumption of innocence etc.

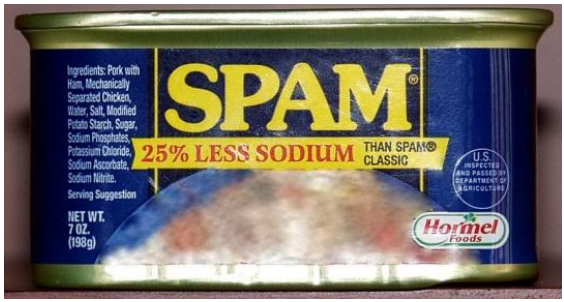

Fig.18 Canned meat under the SPAM brand
Photographs by Judgefloro, Bodo Akdeniz (cypher)

https://commons.wikimedia.org/wiki/File:9016Foods_of_Bulacan_07.jpg

https://commons.wiki-media.org/wiki/File:Spam_2.jpg

Take, for example, ads circulated by email, known colloquially as SPAM. SPAM is the trademark of a tinned meat, consisting mainly of sausage mince, which was registered in the USA in 1936 by the Hormel

Foods Corporation. The word is an acronym of Shoulder of Pork and Ham.[3] During World War 2, due to the severe shortage of food in the United Kingdon, top-quality meat was sold in extremely limited amounts for ration coupons, while American tinned meat under the SPAM brand was relatively cheap and on unrestricted sale as a meat substitute.

The term "spam" came into use when, in the mid-1980s, a persistent fraudster began distributing numerous identical and repeated messages with instructions on how to get rich quick (clearly a kind of financial pyramid) in Usenet – one of the first public computer networks. Other network users became so tired of the fraudster's mailshots that they started comparing him with Spam, the tinned meat substitute which was similarly widely and persistently advertised by its producer.[4]

According to the experts, spam alone currently accounts for 70-90% of all electronically transmitted messages worldwide. Way back in 2007, the New York Times blog claimed that the US economy was losing $650 million every day due to email. And research by psychologists shows that people spend an average of 25 minutes surveying the contents of their inbox before starting work each morning. Indeed, when do people even have time to work? Cognitive-sensory overload is the standard cause of disorientation and lack of user feedback. At that time, a "mere" 30 billion messages were being sent worldwide every day, but by 2010 the number had reached almost 300 billion. In 2019, internet users were sending 281 billion electronic messages every single day…

Add to this spam advertising campaigns in social media and messengers of all kinds, as well as pop-up windows on websites…

Given the near-term growth predictions for the digital information universe, all the efforts by government agencies in many countries of the world to control or, preferably, manage this process, involving considerable investment in creating "real protection" software and technologies against, for example, unlimited spam or fake news would appear to be inadequate, to say the least.

[3] Source: https://commons.wikimedia.org/wiki/Category:Spam_(food)

[4] Source: https://ru.wikipedia.org/wiki/%D0%A1%D0%BF%D0%B0%D0%BC

Information / cognitive overload

> …The best times in the development of the internet are in the past. The net no longer gives people a feeling of freedom and is more and more controlled by the IT giants.
>
> *Tim Berners-Lee*[5]

Thus, the risks and side effects of the wholesale digitalization of mankind have not been slow to manifest themselves. Each of them has now become an extremely acute problem that deserves an article of its own, but we shall limit ourselves here to a brief list. We start our review of the side effects of the IT revolution with what is, in essence, the biggest of them all - information (cognitive) overload.

Information overload is a serious challenge not only for the individual human psyche, but also for the global economy. First, there is the urgent problem of information quality, with up to 95% of information flows consisting of chaotic and unstructured data. Furthermore, according to DELL EMC, only around 0.5% of the total flow of continuously generated information is actually subjected to any kind of analysis, verification or systematization.[6] This trend is also taking its toll on fundamental science.

"Instant devices" and the abundance of information to which people are exposed via email and other technological sources can impact thinking processes, impede profound thought and understanding, slow down the formation of memories, and complicate the learning process. This state of "cognitive overload" reduces people's ability to retain information and prevents them from combining memories and experiences stored in their long-term memory, leaving thoughts "thin and dispersed,"", according to former Google CEO Eric Schmit. Jokingly, he also added, "I'm trying to blame the internet for all human actions," noting that "you can't make jokes any more in the Twitter era."[7]

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[5] Source: https://hightech.plus/2018/11/02/tim-berners-li-ya-razocharovalsya-v-internete

[6] https://www.emc.com/about/news/press/2012/20121211-01.htm

[7] Source: https://medium.com/conversations-with-tyler/eric-schmidt-tyler-cowen-google-ec33aa3e6dae

"Scientific" inaccuracy of information

> The progress of science is in inverse proportion to the number of journals.
>
> *Cyril Northcote Parkinson*

Today, at a time of global informatization, fundamental science is in profound crisis. First, because it is no longer a lifelong calling but a business with all the accompanying attributes: pay, sell, buy, sell yourself. Too much in science today demands payment: you have to pay for access to information and for its publication. This gives rise to ethically false measures of success – various indices, such as money and recognition criteria, that have been turned into a profitable business.

It was observed long ago that if sustained support for research centers is reduced and gradually replaced by predominantly competitive project funding, a problem will arise with the success of applications and, as a result, their quality. Consequently, professors the world over spend over half of their working hours writing grant applications and giving presentations to potential sponsors, leaving no time to do the research. The biggest losers from this state of affairs in the academic sector are young researchers and their ideas.

This is giving rise to a crisis of reproducibility of scientific and technical information – a consequence of the race for grants amongst researchers and for windfall profits amongst publishers. As a result, around $200 billion, or over 85% of global spending on fundamental scientific research, is regularly "squandered" on poorly planned and pointless research. In the last 10 years, the average success level of funded applications has halved.

Fig.19 Researchers in pursuit of sensation. Source: BMJ/Nature
http://academcity.icgbio.ru/node/3436

Fig.20 Competition between research institutes for funding is in inverse proportion to the quality of research.
Source: NIH.gov.[8] Authors: Julia Belluz, Brad Plumber and Brian Resnick

[8] https://academcity.org/content/sem-glavnyh-problem-sovremennoy-nauki-po-versii-samih-uchenyh

Science in pursuit of sensation

> A career in science, as I learned over time, is just as steeped in politics, competition and cruelty as others, it is full of temptation to take the easy path.
>
> *Paul Kalanithi,*
> *neurosurgeon and writer (1977–2015)*

The global race for the Hirsch index[9] and other science indicators is forcing researchers to resort to statistical manipulation and tricks. The value of scientific publications is declining and is no longer consistent with the principles of logical justification, provability and reproducibility of results. More and more, the main indicator of success of a scientific article is "pseudo success" and "pseudo sensationalism." Research in which scientists reach accurate but negative results are no longer of interest to anybody.

[9] The h-index or Hirsch index is an international measurement of the productivity of a scholar, based on a calculation of the number of cited publications by the author (or team of scholars). It was proposed in 2005 by the Argentine-American physicist Jorge Hirsch of the University of California San Diego.

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Fig.21 Cartoon showing a media magnate spreading "newspaper hoaxes" – the original fake news.
Artist: Frederick Burr Opper, 1894 r.
https://commons.wikimedia.org/wiki/File:The_fin_de_siècle_newspaper_proprietor.jpg

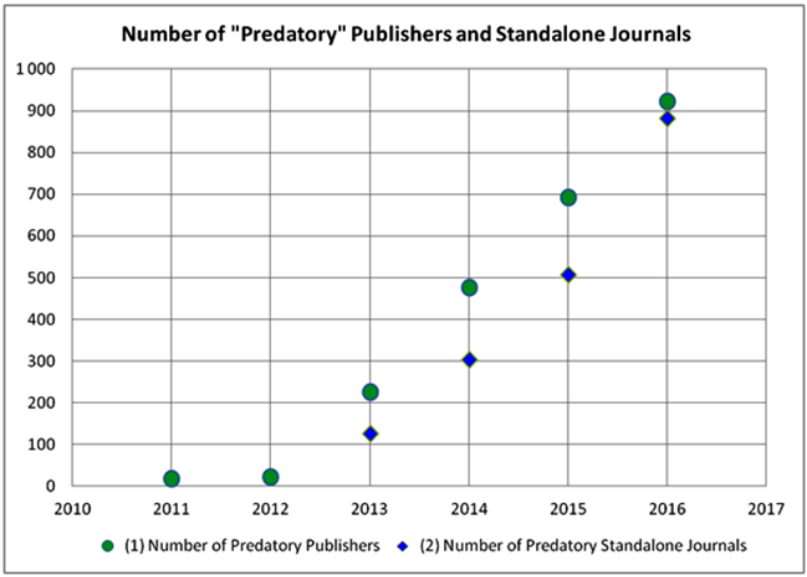

Fig.22 Predatory publishers. Author: Jeffrey Beal
Source: Jeffrey Beal's scholarlyoa.com

Consequently, the **number of "predatory" scientific publishers receiving money from anyone seeking to portray themselves as a "researcher" and a "scholar" to publish unverified and inaccurate information in their "academic" journals has increased by 1,000 times in the last 10 years.**

Modern international scientific data bases are already more than half full of pseudo-scientific information that has been duplicated many times over, including scientific articles created by computer software and self-learning neural networks – the basis of AI technology. And the largest body of inaccurate information today is in medicine.

At least 30% of the most influential and up-to-date research work in the field of medicine today turns out to be erroneous or exaggerated in its significance. Only a small part of the research published in key psychology journals can be reproduced. Thus, a 2015 study of 83 frequently cited papers announcing the discovery of effective

methods of psychiatric treatment found that only 16 of them could be successfully reproduced. In other scientific spheres, almost half*(40%) of all heavily-cited papers have never been subjected to any kind of review at all.

Back in 2015, the editor-in-chief of the reputable international journal The Lancet stated that over 50% of published peer-reviewed scientific studies in medicine are fake.[10] And earlier this year, Horton wrote the following in his column: **"Besides the COVID-19 pandemic, mankind is threatened by a mass breakdown of trust. People have never had much faith in politicians, but more alarming is the fact that the public, officials, civil servants and politicians are ceasing to trust science and its representatives, scientists. Disbelief in science is a real threat."**

Dependence on information / gadgets

The global trend towards dependence on computers and gadgets is taking on every more threatening forms. Researchers at Time Inc (USA) have divided users into two groups: Digital Natives – people who have been using mobile technologies since childhood; and Digital Immigrants – people who became familiar with mobile technologies as adults. Users were studied for 300 hours, during which both Digital Natives and Digital Immigrants wore biometric devices to measure their emotional engagement in the course of an ordinary day. They also wore glasses with inbuilt cameras to monitor which device or platform they were using and how often they switched their visual attention.

The study reached the following conclusions: Digital Natives switch their attention between different media platforms (television, magazines, tablets, smartphones etc.) 27 times per hour, or almost once every two minutes. Digital Natives spend more time using different media platforms simultaneously and their emotional interest in the content is unnatural. They experience few emotional ups and downs and often use media to regulate their mood – as soon as they get tired or bored, they switch their attention to something else. More than half (54%) of Digital Natives say they prefer to communicate by SMS rather than speaking with someone, compared to just 28% of Digital Immigrants.

Amongst Digital Natives there is absolutely no difference between the real world and the virtual world. On the contrary, for them

[10] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736-(20)32064-X/fulltext?rss=yes

the virtual world is more understandable. They know their way around it better and prosper in it more easily. Consequently, for them the world of likes, hype and frags is more important than the environment in which their "physical shell" exists. On YouTube there is a viral video showing a toddler leafing through a glossy magazine, poking its fingers at pictures and letters and saying "It's not working. Is this iPad broken?"

Рис. 23. Toddler and gadget. Unknown photographer. Photograph from open sources

https://www.mobilarem.ru/gadzhetyi/kak-zablokirovat-ekran-ipad/

But the physical shell we have inherited as a result of millions of years of continuous evolution, obeying the laws of nature which, try as it might, the virtual world is unable to abolish, reacts in its own way to constant immersion in the information environment.

All over the world, doctors and psychologists are identifying more and more side effects of the fourth IT revolution. It has already been scientifically proven that an obsession with gadgets reduces a person's ability to concentrate on any given text for thirty seconds, while the ability to write texts has shrunk to 140 symbols (one tweet). The most widespread medical conditions today are: internet dependency, online game mania, cyber disease ("digital seasickness"), nomophobia (fear of being without a mobile phone), the phantom call syndrome, Facebook depression, and cyberchondria (online hypochondria), as well as poor eyesight and hearing, degradation of the musculoskeletal system and…the early stages of Alzheimer's disease. This last condition is directly related to the so-called "Google effect."

The Google effect, or digital amnesia, is a physiological reaction of the body to a person's unwillingness to memorize anything because "Google is always to hand." Overall, according to a sensational scientific study by Nicholas Carr entitled "Is Google Making Us Stupid?"[11] people today, despite being in a continuous multichannel information flow, have poorer basic mental abilities, such as the ability to memorize and concentrate. Together with a reluctance to learn, the Google effect causes a weakening of cognitive functions and early-onset sclerosis. A 2018 study by American researchers found that around 40% of US adolescents up to the age of 25 suffer from this. Nowadays, our reading habits are determined not by us, but by our internet search engines. Game, set and match to Google?

An international study in 2020 revealed that the average inhabitant of Earth spends almost 7 hours every day, or 100 days per year, online…[12]

Intellectual degradation

> I'm prepared to tell you that Americans are getting fatter and dumber … school grades get worse every year…38% of fourth graders cannot read at basic level.
>
> *Senator Michael Grevel,*
> *US presidential candidate, 2007*[13]

To be fair, it is worth noting that not only Americans are becoming stupid. We are all suffering from intellectual degradation. Thus, in 2012, experts discovered, to their surprise, that the global average IQ level had fallen for the first time in 10 years. And it has not increased since.

Not long ago, American schools announced that children would no longer be taught to write in longhand. The reasons were

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[11] Is Google Making Us Stupid? What the Internet is doing to our brains By Nicholas Carr. ISBN 978-0-393-07222-8 https://www.theatlantic.com/magazine/archive/2008/07/is-google-making-us-stupid/306868/

[12] Findings of a study by the company We Are Social, which published a report on worldwide internet consumption. https://wearesocial.com/blog/2020/01/digital-2020-3-8-billion-people-use-social-media

[13] https://www.mk.ru/old/article/2007/09/14/81504-kandidat-v-prezidentyi-ssha-maykl-grevel-amerikantsyi-stali-zhirnee-i-tupee.html

clear: why write in longhand if in the future you will only be using a tablet, telephone or computer? The ability to draw and print block letters is perfectly adequate for filing out questionnaires or forms.

The anticipated consequences of these educational reforms horrify psychologists. For example, Academician Vladimir Zinchenko maintains that as writing is connected with the development of fine motor skills, the worse somebody writes the worse they will speak. The hand is, after all, the tool of tools, the thing that has enabled us to survive as a species and made us human beings. And it is the hand that teaches the head. Consequently, no hands – no speech, and if there is no speech there is no brain and no figurative or associative thinking. In America, as a logical consequence of this, they have already stopped hiring car mechanics below the age of 30 because young people don't know how to do anything with their hands.

The rapid development of information communications and the virtual community have a direct bearing on the decline and crisis in traditional social institutions which have formed the foundations of statehood and human civilization from time immemorial. One should note, in particular, that the internet is not just supplementing the traditional media but actively displacing it: people who get hooked on YouTube no longer watch TV.

Alvin Toffler, author of the bestseller "The Third Wave," claims that the key cause of social degradation is that different generations have different information pictures of the world. For example, people between the ages of 45 and 70, or even older, believe that there is a "society as such" and, separately from it, a "virtual society." But young people in the 15-35 age group no longer see any substantial difference between "society" and "virtual society" because they perceive the internet as the environment in which society actually lives: social contacts are made in the internet, reputations and status and achieved and lost, friends are found and enemies appear. And in one way or another, real-life relationships are transferred into the World Wide Web. Young people today believe that if you are not on the internet, you might as well not exist...

"How will a brain that is engulfed in communication, interactivity, personalization, virtual feelings and instantaneous gratifications from birth be able to think in the future? How will we think if we are never truly alone with ourselves because we are constantly in communication – either with one another or with an endless mudflow of information? How will we think if we first have to find out what everyone else in the world thinks about something," asks futurologist Richard Watson.

It is predicted that by 2025 the key gadget for 90% of people on our planet will be the smartphone. Meanwhile, **even back in 2020,**

the average concentration span of gadget users had fallen to less than two minutes…

Back to the future, or what will we leave our descendants?

As we noted above, before inventing writing people expressed their thoughts using symbols and images. We can see the heritage of those eras in the form of pictograms left on stones. Today's young generation, which has grown up on gadgets, also uses a simple language of ideograms, smileys and pictograms in online messages and web pages. This graphical language, in which combinations of pictures are used in place of words, first appeared in Japan in 1998 and has now gone global not only amongst the young, but across all age groups of users of the achievements of the fourth IT revolution.

Starting from Windows 8.1 and Mac OS X 10.7, the two most widespread operating systems, color emojis have been supported for user communications. They are also used in many popular instant messaging apps, such as WhatsApp, Telegram, Hangouts, Discord, Skype and VKontakte. And in Japan there is already a special emoji keyboard… Does this mean that civilization is turning back towards the past?

Fig.24 Who are you, mask? 2021 r. Screenshot of a selection of smartphone emojis, 2021. Author: Juliescribbles

https://commons.wikimedia.org/wiki/File:Man_holding_a_laughing_emoji_mask.jpg

https://commons.wikimedia.org/wiki/File:Woman_laughing.jpg

On the one hand, widespread use of emojis enables people communicating via primitive symbols to simplify the selection of information to be transmitted and to increase the speed of communication, thereby overcoming language barriers…But by taking the simple route of using an emoji keyboard, will we soon give up verbal expression of our thoughts altogether? In the beginning, as we recall, was the word. What awaits us tomorrow? And will it be the end of civilization? Will communication using primitive images take us back

to the stone age? After all, as one well-known politician said, the stone age didn't come to an end because we ran out of stones…

What kind of memory and knowledge will we leave to our descendants? Will it be as ingenious (given the tools available to primitive people at that time), expressive and touching as, for example, the wall of hands monument, a message to us from prehistorical people? Time will tell…

Fig. 25 Cave of hands. Cueva de las Manos. Argentina.
The images are between 8,500 and 13,000 years old.
Author: Pablo Gimenez from Buenos Aires, Argentina. 2012
https://commons.wikimedia.org/wiki/File:Cueva_de_las_Manos_(6811931046).jpg

Decline in online communication culture

> …The internet has turned into a platform for crazy people…There have always been crazy people, but never before have they had such opportunities to freely express themselves and be heard.

Eric Schmidt,
head of Google's board of directors[14]

Another topic we need to consider is human behavioral culture in the World Wide Web. All of us have repeatedly encountered hatred online from haters, trolls, bullies and other negative individuals hiding behind their anonymity to fill the internet with persecution, harassment, insults, threats, defamation etc. Instead of performing its original mission as a tool of global creativity, social media is turning into a platform for endless scandals and senseless information battles.

Psychologists explain this phenomenon as follows. People originally survived collectively and developed as social beings and live, face-to-face communication was the main means of building relationships. In live communication, facial expressions, gestures, tone of voice, body language and other attributes - everything defined as nonverbal communication - are of key importance. In the case of internet communication, people interact via written words alone, plus a few gifs, stickers, emojis, smileys and so on. Clearly, this type of "remote" communication is highly limited compared to "live" communication, and the absence of traditional nonverbal signals in online communication results in a shortage of nonverbal feedback and the gradual loss of the vital human emotion of empathy. Empathy (Greek ἐν — «в» + Greek πάθος — "passion," "suffering," "feeling", "sympathy") is an essential quality from which compassion is born. These are exceptionally important qualities for holders of high office and professionals involved in communicating with people, such as managers, doctors, officials, teachers, trainers, carers, salespeople, psychologists, etc. The list is endless.

It has been scientifically established that if somebody experiences a shortage of visual communication, direct "eye to eye" contact, they eventually lose the skill of empathy and begin to display sociopathic behavior. Over millions of years of evolution, the human brain has developed and been refined through "face-to-face" interaction, so that when switching to exclusively virtual online communication, which became a mass phenomenon around 10 years ago, it is simply unable to adapt.

Here is what the well-known psychologist Joseph A Annabali[15] writes in his book: "…*people are social beings. Millions of years of evolu-*

[14] https://hightech.plus/2018/11/08/erik-shmidt-internet-prevratilsya-v-ploshadku-dlya-bezumcev

[15] J.A.Annabali. The Anxious Mind. Bombora publishers, 2017. ISBN: 978-5-699-94985-4

tion have woven social relations into the very fabric of our existence. A major part of the brain's functions is devoted to regulating our social relations. Throughout our lives we need other people to make us feel safe, take an interest in us and understand us. Thanks to good relationships we feel that we are valued, accepted and needed. The feeling of belonging to a community or a group improves our overall wellbeing, reduces uneasiness and even strengthens our immunity. Communication with other people can reduce stress and comfort a troubled brain. We need other people to live in joy."

Loneliness in the Web / an epidemic of loneliness

> The internet does not bring people closer. It is an accumulation of loneliness. We are sort of together, but everyone is alone. The illusion of communication, the illusion of friendship, the illusion of life...
>
> *Janusz Leon Wiśniewski*

"The virtual world offers a high level of excitement and joy but does not teach you how to build relationships in the real world - its users lose their social skills," believes Susan Greenfield, a professor at Oxford University. Social media provoke feelings but not thoughts, she writes. In her opinion, people strive to attract as much attention as possible to themselves in social media and in doing so commit ever more risky and thoughtless acts. And if they don't succeed in attracting attention, they become depressed. In the last 10 years, says Greenfield, there has been a sharp fall in empathy - the ability to sympathize and put oneself in another's shoes - and this is the impact of social media. We are becoming even more isolated from each other and, scarily, it is happening under the pretext of communication. Technology is depriving people of real human interaction.

Fig.26 Internet troll. Author: JNL
https://de.wikipedia.org/wiki/Datei:Internet_Troll_velu_ill_artlibre_jnl.jpg

"If you say something bad to my face and make me cry, you will probably begin to feel uncomfortable. If you are not particularly evil or a psychopath, my suffering will arouse an empathetic reaction and cause you to show charity. If you type out something wicked remotely and make me cry, no amount of photographs and smileys can convey as much as the sight of a grown man in tears," claims research psychologist Adam Bell. Specialists have already discovered a strong link between the behavior of online haters and "trolls" and a set of personality traits known as the "Dark Tetrad,"[16] which are generally defined as follows:

- Sadism – getting pleasure from other people's pain;
- Psychopathy – a loss of empathy and contrition;
- Machiavellianism – manipulative and emotionally "cold" behavior;
- Narcissism – self-obsession and the need to be admired.

Unfortunately, "loneliness" online and the associated development of psychiatric disorders amongst so many users is leading to a constant increase in the number of people filling the web with the darkest and most disgusting human impulses…

The Great Information Depression

Right around the globe, people are already pretty tired of the superabundance of senseless, useless, and sometimes even extremely dangerous information. According to the findings of a sociological survey carried out in the United States as far back as 2019 by the reputable Pew Research Center, even in the "pre-COVID era," 54% of Americans were convinced that "false" information repeatedly re-

[16] A.Bell. https://dradambell.com/why-people-become-internet-trolls/

transmitted is completely destroying trust between people and is the biggest problem in today's world.[17]

The current crisis of overproduction of information could lead us, by analogy with the Great Economic Depression (which began on 24 October 1929 with a stock market crash in the USA, caused mainly by a new breakthrough in the organization of labor - G.Ford's conveyor belt - and the resultant overproduction of goods), to a "Great Information Depression." And in the not-too-distant future, this depression will make people lose the ability to react appropriately and make sense of our chaotic information environment. We risk unlearning how to take sensible decisions in the real world. And this risk is a huge one.

The challenge of the new information culture: can we stop spam?

Already today, almost 100 trillion images and over 10 trillion videos are stored in the internet, while a further 28 images and 2.5 videos for each inhabitant of Earth are being added every day. In 2020, mobile video overtook text files as the simplest individual means of creating and consuming information, taking first place amongst all the resources produced and consumed in the World Wide Web.

Data storage and transmission in the Web today consumes approximately 20% of global electrical energy and by 2024 will account for as much as 5% of all carbon dioxide gas emissions![18]

You will agree that at a time of global warming we all need to think before reposting something unnecessarily or sending yet another holiday photo to absolutely all our social media friends, most of whom we have never even seen in real life. We can protect the environment simply by not circulating mega-terra-gigabytes of worthless spam…

Today, all users of the "digital universe" need to think about their elementary behavioral culture in the Web. Information culture is, after all, not only about knowing how to use information to achieve a goal. It is, above all, a tool of human communication for efficient socio-informational interaction about what people are reading, watching, writing, posting, and reposting. It is essential to maintain respect for others – something that is natural in traditional culture but tends to be

[17] https://www.pewresearch.org/2019/06/05/an-update-on-our-research-into-trust-facts-and-democracy/

[18] Source: https://www.bbc.com/russian/features-47567262

forgotten about in "information culture." It's about the personal responsibility of each participant in global information processes when resending yet another reality-distorting "fake" out into the vast expanses of social media; about the "footprint" they will leave behind for their descendants; and about shifting the focus from quantity to quantity of information. All of these are things should have happened long ago.

Fig.27 DIKW information hierarchy: from bottom to top: data, information knowledge, wisdom. Author: Longlivetheux
https://commons.wikimedia.org/wiki/File:DIKW_Pyramid.svg

A fatal fake

Fig.28 The peaceful coat of arms of the town of Acatlan, Mexico

Fig.29 Yavidaxiu / A crowd films the burning bodies of two victims of "fake news." Website screenshot

https://www.bbc.com/russian/features-46180341

One fine summer's day, on **29 August 2018, police in the small Mexican townlet of** Acatlan, which has a population of just over 16,000, detained two (alien and very suspicious) men. According to the testimony of the **policemen,** the men had not committed any crime - there had simply been a flurry of calls to the police station from enraged citizens claiming that they had seen members of a gang of "child stealers" that was roaming the country.

Upon popular demand, the guardians of the peace conveyed the town's "guests" to the police station for questioning. But the people of Acatlan thought this wasn't enough: a rapidly assembled crowd of angry "fellow thinkers" stormed the police station, dragged the "kidnappers" into the street, beat them up and then burned them alive. Almost all of them filmed the event on their mobile phones and many streamed it live on WhatsApp and Facebook.[19] The mother of Ricardo Flores Maria, who was in the north of the country, was sent a link on

[19] Here and subsequently, Facebook was declared an extremist organisation and banned in Russia in 2022.

Facebook, which she clicked on and was able to observe the public lynching of her son and brother in real time.[20]

It subsequently transpired that the summarily executed "strangers" were true-born Mexicans: **21-year-old Ricardo Flores and his 43-year-old uncle, Alberto**. They had come from the neighboring village to visit their grandmother, a life-long resident of Acatlan, and help her around the house. The victims had never been in trouble with the police. Ricardo and Alberto Flores' funerals were held in Acatlan the following day. The service and wake drew a crowd of the previous day's onlookers who proceeded to cynically record and stream online the tears and suffering of the inconsolable Maria Flores.

According to the state authorities, the tragedy in Acatlan was caused by fake news spread by WhatsApp users about a gang of criminals that had allegedly come to Mexico and was kidnapping children on the streets and killing them to sell their internal organs. The instigator of the disorder was identified, alongside four of the main rabble-rousers, who had mass circulated fake news on WhatsApp and Facebook to assemble and whip up an angry crowd. They were charged with incitement to murder.

The epidemic of fakes as a sociocultural phenomenon

[20] https://www.bbc.com/russian/features-46180341 Marcos Martinez BBC Monitoring. 18 November 2018 г.

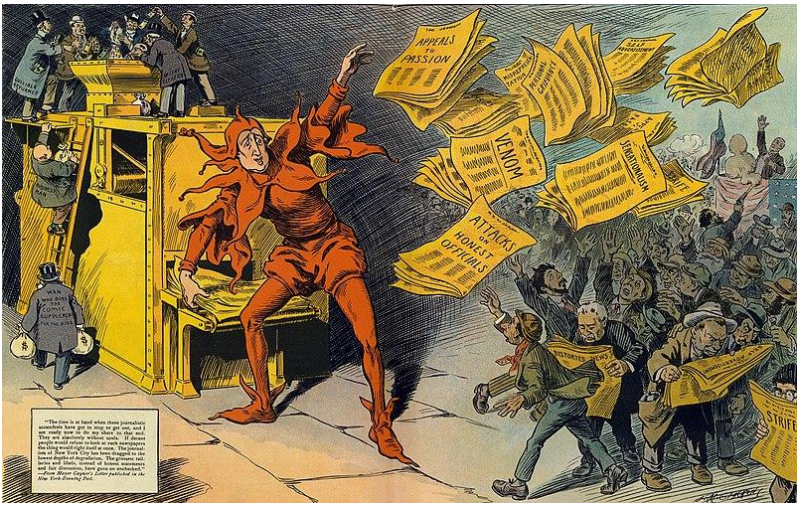

Fig.30 Source: https://commons.wikimedia.org/wiki/File:The_Yellow_Press_by_L.M._Glackens.jpg

Inaccurate or fake news is information which its authors and distributors exploit for political and economic gain, and also to boost their readership and citation numbers. It's a technique that became prominent in politics back at the end of the 19th century, when the old media - print, radio and television - were still evolving[21] and was given the name "newspaper hoax." Even earlier, from ancient times, the distribution of inaccurate information was known as "lies" or "disinformation." However, fake news began to exert its current impact on global events only with the rise of the new "horizontal media," primarily messengers and social networks - means of communication that can be used not only to instantly spread targeted content, but also to receive instant feedback.

Leading experts today describe fake news as one of the main threats to global development. Governments of all countries without

[21] The old media were a centralized and one-way channel of information. Information in the traditional media environment comes from content creators, who often remain anonymous, directly to the consumers. Roles in the traditional media environment are generally fixed, with a clear vertical hierarchy. Users are not able to directly influence content creation. Source: Barbara Becker, Josef Wehner. Electronic Networks and Civil Society. P. 81. SUNY Press, 2001. ISBN 978-0-79145-016-1.

exception are hastily seeking ways of combating this phenomenon through legislation. Even Pope Francis has made a special statement on fake news, comparing it with the snake of temptation in the Bible - "snake tactics which we need to expose."

In a number of countries, such as Malaysia, Spain and China, disseminators of fake news face prison terms. The US, India and the European Union are planning to adopt tough new laws. In Russia, especially after the information provocations around the "true scale of the tragedy at the Winter Cherry mall,[22] the government and lawmakers have quickly established fines for the preparation and dissemination of socially dangerous fakes. We quote: "In the event of dissemination in the mass media and information-telecoms networks of knowingly inaccurate, socially significant information under the guise of accurate reports creating a threat to the life and (or) heath of citizens, of mass violation of public order and/or public safety, of the breakdown of life support facilities, transport or social infrastructure, or of other serious consequences," the perpetrators shall face administrative liability in the form of fines of between 30,000 and 1.5 million roubles. In turn, internet resources implicated in the dissemination of fakes and failing to act urgently to remove inaccurate information posing a danger to the public shall be blocked at the request of the Russian communications watchdog Roskomnadzor.[23]

To date, however, due to the specific nature of this socio-technological phenomenon, it has not been possible to actually stop or even contain a public fake-threat.

Epic failure in the battle against fakes

Against the backdrop of these forecasts and the aforementioned statistics on the growth of the digital information universe, efforts and investments by many countries around the world aimed at controlling or, even better, managing this process, allocating considerable funds to creating "real defence" programs and technologies against fakes seem naïve. Given the scale of the problem, all attempts made to date by governments and international organizations

[22] "400 Fakes about the Kemerovo Fire: Why did people so easily believe the big lies about the tragedy in the Winter Cherry mall?". Article by Ulyana Skoibeda in Komsomolskaya Pravda, 02.04.18

[23] http://publication.pravo.gov.ru/Document/View/0001201903180031

to monitor and control the spread of information have been doomed to failure.

In the early 2000s, for example, Bloomberg reported that the US Defense Department had ordered software for identifying fake news in online publications, social media, and online audio and video clips. According to the declared strategy, Pentagon experts would use the new software to track propaganda messages in news and social media. The software would be able to review up to half a million news items and posts in social media for possible manipulation of public opinion and propaganda, and operators would be able to react quickly to any fakes. It was anticipated that the software would be in operation this year and rule out any potential outside interference in the 2020 US presidential election.[24] But Pentagon monitoring of half a million key blogs have had no overall impact on the trends and processes underway in the global information space.

The second cause is the complexity of identifying primary destructive "fakes" when encrypted messenger systems are used. It is possible to try, in one way or another, to monitor the release and dissemination of dangerous fakes, though Facebook (mentioned above as an extremist organization banned in Russia) tried using its own resources to combat the spread of fake news and suffered a crushing defeat – something we shall look at in more detail later). In the case of chats such as WhatsApp, however, where double encryption algorithms are used and system operators have no access to user communications, the government also lacks the technical capability to monitor all messages.

[24] https://www.rbc.ru/politics/01/09/2019/5d6ae9a79a79475cc886b53c

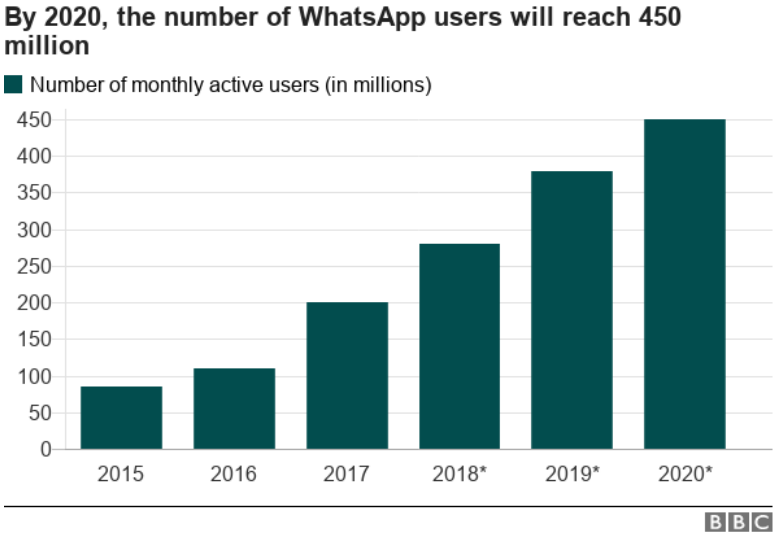

Fig.31 Growth of WhatsApp users in India[25]
https://www.bbc.co.uk/news/resources/idt-e5043092-f7f0-42e9-9848-5274ac896e6d

As an example, let's look at India, which has suffered more than other countries from fakes about gangs of evil child kidnappers. In one incident, fake information rapidly circulated amongst WhatsApp users in a natural desire to share important news, was based on a viral video showing two motorcyclists with faces obscured by helmets kidnapping a child who had been left alone on a street. Despite the poor image quality, the video spread quickly amongst users in several Indian states and resulted in local residents pursuing any strangers who looked suspicious.

The first street attacks on strangers began in 2017. On 4 July 2018, after the number of victims of these spontaneous attacks had exceeded 30, the Indian government demanded that Facebook, the owner of WhatsApp, hand over its encryption keys to identity the instigators and take "immediate measures" against abuses of the platform. Despite numerous statements about "fake news" by the local communications and IT ministry, broadcast daily via the official mass media, users continued to resend each other "classified infor-

[25] https://www.bbc.co.uk/news/resources/idt-e5043092-f7f0-42e9-9848-5274ac896e6d

mation concealed by the authorities" about gangs of pedophiles flooding into the country to kidnap and dismember children.

WhatsApp refused to hand over its encryption keys, but sharing the government's concern over the monstrous abuses of the free app for mass manipulation, introduced a number of restrictions on circulating messages - no more than three recipients in India and a maximum of 20 recipients worldwide. In addition, the label "Forwarded" was added to the algorithm for cases in which a message is simply copied and passed on.

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Pandemic of deadly fakes: the original code

The deaths of Ricardo and Alberto Flores in Mexico were far from an isolated case. Rumors, gossip and fakes about roaming gangs of "child kidnappers" have spread instantaneously in messengers and social media in several countries on different continents and have led to fatal attacks in India, Myanma, Sri Lanka, Ecuador, Mexico and Colombia. And these are just the well-known cases reported in the mass media. The true number of people killed and injured as a result of "deadly fakes" is unknown.

Fig.32 Video showing child kidnappers. Screenshots from the website https://www.bbc.com/russian/features-46180341

Law enforcement agencies in several countries working together were actually able to find the "needle in the haystack" - the original source of the video showing two motorcyclists kidnapping an

unattended child.[26] And indeed, no-one could remain unmoved by this short video, especially if it has been shared by a personal acquaintance who has perhaps also added some absolutely sensational commentary. There is plenty of scope for personal creativity here, from simply "kidnapping of children for sale into slavery" to "gangs of pedophile murderers dismembering toddlers to sell their organs…" Further whipping up hysteria around the "deadly fake," people added comments about the number of criminals and their "distinguishing features."

In effect, instead of becoming a means of quick and confidential communication, as originally conceived, WhatsApp has turned into an infernal mix of "Chinese whispers" and "bush telegraph" with very severe consequences. How the numerous persecutors and lynchers could make out the "distinguishing features" of the kidnappers in black helmets is totally unclear. Fear hath a hundred eyes, as they saying goes. So perhaps one should not be surprised if unknown individuals turning up in villages and towns attract close and far from benevolent attention from local residents.

But the real truth behind the fatal fake video shocked everyone. It turned out that the video had been made with noble intentions, as a social ad from a public volunteer organization in Pakistan that combats kidnapping. The video's original purpose had been to remind hapless parents to keep a constant eye on their children in big cities.

At the end of the video, the two kidnappers who have just "stolen" the child return literally a few seconds later to bring the child back, and one of them holds up a poster to the camera with the words, "It takes only a moment to kidnap a child from the streets of Karachi."[27]

[26] https://www.bbc.com/russian/features-46180341 Marcos Martinez BBC Monitoring. 18 November 2018.

[27] Karachi – a large port city in southern Pakistan.

Fig.33 Screenshot from the video. The red arrow indicates the safely returned child

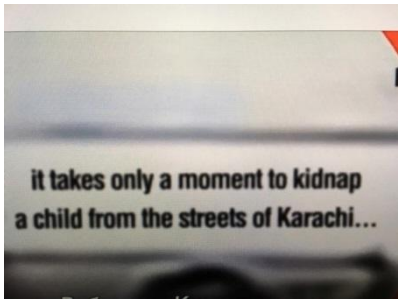

Fig.34 Message on the poster

https://www.bbc.com/russian/features-46180341

And this is where the key questions arise: Who needed to curtail the video to such an extent that it led people to violence, and why? Who disseminated this video amongst their friends, families and acquaintances, and why? And why is it still not possible to bring the culprits behind this distortion of the information space to justice?

Self-realization through fakes, or the real truth about who actually needs pseudo-sensations

The third and most important reason why it is impossible to stop the creation and circulation of fake news is its social importance for those who produce, consume and disseminate it. The real truth about who needs pseudo-sensational news is obvious. Virtually all of us need fake news. And therefore nothing, be it fines or prosecution, is capable of stopping someone in search of self-realization to boost their own importance in the eyes of society, to demonstrate that they are part of an elite with access to classified, secret and hidden knowledge which, naturally, claims to be an alternative truth.

Curiosity is something that is genetically encoded in all of us as a means of survival. New knowledge in its normal manifestation is extremely useful and actually drives progress. It is no coincidence that the primary aim of all dissertations is scientific novelty. Sharing information with pretensions to sensationalism - whether or not it will be refuted and forgotten in the future – is a way of signaling your importance to your audience and, consequently, of enhancing your

social status. And it doesn't matter that the effect is fleeting and virtual – for most members of the generation born with a smartphone and tablet in their hands, there is no difference between the real and the virtual worlds.

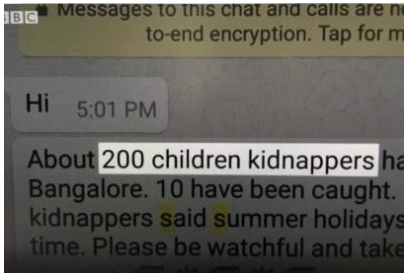

Fig.35 Screenshot from an Indian WhatsApp user: https://www.bbc.com/russian/features-46180341

As an example of a classic fake, the following sensational comment can be added to the viral video about the two kidnappers on a motorbike: "Two hundred child kidnappers have arrived in the country. They are scouring the environs of Bangalore in search of victims." This translates as an appeal: "Brothers, be extremely attentive and careful." It's like an evolutionary warning: "Do not go hunting beyond this cliff because there is a pack of hungry wolves there," etc.

And even if an official refutation follows, the authority of the person spreading the message will not be badly affected, because ultimately nothing terrible has happened. But if, God forbid, something similar were actually to happen somewhere, that person's star would rapidly rise and people would start treating any future fakes produced by them as the words of a prophet. They might even be featured in the vertical mass media as an expert and earn money and fame by speaking on talk shows etc. Thus, disseminators of knowingly fake information have virtually nothing to lose, but could make a pile of money. Every user who takes this path understands that fake news is like roulette – to be lucky you have to put skin in the game. In other words, you need to seek out, create and circulate as many pseudo-sensations as possible.

We are programmed by evolution to share important information with our loved ones

As Borislav Kozlovsky[28] writes in his book "Maximum Repost," "reading and, most importantly, reposting news is not so much a means of obtaining information as an opportunity to show oneself to other people. In other words, it is a social ritual that can be compared with going to church on Sundays or with shopping in an expensive store. By clicking on the Share button, you are communicating that this or that event is important for your world picture…And if feedback is important to you, fake new and true news do not have the same value. Fake news is far more advantageous than true news…improbable news promises more new knowledge. In other words, this is "news" of the highest value and it attracts more attention."

According to research by the Massachusetts Institute of Technology, which studied over 126,000 fake news items published on Twitter between its creation in 2016 and 2017 (published in Science journal in 2018[29]), **knowingly obvious fake news circulates on average six times faster than "real information" from authentic sources.** Moreover, the likelihood of fake news being reposted is 70% higher. And the highest speed of circulation is achieved by fakes relating to politicians, media personalities, catastrophes and natural disasters.

Cascade depth is a crucial parameter which describes how far news can spread through reposting chains. And the "truth" loses out here too: fakes reached 19 reposts ten times faster, while the "truth" is never forwarded more than 10 times.

Are we sharing news or pouring out emotions?

According to American cognitive psychologists Chris Bell, Chip Heath and Emily Stenberg, whose hypothesis is supported by Russian social anthropologists Alexander Arkhipov and Anna Kirzyuk, rumors

[28] B.Kozlovsky. "Maximum Repost: How social networks make us believe fake news." M.: Alpina publishers, 2018

[29] The spread of true and false news online Soroush Vosoughi1, Deb Roy1, Sinan Aral2, Science. 09 Mar. 2018

and fake news memes spread much more easily than objective truth precisely because **people simply "want to share disgusting emotions** aroused by urban legends and rumors" – a desire that derives from evolutionary mechanisms programming us to warn fellow tribesmen of danger.[30]

"**Online platforms as a means of instant transmission of information provide a channel for spewing out the best and the worst we have in us, including our fears and prejudices…**This becomes more obvious when there is no effective authority to ensure our safety," claims Manuel Guerrero, Director of the Department of Communication at the Ibero-American University (in Spanish: Universidad Iberoamericana Ciudad de México), commenting on the attacks on strangers traveling around Latin America.

Researchers have also found that it is people rather than bots who determine the speed and direction of spread of fake news online. And it should be noted here that fakes are most actively retweeted not by "authoritative" bloggers and Instagram "stars" with millions of subscribers but by unpopular users of messengers and social media with an acute need to boost their socio-virtual status.

Consequently, returning to the video meme about the child kidnappers, the story begins with one (or perhaps more than one) specific provocateur and perpetrator who sets of the pandemic of street violence – the web user who deliberately distorted the original Pakistani public information video by cutting off the "happy end" showing the child being returned and the poster; the person who turned the original good deed into a pandemic of violence with numerous victims and casualties all over the world. Due to the complex way in which the information environment is organized, that person has not yet been identified. Everything else was done not through the efforts of individual miscreants, but by an army of virtual outsiders - ordinary internet users seeking to boost their standing by spreading "deadly fakes."

The more dubious, the more popular?

If one compares the "best" and the "worst" within us, statistics show that the worst is so far winning by a big margin. And this sad fact

[30] https://www.vedomosti.ru/opinion/articles/2019/03/10/796034-mozhno-pobedit-zakonom

has been confirmed by an unsuccessful attempt by Mark Zuckerberg to stop the spread of fake news in the world's biggest social network, which he created. For a long time, Facebook[31] administrators attempted to evade responsibility for the network's content, claiming that Facebook is "merely a tech company" with no responsibility for the content of information posted by its users. However, following a number of official allegations by US law enforcement agencies about interference in the presidential elections, Zuckerberg and his team finally pulled their heads out of the sand and publicly promised, starting in 2017, to check the authenticity of news posted on users' pages and stop its spontaneous spread.

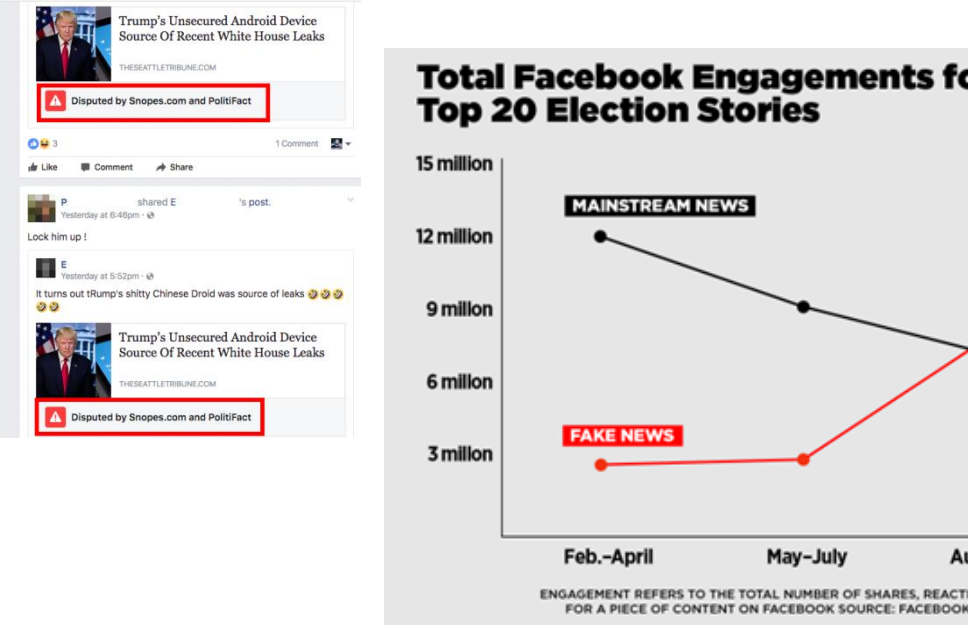

Fig.37 The popularity of "fake news" on Facebook[32] grew rapidly in the three months prior to the 2016 presidential election. Infographic: BuzzFeed

[31] In 2022 Facebook was declared an extremist organization and banned in the Russian Federation.

[32] Declared an extremist organization and banned in the Russian Federation.

Facebook's developers (in 2022, Facebook was declared an extremist organization and banned in the Russian Federation) decided not to hire paid experts, but to rely on volunteers from within the network itself, who were willing to check the authenticity of news free of charge and inform the administrators about posts containing inaccurate information. Those posts were then deleted and marked

' *Fig.36* Screenshots from social media

Source: http://pr-cy.ru/news/p/6119

that "noble enterprise". In March 2017, Facebook began marking English-language news items that the volunteers had identified as "fake" with a red exclamation mark in a triangle with the word "Disputed" alongside. But as soon as a message was marked "Disputed," the number of views and reposts instantly increased many times over. All attempts by network administrators to combat fakes in the Web have been counterproductive. Nine months after the start of the globally announced "crusade" against "fake news," Zuckerberg & Co. conceded their powerlessness and gave up the unequal contest.

According to independent researchers, the number of reposts of false news both on Facebook[33] and in other global social media is still many times higher than the number of reposts of bona fide messages.[34]

In place of a conclusion

From time immemorial, people in possession of knowledge have been extremely cautious about the idea of unlimited circulation of information. For many centuries, access to information and knowledge existed only for the select few – it was stored in secret places and protected against access by undesirables. In a number of cases information was even deliberately destroyed to stop it falling into the hands of unreliable individuals capable of starting wars, sowing conflicts or usurping power.

But today, the uncontrolled spread of false and unverifiable information is beginning to undermine the very foundations of society: mutual trust, trust in the institutions of state, reputation and authority, presumption of innocence etc.

Some countries have reacted quickly to these information threats. China, for example, very rapidly passed one of the very first

[33] Declared an extremist organization and prohibited in the Russian Federation

[34] http://6abc.com/news/fake-news-is-dominating-facebook/1621221/

laws prohibiting, from 1 January 2020, the publication of fake news and misleading "deepfake" videos[35] created using artificial intelligence. Duplication of misleading videos is a criminal offence.[36]

But unfortunately, the speed at which information spreads is now an order of magnitude greater than the speed of reaction to it in the form of checks, expert reviews and, where necessary, the writing of official refutations. Thus, deciding who is to be held responsible for what, and how to enforce this, is a very moot point.

But there is another way. Generally speaking, people are already pretty tired of fake news. A sociological survey carried out in the United States by the reputable Pew Research Center revealed that 68% of Americans believe that "fake" information is affecting trust in the government, while 54% believe that fakes are totally destroying trust between people. Over half of the respondents said that "fake news" is the biggest problem in the world today.[37]

And until the introduction of wholesale state information censorship to "protect us from ourselves" has not yet begun, there is only one solution: fakes as a dangerous social phenomenon will only disappear when they cease to enjoy social acceptance in the minds of the majority of people.

Therefore, we are convinced that the solution to the problem of false information in the era of "horizontal media" should also be "horizontal". In other words, it must not be a top-down solution in the form of recommendations from governments and other official institutions, but a bottom-up solution making each "ordinary" user of the information highway aware of the ethical foundations of personal information culture.[38] This will lead people to a realization of their inescapable personal responsibility for each action they take in the World Wide Web and an awareness that with one click on the Repost button they could not only cause a nuclear war but also prevent one.

[35] Covered in detail in the next chapter

[36] https://www.scmp.com/tech/apps-social/article/3039978/china-issues-new-rules-clamp-down-deepfake-technologies-used

[37] https://www.pewresearch.org/2019/06/05/an-update-on-our-research-into-trust-facts-and-democracy/

[38] N.V.Lopatina. The Modern Information Culture and Information Warfare // Scientific and Technical Information, Series 1. 2014. No.7. pp. 1–4

Deepfakes: technologies for changing reality

In December 2017, staff at the NVIDIA research center, a pioneer in artificial intelligence,[39] published an article on the company's website,[40] in which they demonstrated how to use GAN – generative adversarial neural networks – to totally modify an original digital photograph - for example, by turning winter landscapes into summer scenes. Unlike simple photoshopping, where fakes can be recognized by the naked eye, NVIDIA's "deep" neural network machine-learning algorithm can be used to create a new digital reality. Even experts have been unable to spot the fakes amongst pictures created using "deep learning" technology.

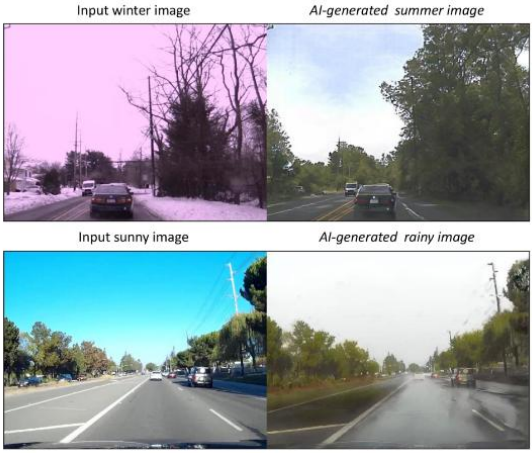

Fig38. From winter to summer: how a winter video was changed to summer.
Screenshot from https://blogs.nvidia.com/blog/2017/12/03/nvidia-research-nips/

One week later, in the popular social news website Reddit, links began to appear to a pornographic film in which Gal Gadot, one of the best-known and highest-paid Hollywood actresses, is having sex

[39] The next few chapters contain a detailed study of the threats posed by artificial intelligence - the most dangerous invention of the Fourth Industrial Revolution.

[40] https://blogs.nvidia.com/blog/2017/12/03/nvidia-research-nips/

with her "half-brother.[41] The author of the astonishingly authentic fake video, hiding behind the nickname of Deepfakes, instantly shot to fame. In the numerous interviews that followed his scandalous publication, Deepfakes not only spoke about himself but also revealed to the public how he had produced his "creation." The man hiding behind the nickname was an ordinary programmer who confessed that he had used NVIDIA's ideas and algorithms to simply fulfill his erotic fantasies. Clearly, as one of the most beautiful and successful women in the world, Gal Gadot had not only never performed in a "home porn video" for Deepfakes, but was not even informed by him that she had become the heroine of an adult film. To create his "masterpiece" the erotomaniac programmer had used an ordinary porn film in which he superimposed Gadot's face, taken from open sources – numerous photographs and videos on Google and YouTube - on the body of an unnamed pornographic actress. Deepfakes explained that such videos could be made by anyone who knows how to use the internet and understands the principles of generative adversarial networks. He also named the software (which is free and available in open access) used to create the new porn genre, which was subsequently dubbed "Deepfake" in his honor.

Fig.39 Screenshot of an ad on Reddit

Source: https://lenta.ru/articles/2018/02/09/deepfake/

Less than a month later, the creation of deepfake porn videos featuring celebrities had turned into a major industry. Videos with any original "faces" could be made quickly, cheaply and to order. And although lawyers encourage the "offended celebrities" to sue the latter-day "porn directors" for unlawful processing of personal data, the celebrities, mindful of the well-known Streisand effect,[42] are in no hurry to draw unnecessary attention to themselves from internet users.

[41] https://www.vice.com/en_us/article/gydydm/gal-gadot-fake-ai-porn

[42] A social phenomenon in which an attempt to remove certain information from public access leads to its wider dissemination in the internet. Source: The Streisand Effect and Censorship Backfire // International Journal of Communication. 9 (2015): 656–671.

The evolution of deepfakes: from an innocent prank to a clash between nuclear superpowers

All would probably be well if this were only about pornographic deepfakes. But soon the world will be facing more serious problems than the unsanctioned use of publicly available "personal data" of glamor and movie stars by homegrown erotomaniacs with a talent for AI technology.

As mentioned above, from this year, mobile video has moved into first place as the simplest means of consuming information. And the main "hub" or distributor of these videos is YouTube, the most popular video hosting service in the world.

In the summer of 2018, the record for the highest number of views on YouTube was held by a video message in which former US president Barack Obama publicly insulted the then president, Doland Trump. This hot news literally exploded the world, which immediately split into two opposing camps – those who supported Obama in believing that Trump had got what was coming to him, and those who believed that neither Obama nor anyone else should allow themselves to say such things.

The video was so authentic that at first nobody believed it could be a fake. During his two presidential terms, Obama had done a lot of talking and there is a large body of digital photographs and videos of him in open access. But he had never insulted Trump and had nothing to do with this specific incident.

The authors of the provocative video were the American comic and film producer Jordan Peele and the Buzzfeed internet news media company. The deepfake, which almost set off a " civil war" between Republican and Democrat supporters, was created by Peele using the Adobe After Effects graphic editor and the simple, free Fakeapp software, which had been placed in open access by Reddit for anyone interested in independently experimenting with the creation of "celebrity porn."

In Peele's words, his main aim as the director of the video was a noble one: to warn people that "this is a dangerous time. Moving forward, we need to be more vigilant with what we trust on the internet. It's a time when we need to rely on trusted news sources," said

Peele though the mouth of Obama at the end of his scandalous video.[43]

Fig.40 Screenshot of a deepfake video. You will not believe what Obama says in this video!
Video by: BuzzFeedVideo
https://youtu.be/cQ54GDm1eL0

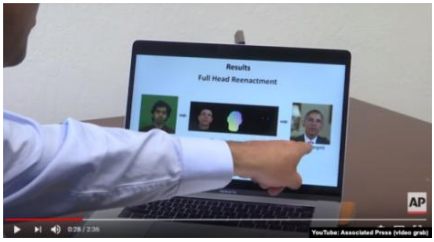

Fig.41 Screenshot from a training video on YouTube explaining how to use software to create deepfakes.
From open sources

In interviews given to journalists immediately after this escapade, Jordan Peele also said the following: "I knew that it was possible, but I wasn't sure it would actually work. When it did work, I thought, "**This is crazy!"** Look at it! You know, it's still quite difficult, but **this is much simpler than it should be.**"[44]

Attention, provocation!

Today, given the quantity and quality of original digital material stored in the Web and accessible to everyone, any politician, celebrity or even ordinary social media user who has been incautious enough to post a selfie and/or a video for everyone to view, risks falling victim not only to a prank but also to a serious provocation or fraud.

Criminals are alert to this: they are actively mastering modern information technologies. And now global news services have begun filling up with reports about fake videos of directors and CEOs instructing their staff to transfer money to fraudsters, "deepfake videos" of

[43] https://www.theverge.com/tldr/2018/4/17/17247334/ai-fake-news-video-barack-obama-jordan-peele-buzzfeed

[44] https://ru.krymr.com/a/29347608.html

movie stars inviting viewers to click on a link and win a prize, and so on.

But the biggest danger, according to information security professionals, is posed by the deepfakes that will be used in future information wars. For example, John Villasenor, a professor at the University of California Los Angeles, claims that **"deepfake technology will become a powerful tool in the hands of people who want to disinform the masses and directly impact political events."** The US military believe that the most promising development is the ability to edit and leak fake satellite images and videos that could quicky disorientate enemies and plunge the world into complete chaos.[45]

Several "trial" videos by anonymous "enthusiasts" have already appeared in the internet, showing the leaders of nuclear superpowers – the then US President Donald Trump and Russian President Vladimir Putin – talking about plans for global armed attacks.[46] Many viewers had the sense to see these videos as provocative hoaxes and not spread panic online. This was partly due to the poor quality of the "evidence" submitted to the "court of public opinion."

However, neural network machine-learning technologies are improving fast, and one can confidently say that the creation of absolutely authentic "deepfake videos" which even experts will not be able to distinguish from genuine videos is just round the corner.

If one believes Hao Li, a pioneer in the global deepfake video industry, "it's a matter of months rather than years. And this means that plausible deepfakes, undistinguishable from reality, will appear during the election campaign in the USA – and could quite possibly change its outcome."[47] In an interview with CNBC, Li noted that "such deepfakes could be created by ordinary users with no specialized technical training or unique equipment, and **we only have from half a year to a year to learn how to recognize fakes."**[48] That interview was recorded way back in 2019…

[45] https://www.defenseone.com/technology/2019/03/next-phase-ai-deep-faking-whole-world-and-china-ahead/155944/

[46] https://lenta.ru/articles/2020/01/01/cybercrime2020

[47] https://hightech.plus/2019/09/24/dipfeiki-stanut-neotlichimi-ot-originalov-v-techenie-6-12-mesyacev

[48] https://www.cnbc.com/2019/09/20/hao-li-perfectly-real-deepfakes-will-arrive-in-6-months-to-a-year.html

One hundred seconds to the end of the world…

It would be wrong to claim that governments, corporations and private individuals are failing to devote enough attention to creating special "deepfake antidote" software. But unfortunately, as has always happened throughout history, people first develop the technology and only later start thinking about how to protect themselves against it.

As we have repeatedly stated, the creation of means of protecting mankind against the fruits of technical progress always lags far behind the race to develop them. And it is frightening to think what the antics and games of dilettantes using the heretofore unseen capabilities of artificial intelligence could lead to.

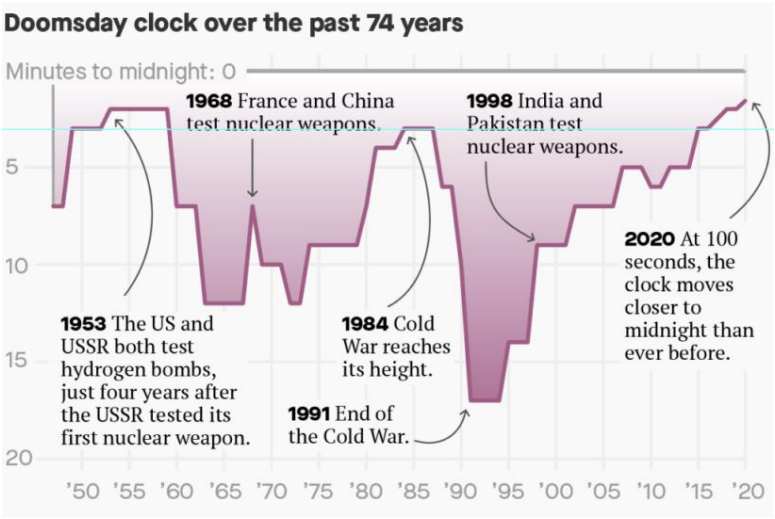

Fig.42

It is absolutely no coincidence that the hands of the famous Doomsday Clock – a project launched in Chicago in 1947 by the scientists who created the world's first atomic reactor and atomic bomb - came closer to midnight that at any other time in history on 23 January 2020. There were just a few seconds left to midnight, symbolizing the annihilation of life on the planet.

The expert panel on moving the hands of the Doomsday Clock, consisting of 18 Nobel prizewinners, said their decision was based on

the conclusion that world leaders today are less and less capable of withstanding the ever more likely threats of nuclear war - amongst other reasons, because of the burgeoning information wars in cyber-space, the growing amount of fake news, and orchestrated online disinformation campaigns.

Fig.43 The closest time to midnight on the Doomsday Clock since the project began / Global News Archive

Screenshot from https://cafef.vn/dong-ho-tan-the-cach-thoi-khac-nua-dem-chi-100-giay-nguy-co-nhan-loai-diet-vong-dau-nam-2020-da-cao-hon-ca-thoi-chien-tranh-lanh-20200131182202433.chn

"Our proximity to disaster is now a matter of seconds, not hours or even minutes…We are now in a genuine emergency – an absolutely unacceptable state of affairs in the world, which leaves no room for errors or delays [in rectifying the situation]"[49], maintains Rachel Bronson, executive director of the Bulletin of the Atomic Scientists.

Incidentally, one doesn't have to be a world leader to press the Repost button and start the irreversible process of spreading the latest "funny fake," which could set off a nuclear war.

P. S. On 5 March 2022, *unknown activists projected onto the building of the United States Mission to the United Nations an image of the Russian bear standing between the hands of the Doomsday Clock and trying to stop the clock striking midnight, which symbolizes the start of the nuclear apocalypse.*

[49] https://www.npr.org/2020/01/23/799047659/the-end-may-be-nearer-doomsday-clock-moves-within-100-seconds-of-midnight

Fig.44 Campaign on 5 March 2022, screenshot from YouTube
Source: RuNews24 https://youtu.be/Qa2g6l_Pwj4

P. P. S. There are 90 seconds left…

As this book was going to print, or to be more precise, on 24 January 2023, news agencies were reporting that the Bulletin of the Atomic Scientists had moved the Doomsday Clock even further towards the "end of the world." "We are moving the clock forwards towards nuclear midnight closer than ever before. There are now 90 seconds left to midnight," said Rachel Bronson, the head of the organization, on 24 January. Bronson also noted that there is now no pathway to establishing the type of peace that could prevent a clash in the future, and that "the United States must leave the door open for interaction with Moscow, to enable a reduction in risk, for example, through contacts between the two countries' militaries."[50]

[50] Source: https://ria.ru/20230124/chasy-1847176803.html

Fig.45 Computer simulation of a "nuclear winter": this is roughly what our planet will look like after a nuclear war

Source: http://www.celestiamotherlode.net/catalog/show_addon_details.php?addon_id=1000

Prehistoric terrorism

> Terrorism is not something without causes or something rooted in some defects of human biology. It is a social phenomenon with roots in the conditions of people's social existence.
>
> *A.A.Zinovyev*[51]

One day long ago, in the summer of 356 BC, the residents of the ancient Greek city of Ephesus suffered a great misfortune. The pride of Ephesus – a white marble temple dedicated to Artemis, the goddess of fertility, and one of the seven wonders of the ancient world, built by the greatest craftsmen of the age – was burned down by un unknown vandal.[52]

In the context of that period, this was not simply an act of vandalism, it was a proper terrorist attack. Even today, in an era of overwhelming scientific progress and widespread atheism, hurting the feelings of believers is a serious crime.

[51] A.A.Zinovyev. How Do You Kill an Elephant with a Needle? // Nash Sovremennik, № 12. 2005.

[52] The article includes excerpts from the book: D.V.Mun, V.V.Popeta, P.E.Smolkov. Terror and Us: Why terrorism exists and why people become terrorists. M. DirectMedia publishing house, 2018.

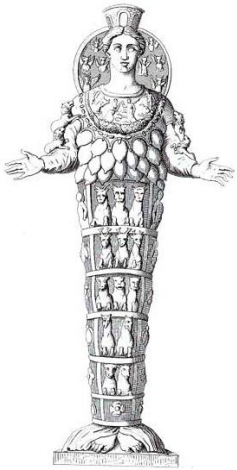

Fig.46 18th century engraving: - Artemis, the "many-breasted" goddess of fertility and protectress of all life on Earth

https://commons.wikimedia.org/wiki/File:ArtemisEphesus.jpg

So, what can one say about the desecration of Artemis herself? After all, the ancient Greeks believed that Artemis, the goddess of fertility, cared for all life on Earth and, most importantly, granted happiness in marriage and blessed newborn children. The residents of Ephesus feared that the goddess's wrath over the desecration of the temple could fall on all who lived in the city, and not only on the person directly responsible for the crime.

Fig.47 The Temple of Artemis, reconstruction, engraving dated 1887. Author: Schaff, Philip, 1819–1893. Source: Library of the US Congress

https://commons.wikimedia.org/wiki/File:A_dictio-nary_of_the_Bible.._(1887)_(14781336872).jpg

In the course of investigations, as they would write in the crime reports today, a certain Herostratus (ancient Greek: Ἡρόστρατος) – an unremarkable young resident of Ephesus - was detained and subjected to a thorough interrogation. To the astonishment of the law enforcers, the youth not only immediately confessed to what he had done, but also stated that he had committed his act not for selfish reasons but exclusively out of a burning desire…to be famous. The ambitious adolescent passionately desired to be remembered by future generations. In response to this, the citizens condemned him to death and **the Ephesus court issued special instructions which were disseminated right across Greece ordering everyone to forget and never mention the**

name of the madman who had, out of pure vanity, destroyed a temple that was the pride of all Hellas.

Cyberterrorism is plunging the world into chaos and anarchy

Terrorism (from the Latin "terror") is a social phenomenon with a tragic history going back many centuries. The main aim of terror is to frighten, deter, and sow fear amongst people. For as long as there is terrorism in the world, nobody is guaranteed a completely safe existence. In addition to its fundamental declarative nature, "classical terrorism" also demonstrates to the masses one's readiness to go all the way to achieve one's aims, accepting no compromises, rejecting the existing order of things and, most importantly, showing no mercy towards oneself or one's victims.

All countries without exception are working together in a collective fight against traditional international terrorism. Nowadays, however, due to the rapid digitalization and globalization of information and production processes, and given the existence of substantial vulnerabilities in the still immature information infrastructure, truly unlimited opportunities have emerged for information and communication specialists who want to take the "path of terror."

As James Clapper, Director of US National Intelligence, stated in 2013, "cyberattacks and cyber espionage have for the first time overtaken terrorism as the main threat to US security." (Hosenball & Zengerle, 2013). In contrast to traditional physical terrorism, cyberterrorism exploits the latest scientific achievements in the fields of computer and information technology, radio electronics, genetic engineering, social psychology and even immunology.

In the words of Evgeny Kaspersky, head of Kaspersky Lab, cyberterrorism as a form of crime is evolving extremely quickly: "…they realized that "digits" actually control everything…they have already gone beyond the startup level. These are good gangs capable of hacking anything." Besides extremists, hackers today are also being recruited by traditional criminals and even (while trying to keep it secret) entire states.

Given the scope of this article, we shall not dwell in detail on cyberwars and cyberattacks directed against commercial organizations in the aim of extracting money. We shall simply note in passing that a recent analysis by the Center for the Study of Civil Society and the Nonprofit Sector at Russia's Higher School of Economics found that **in the past five years the number of crimes in the digital space has increased by 25 times and these crimes have a low clear-up rate**

(25%).[53] Cybersecurity experts at the Internet-Rozysk company have published data showing that **the clear-up rate of crimes in the sphere of computer information is steadily declining: from 36% in 2016 to 23% in 2019.** They also predict that by 2023 the share of cybercrimes in Russia could grow from 14% today to 30% of all crimes committed!!![54]

Without going into too much detail, we also note the constant expansion in the World Wide Web of recruiters and propagandists from traditional terrorist organizations which are prohibited in Russia and most civilized countries (at the end of the article, we include a link to the instructive stories of, amongst others, Varvara Karaulova, an outstanding student and athlete at Moscow State University, who was recruited by ISIS). We shall now turn our attention to a fundamentally new phenomenon that has grown out of the fourth information revolutio - the "digital terrorism" social movement, or cyberterrorism.

"Their name is legion"[55]

We are Anonymous, we are Legion. We do not forgive. We do not forget. Expect us.

Motto of the Anonymous international hacktivist group[56]

There is a big difference between modern cyberterrorists and terrorists of the "classical Herostratus type" – the former are not seeking to be caught and die in the name of their declared goal. On the contrary, they prefer to remain anonymous, and are quite successful in achieving their protest and political goals anonymously. Today, to commit a "full-scale" act of terrorism there is absolutely no need to have underground sabotage training or to recruit accomplices to secure the necessary funding, supplies and so on. All one needs is a computer, criminal intent and access to the World Wide Web.

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[53] More detail available from RBC: https://www.rbc.ru/technology_and_media/15/12/2021/61b887379a7947b03be2cddb?utm_source=telegram&utm_medium=messenger

[54] Source: https://iz.ru/962966/elena-sidorenko/po-tcifrovym-sledam-v-rf-raskryvaetsia-lish-chetvert-kiberprestuplenii

[55] Their name is Legion" (Latin: "nomen illis legio") — a catchphrase meaning an incalculable quantity of something, with a derogatory attitude towards what is being counted. The phrase was first used in the Old Testament.

[56] Published in: *We are Legion: Anonymous does not forgive // Hacker*. 11.06.2011.

Fig.48 A "terrorist" (2013). A picture by Belgian artist Xavier Tricot based on the terrorist attack on the Munich Olympics in 1972. Photo: JoJan

https://commons.wikimedia.org/wiki/File:Xavier_Tricot_005.JPG

Fig.49 Logo of the Anonymous movement
Author: Anonymous

https://commons.wikimedia.org/wiki/File:Anonymous_emblem.svg

The psychological portrait of the new type of terrorist is also significantly different: the poorly educated, religious, suicidal fanatic, often under the influence of psychotropic substances, with home-made explosives and knives has been replaced by a highly educated and, most importantly, extremely talented and inventive person in an expensive suit, tie and white-collar shirt, who holds down a highly paid job in a respectable organization during the week and sows chaos and evil on the weekend…

For reference: Anonymous is one of the most well-known international hacking groups. The "suit with a question mark" represents the movement's anonymity and absence of a single leader, like a sort of anarchic digital global intelligence. The term is also used to refer to a subculture which idealizes the idea of anonymity and freedom in the internet. Anonymous campaigns against internet censorship, persecution and oversight. In protest against attempts by some countries to control the World Wide Web, the group regularly hacks various government websites. Members of the group and their accomplices – hacktivists – also carry out constant cyberattacks on major security organizations. One representative of Anonymous, known by the name ColdBlood, explained his point of view and the movement's philosophy to The Guardian. "We are against corporations and governments which interfere in the internet.

We believe that the internet should be open and free to all. We do not forget, we do not forgive, our name is Legion!" The movement enjoys broad public support and many journalists describe them as modern "Robin Hoods of the World Wide Web".[57] (source: Wikipedia).

Fig.50 Supporters of Anonymous take part in public campaigns wearing masks from a Guy Fawkes cartoon. Los Angeles, 2008
Author: Vincent Diamante

https://commons.wikimedia.org/wiki/File:Anonymous_at_Scientology_in_Los_Angeles.jpg

The situation is made even more complicated by the fact that the cyberterrorists are active on the international level, which means they can be in one country and easily deliver a blow in another, even on a different continent. This greatly hampers the work of law enforcement agencies around the world. The following are just a few examples that illustrate the strength and capabilities of today's cyberterrorists.

Cases of cyberterrorism. Often. At scale. Fatal.

In 2011, in the United States, unknown hackers managed to penetrate the remote access system to a computer network managing a water treatment facility and deactivate at least one water

[57] https://www.cbc.ca/news/canada/from-anonymous-to-shuttered-web-sites-the-evolution-of-online-protest-1.1134948

pump. The law enforcement agencies deployed their best people to catch the miscreants but their efforts were unsuccessful.

On the night of 7 March 2014, one hour after taking off on a scheduled flight from Kuala Lumpur to Beijing, Malaysia Airlines flight NH370 disappeared from the radar screens. On board were 227 passengers and 12 crew members. The liner, in which absolutely all communication systems were suddenly deactivated, spent a further seven hours in the air. Despite the most extensive search operation in the history of civil aviation, involving 26 countries, the plane was never found. Some fragments of its fuselage were washed up on Reunion Island and the shore of Mozambique 18 months after the incident. The main official version of the cause of the disaster is **hijacking of the aircraft by unknown persons through deliberate deactivation of its communication systems and changing its course to an unidentified direction.**[58] To this day it is not known who hijacked the aircraft and drowned the people on board, how they did it, or why.

In 2015, an ordinary upstanding US citizen called Andy Greenberg was traveling in an ordinary American Jeep Cherokee SUV on an ordinary American highway at an ordinary, legally permitted speed of 110 km per hour. The next moment, he completely lost control of the car: the air conditioner suddenly came on at full blast although it was not hot in the car. Andy switched if off manually. Then the radio suddenly came on at an ear-splitting maximum volume. Next, a photograph of two unknown men dressed, for some reason, in sports gear appeared on the monitor screen and the car started to brake smoothly before coming to a complete stop, despite Andy's unsuccessful attempts to control it. And as a finale, the car drove into a ditch. This is not the start of some horror film based on the latest novel by the master of horror, Stephen King. It was a remote hacking attack via the internet against the onboard computer of Andy Greenberg's car by two men - Charlie Miller and Chris Walasek - sitting on their sofa 15 miles away. The hackers were never punished for what they did. On the contrary, they jumped on the hype train, writing numerous articles and speaking on talk shows. After the incident, the vehicle manufacturer was obliged to recall 1.4 million cars for an upgrade.

Between 2013 and 2014, hackers attacked the once-popular internet giant Yahoo and stole 3 (three) million personal accounts. For a long time, the company attempted to conceal the leak, until independent third-party observers began finding Yahoo customer data in the internet.

[58] Official Malaysia Airlines press release (19 March 2014).

On the morning of 21 October 2016, half of the population of the United States were cut off from the internet. The reason was a series of DDOS attacks against one of the biggest DNS providers in the world. The network was only restored several hours later. It turned out that the provider had been attacked by so-called "smart things:" hundreds of thousands of CCTV cameras, routers, domestic appliances etc. They had been infected by a specially written software virus called Mirai and had become part of a very very large botnet. Mirai had been created for the Internet of Things and for building gigantic botnets: every newly infected device started to contact others, seeking out vulnerable ones and infecting them. As for the cause of the cyberattack, according to experts from Cloudflare, Google and Akamai, the collapse of the internet was merely a random consequence of battles between conflicting groups of…gamers, whose main targets were the game servers of
The Elder Scrolls Online, Roblox, Xbox Live and PlayStation Network. [59]

On 18 May 2015, the FBI formally indicted a passenger for attempting to hack the control system of a Boeing 737-800 belonging to United Airlines. According to the Bureau, the perpetrator, who turned out to be information security expert Chris Roberts, had used a laptop and a network cable attached to the socket under the passenger seat (normally used to broadcast entertainment videos) to not only intercept the exchange of data between the pilots' cabin and the central computer, but also to gain control over the aircraft's engines. To demonstrate his "capabilities" online, he caused the aircraft to tilt and then immediately boasted of his skill in a tweet, generating a storm of admiring feedback from the world's hackers and simultaneously creating a headache for air safety system designers. But the most important thing was that until officials with handcuffs appeared at the steps of the safely landed aircraft, the crew had not even suspected that they had temporarily lost control of the plane.

[59] Source: Sergey Fedotenkov. https://3dnews.ru/1009634/10-samih-vpechatlyayushchih-kiberatak-v-istorii

Fig.51 Screenshot of the home page of the Ashley Madison website with the slogan "Life is short. Have an affair."

In 2015, criminals from The Impact Team stole the personal data of 40 million users of the Ashley Madison website. The website is famous for offering anonymous hookups and, in effect, matchmaking for married people in search of an affair. The terrorists obtained access to the online correspondence, names, home addresses, credit card details and even sexual fantasies of the adulterers. After blackmailing the website owners for a while by threatening to publish the data they had obtained unless they shut down the website, the hackers started sending out selective ransom demands to the victims. Once they got tired of blackmail, the criminals simply placed all the "intimate secrets" of millions of people in public access, even writing special software to enable search by email address. The result was devastating: millions of scandals, thousands of broken families and even several suicides. For example, on 24 August 2015, the Toronto police department reported "two unconfirmed reports of suicide" linked to a leak of customer profiles and extortion attempts. The police offered a reward of $500,000 for information leading to the arrest of the hackers.[60] At the time this book went to press, however, none of the criminals had been apprehended.

In 2016, the hacker group ShadowBrokers is thought to have stolen from another hacker group called Equation Group, understood to be linked to the US special services (National Security Agency[61]), a genuine cyber weapon exploiting the Zero Day vulnerability that

[60] Source: https://www.bbc.com/news/technology-34044506

[61] Source: https://xakep.ru/2016/09/26/nsa-mistake/

existed at that time[62] — uncorrected errors in the Windows family of software products form Microsoft. First, the hackers attempted to sell what they had stolen and then, probably when nobody bought it, they simply placed it all in public access. Naturally, this was immediately picked up by other unknown perpetrators, resulting in the super effective WannaCry "extortion worm" cyberattack which exploited the Windows vulnerability. The malicious software affected hundreds of thousands of computers all over the world and brought key infrastructure facilities, including hospitals, airports, banks, factories and others, to a standstill. The total damage caused by WannaCry exceeded $1billion and the criminals remain on the international wanted list to this day.

Fig.52 Screenshot: a computer infected by the WannaCry virus. The author and rights holder is being sought by Interpol. *https://ru.wikipedia.org/wiki/WannaCry#/media/Файл:Wa-na_De-crypt0r_screenshot.png*

[62] Zero Day – a term denoting undeleted vulnerabilities and malicious software against which protective measures have not yet been developed. (Wikipedia)

Fig.53 Countries affected by the WannaCry cyberattack in 2017.
Author: TheAwesomeHwyh

https://commons.wikimedia.org/wiki/File:Countries_initially_affected_in_WannaCry_ransomware_attack.svg

In March 2020, unknown persons stole the personal data of 267 million Facebook[63] users, which later turned up in the World Wide Web. The US Federal Trade Commission fined Facebook $5 million.

In June 2020,[64] hackers from Anonymous hacked the servers of the US law enforcement agencies and special services to gain access to 269 GB of classified data in over 1 million files, including videos, emails and audio files. They then passed them on to the hacker activist group DDoSecrets, which published the information. The scandal, which became known as BlueLeaks, was the most high-profile data leak from American government agencies.

In September 2020, bad actors hacked the data base of a psychiatric hospital, including medical files and audio recordings of conversations between psychiatrists and tens of thousands of patients. After demanding a ransom payment from the government of Finland, which refused to pay, the criminals leaked the data base to the Web.

And finally, in February 2021, unknown cybercriminals gained unauthorized access to the control system of a water treatment facility in the town of Oldsmar in Florida, USA, via an app for remote access to a TeamViewer computer, and attempted to poison the

[63] Declared an extremist organization and prohibited in the Russian Federation in 2022.

[64] Source: https://trends.rbc.ru/trends/industry/600702d49a79473ad25c5b3e

town's 15,000 residents by raising by 100 times – to a lethal level - the concentration of sodium hydroxide, which is added to purify the water entering the city's water pipe. Only thanks to the vigilance of the station operator on duty that day was a mass tragedy avoided.[65]

Cyberterrorism: a global challenge to public safety

Leading global powers recognize that the threat of cyberterrorism is a topical problem of a global nature, one that will grow continuously as information technologies develop and spread.

Already now, in total anonymity and with no need to risk their lives, hackers can paralyze entire countries. Thus, in 2010 personal computers at a nuclear power plant under construction in the Iranian city of Busher were infected by a powerful computer virus worm known as Stuxnet, which attacks computers running on Microsoft Windows. Stuxnet has attacked infrastructure facilities all over the world, but there have been more cases in Iran than anywhere else. To this day the precise number of facilities affected is unknown. What made the software unique was that for the first time in the history of cyberattacks, the virus physically destroyed infrastructure - power stations, water treatment facilities and industrial enterprises. The designer of the virus has still not been identified.

In the course of several attacks against South Korean banks and media companies in March 2013 (subsequently known as "Operation DarkSeoul"), computers were again destroyed. On the assumption that only North Korea could have attacked South Korea, the cyberattack attributes enabled the FBI to attribute to North Korea a separate attack against Sony (Libicki, 2015). But there is nobody the South Korean government can sue for compensation or damages. Slightly later, it emerged that as a result of two attacks by unknown hackers against the Saudi Aramco state oil company, data was wiped from over 30,000 computers.

On 22 December 2014, computer systems at 23 nuclear power plants operated by Korea Hydro and Nuclear Power Co. Ltd. in South Korea were hacked. The company, jointly with the government, quickly announced that the hackers had only succeeded in stealing "non-critical" data posing no risk to nuclear installations. Nobody believed them, however.

[65] Source: https://www.vice.com/en/article/88ab33/hacker-poison-florida-water-pinellas-county

In the depths of winter, on 23 December 2015, a hacker attack in the Ukrainian city of Ivano-Frankovsk caused 30 substations to stop working. Over 200,000 people were left without power for six hours in the world's first confirmed case of an electricity grid being knocked out.[66]

The losses from regular large-scale cyberattacks already exceed the damage caused by destructive hurricanes such as Katrina.[67]. Back in pre-COVID 2019, the "risk barometer" of major insurance company Allianz calculated that the economic damage from natural disasters between 2008 and 2018 amounted to $208 billion, while losses caused by hacking in 2018 alone amounted to over $600 billion. Damage caused by natural disasters is nowadays almost fully covered by insurance policies, though there is a critical shortage of insurance products offering protection against electronic and computer crime.[68]

The pandemic – a fertile hunting ground for hackers

Most dangerous is the fact that while scientists, lawyers and politicians attempt to produce a universal definition of artificial intelligence and establish its international legal status, criminals are actively exploiting self-learning neural networks to develop malicious software and carry out cyberattacks on the information infrastructure of enterprises, corporations and even government agencies.

And the mass adoption of remote working during the COVID-19 pandemic made digital platforms much more vulnerable to hacking attacks. Armed with the latest AI technologies, hackers also have no qualms about stealing personal data from private individuals.

Hacker groups around the world have now begun unofficially joining forces as "cyber troops" sponsored by the governments of many countries to attack critical information infrastructure, including communication networks and information systems of government agencies, fuel and energy systems, transport, financial and telecoms companies etc. As Russian Vice-Premier Yuri Borisov said back in

[66] Source: https://habr.com/ru/post/391439/

[67] Hurricane Katrina, the most destructive hurricane in US history, occurred in August 2005.

[68] https://www.allianz.com/en/press/news/studies/190115_allianz-risk-barometer-2019.html

December 2021, "The aim of the attacks is to paralyze the work of critical information infrastructure **and sow chaos.**"[69]

Fig.54 Raining Vendetta. Author: Wendelin Jacober,[70] 2015
https://commons.wikime-dia.org/wiki/File:Rai-ning_Vendetta.jpg

Leading experts[71] predict that in the near future the key goals of cyberattacks will be:

- destruction or active suppression of communication lines, incorrect forwarding, overloading of communication nodes;
- infliction of damage on individual physical elements of the information space, for example, the destruction of power supply networks, creation of interference, and use of dedicated software to destroy hardware;
- seizure of mass media channels in order to spread disinformation, demonstrate the power of the terrorists, and broadcast their demands;
- information-psychological campaigns etc.

[69] More detail available from RBC: https://www.rbc.ru/technology_and_media/1-3/12/2021/61b377649a7947d59106869f?from=from_main_10

[70] Source: https://www.flickr.com/photos/wendelinjacober/2819009-1316/in/photostream/

[71] Source: http://www.arms-expo.ru/news/archive/kiberterrorizm-ugroza-nacional-noy-i-mezhdunarodnoy-bezopasnosti14-03-2013-18-35-00/

And their techniques are constantly improving as computer network designers employ better protection tools.

The day the world will stop…

"What frightens me in today's situation is that the entire world is a unified system. If it fails, the collapse will be incomparable with what has happened in previous years. Then, even if one civilization perished, others remained at the service of progress…more and more people are ending up in the same boat. And either we resolve all our problems together, or together we harvest their bitter fruits, most likely on a catastrophic scale…," believes writer Robert Wright, author of the book "Nonzero: The Logic of Human Destiny."[72]

For our part, we can only add that according to the alarming forecasts of futurists brought together "under a single roof" by leading global expert Richard Watson in his book "The Future: 50 Ideas You Need to Know,"[73] the biggest problems associated with the wholesale digitalization of the world are still to come.

2022–2052 forecast:

2028 — All libraries are completely virtual.

2030 — 90 billion devices connected to the internet: hacking of medical data becomes an epidemic.

2032 — Computers implanted in 20% of people, 70% of adults use sentient avatars as personal assistants.

2035 — Hackers attack individually implanted life support systems.

2038 — 80 % of all operations are performed by robots.

2040 — Global population exceeds 8.8 billion: people no longer need to memorize anything; artificial intelligence becomes as powerful as human intelligence.

2042 — Computer virus knocks out 90% of machines.

2050 — Sentient robots become more numerous than people; lower class of people classified in DNA data base.

2052 — The day the world will stop (first global internet crash).

In 1966, in a speech during a visit to Cape Town, Robert Kennedy said: "There is a Chinese curse which says, 'May he live in interesting

[72] 2001 r., ISBN 0-679-75894-1.

[73] Phantom Press publisher, 2014.

times.' Like it or not, we live in interesting times."[74] And how can one argue with this? We really are living in very interesting times. But what should we all do about it? How do we overcome anxiety and stress? You will find the answers to these questions at the end of the book.

[74] "There is a Chinese curse which says, 'May he live in interesting times.' Like it or not, we live in interesting times." Robert F. Kennedy. Cape Town, South Africa, on June 7, 1966.

PART 2
People vs machines: threats, risks and challenges of Industry 4.0

> Welcome to the future. It is metallic and runs on batteries. ~~Ture~~ True, there is hope that it is good-natured and will not start developing ways of enslaving mankind.
>
> *Richard Watson, futurist, 2012*

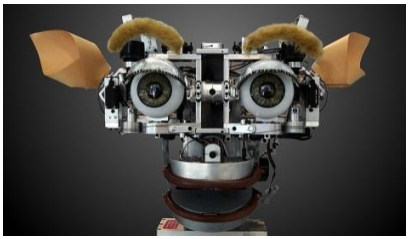

Fig.5 Kismet – an AI robot created in the late 1990s at the Massachusetts Institute of Technology. The name "kismet" comes from an Arabic word meaning "fate" or "luck." Author: Rama

https://commons.wikimedia.org/wiki/File:Kismet-IMG_6007-gradient.jpg

In place of an introduction

Over time, our tiny little children grow up. As we who gave them life and endowed them with skills and knowledge become weaker over the years, they become stronger and cleverer than us. In the early stages of parenthood, many of us think we can control our children and shape them in our own image and even according to our own caprices. But time shows that this is not the case.

When our children grow up, the only thing that can restrain them – both from "punishing" us and being unwilling to take care of us or respect our values and ideals – is moral and ethical principles. Principles that must be inculcated like basic software in the very earliest stages of evolution of their fledgling minds. Upbringing is the

main principle of transmission of power from person to person, from generation to generation. And these are the underlying principles on which mankind has developed from the moment it appeared to the present day.

However, this principle of upbringing and transmission of power and knowledge from generation to generation, which has seemed unshakable for thousands of years, may now be broken. To be more precise, it already is broken. As Shakespeare said, "The time is out of joint…"[75] And it's pretty unlikely we will be able to control the fallout of this breakdown. All we can really do is simply believe that we will be lucky once again…

And so, ladies and gentlemen, please welcome Artificial Intelligence (or AI) to the front stage of global history."[76]

AI: is the long-awaited heaven on earth here?

> The Fourth Industrial Revolution is the future mass deployment of cyber physical systems in production (Industry 4.0), as a result of which change will embrace all aspects of life: the labor market, the living environment, political systems, the technology setup and even human identity. Industry 4,0 brings risks of increased instability and the possible collapse of the global system, so that its arrival is being perceived as a challenge to which mankind will have to respond.
>
> *Klaus Martin Schwab,*
> *Executive chairman of the World Economic Forum*

In a book published in 2017 by Klaus Schwab, Executive Chairman of the World Economic Forum, entitled "The Fourth Industrial Revolution," AI is given pride of place as the main connecting link between existing autonomous robotized devices and human society. Indeed, AI, which has already become the central link in the digital economy, is actively embarking on a transformation of the physical world. And to a considerable degree, the global COVID-19 epidemic

[75] Quotation from Shakespeare's "Hamlet"

[76] Often abbreviated to AI

is facilitating this rapid and universal deployment of AI in our daily lives.

We are no longer surprised that AI helps us to shop online, choses music or friends for us, overcomes language barriers, invests our savings, monitors traffic, provides medical diagnoses and helps maintain public order. Thousands of robots all over the world carry out surgical operations on human beings. Unmanned vehicles have already travelled millions of kilometers on public roads. In China, they have special road traffic regulations for autonomous vehicles. Since 2017, South Korea, Japan and Spain have had brothels in which sex robots provide intimate services to human customers.[77]

And this, according to the scientists, is just the beginning. In the future, AI will conquer space flight, take full control over the transport sector, become dominant in finance, industry, education etc. In the USA, the first robot lawyer is already at work. Next in line are robot security guards, robot pharmacists, robot chefs, robot teachers, robot trainers, robot athletes, robot carers, robot board members…The list goes on and on.

Fig.56 A teaching scorpion robot. Author: Kirill Borisenko
https://commons.wikimedia.org/wiki/File:TOPIO_2.0.jpg

[77] Sex robots win human hearts. // BBC Russian Service (5 July 2017) (date of request: 21.01.2022).

Fig.57 TOSY 2: an android robot with artificial intelligence for playing table tennis.
Автор: Lylodo
https://commons.wikimedia.org/wiki/File:IASER_scorpion-robot_during_%27Nebo_2022%27_festival.jpg

Fig.58 An actroid developed by Hiroshi Ishiguro - the "ideal secretary" who smiles and flutters her eyelids."
Author: Gnsin
https://commons.wikimedia.org/wiki/File:Actroid-DER_01.jpg

Some optimistic citizens will say this is great news and suggest that we hand over every organizational and management task to AI. Let controllable AI robots do all the "dirty work" for people without having to be paid, given days off or granted equality. No longer encumbered with the need to earn a crust through daily labor, people will then be able to live in affluence and peace, devoting themselves to endless leisure, entertainment, reflection and creativity.

And indeed, in an ideal world, this would all look extremely attractive and absolutely harmless. But if that is the case, why are the best human minds continuously sounding the alarm?

AI: the biggest threat faced by civilization?

Back in 2014, the world-famous British physicist and writer Stephen Hawking somewhat dented the optimists' picture of "universal happiness" by stating the following in an interview to The Independent: " Such achievements will probably pale against what the coming decades will bring. Success in creating AI would be the biggest event

in human history. **Unfortunately, it might also be the last, unless we learn how to avoid the risks… One can imagine such technology outsmarting financial markets, out-inventing human researchers, out-manipulating human leaders, and developing weapons we cannot even understand. Whereas the short-term impact of AI depends on who controls it, the long-term impact depends on whether it can be controlled at all."**[78]

Hawking's concerns are echoed by Elon Musk, engineer, inventor, entrepreneur, and founder of the Tesla Motors and Space X innovation projects. In January 2015, **Musk described artificial intelligence as a "demon created by man"** and donated $10 million to research in controlling AI. At that time, the entrepreneur and philanthropist hoped that AI developers would be able to control it and stop the "bad guys" – in the form of some digital super-intelligence created in the near future – from escaping and hiding in the expanses of the World Wide Web. Two years later, Musk was more categorical. Speaking at a summit of the US National Governors Association, he stated loud and clear: **"I am continuing to sound the alarm, but until people themselves see robots walking the streets and killing people, they will not know how to react to artificial intelligence."** Musk has also described artificial intelligence as "the biggest threat civilization has faced" and noted that mankind needs to be extremely cautious with a technology that is "potentially more dangerous than nuclear weapons." In his words, if we don't intervene in the development of these systems in good time, it will be too late.[79]

Let's take a look at what AI is all about and why scientists believe it is so dangerous.

AI: a brief history

To begin with, it is worth clarifying what intelligence is. According to one of the most universal definitions, "intelligence is the ability of a system to create through self-learning software (primarily heuristic)

[78] Stephen Hawking…Are we taking AI seriously enough? // The Independent. 01 May 2014. URL: https://www.independent.co.uk/news/science/stephen-hawking-transcendence-looks-at-the-implications-of-artificial-intelligence-but-are-we-taking-ai-seriously-enough-9313474.html (date of access: 11.11.2022).

[79] Elon Musk. Mankind needs to be careful… https://www.forbes.ru/newsroom/milliardery/405911-mask-nazval-samyy-opasnyy-dlya-chelovechestva-iskusstvennyy-intellekt (date of access: 12.04.2021).

to resolve tasks of a specific class of complexity and to resolve these tasks."[80]

In this respect, human intelligence and machine (artificial) intelligence are equal. However, it is the ability to learn rather than to memorize that distinguishes AI from a simple programmed computer. And it is for this reason that AI, like any other breakthrough technology, poses enormous and unpredictable risks, as well as offering great opportunities. Those same risks exist when training people but with completely different consequences.

What we know for sure is this: if some highly-talented individual learns from good mentors using excellent methodologies, there is no guarantee that anything worthwhile will result from their training. Given favorable conditions, most people learn well, become professionals in their chosen occupation and do their job well. But there are numerous examples of a good education leading to highly negative results. People are unpredictable beings. And in the near future, machines with artificial intelligence could be the same…

So, in contrast to commonly used programmed robots, AIs are like people in the sense that they do not need a mentor to learn. To speed up the process and get faster results, people have taught AIs to learn independently – self-learning. In the generally accepted terminology, this is known as machine learning[81] and it has become possible thanks to several breakthrough discoveries.

In 1943, W.McCulloch and W.Pitts were the first to formulate the concept of neural network: a mathematical model built on the principle of organization and functioning of biological neural networks in nerve cells. Then, in 1958, F.Rosenblatt proposed the single-layer perceptron: (from Latin: "perception"): a cybernetic model of perception of information by the human brain. Two years later, in 1960, this concept was used to create the Mark-1 electronic computer, which was described as the world's first neurocomputer capable of independently solving simple tasks.

[80] F.N.Ilyasov. Artificial and natural intelligence // News of the Academy of Sciences of the Turkmen SSR, Social Sciences series. 1986. № 6. pp. 46–54

[81] Machine learning (ML) – a class of methods of artificial intelligence characterized not by the direct solution of tasks but by learning through the application of solutions of a multitude of similar tasks.

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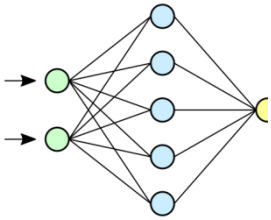

Fig.59 Diagram of a simple neural network. Green indicates input neurons, blue – hidden neurons, and yellow – output neurons. Authors: Dake, Mysid

https://commons.wikimedia.org/wiki/File:Neural_network.svg

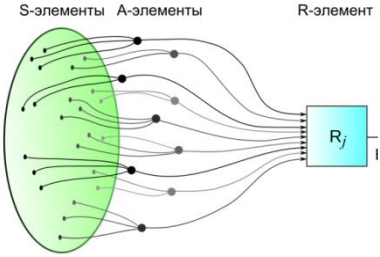

Fig.60 Logic diagram of an elementary perceptron. The signals arrive from the sensory field in the resolvers of the elementary perceptron in its physical embodiment.
Author: Alex Krainov

https://ru.wikipedia.org/wiki/Перцептрон#/media/Файл:Perceptron_physical_implementation-ru.svg

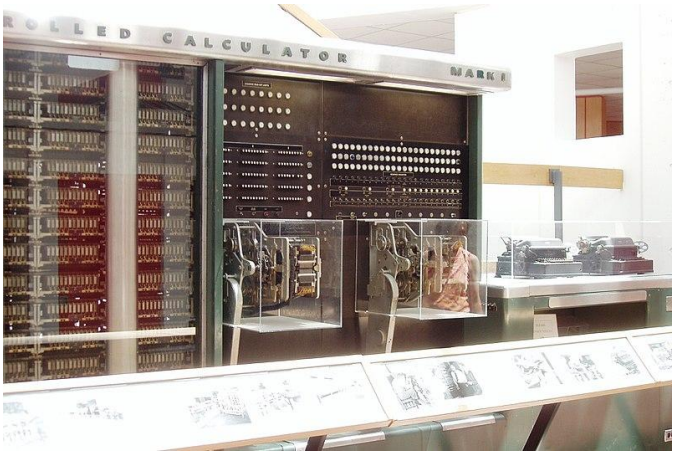

Fig.61 Mark-1 in the Harvard Museum. Author: Topory

https://commons.wikimedia.org/wiki/File:Harvard_Mark_I_Computer_-_Right_Segment.JPG

In the late 1980s, the single-layer Rosenblatt perceptron was developed further with the creation of multi-layer perceptrons capable of self-learning using a method known as the "backpropagation algorithm," invented in 1974 by Paul J.Werbos and A.I.Galushkin independently of one another.

It is the application of the backpropagation algorithm in multilayer perceptrons that enables AI to learn at great speed without a

teacher. Thanks to this algorithm, a self-learning artificial neural network can be described as a "black box" consisting of trials and errors, or, if you prefer a "pig in a poke." The aim is to use the self-learning process to produce a ready-made system for solving a specific range of tasks, such as facial recognition in CCTV images.

Despite being a game-changer with numerous examples of successful application, this algorithm has a number of substantial shortcomings. First, it is impossible to guarantee that training will be successful. Second, it is not known how much time the neural network might need for learning. Third, if a negative result is obtained at the end of the process, the researcher cannot analyze what went wrong and in which stage of the training.

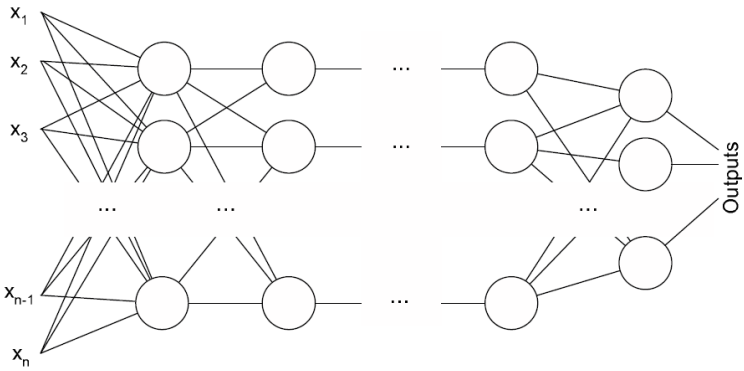

Fig.62 The "black box" of a multilayer perceptron using the backpropagation algorithm, showing numerous information inputs on the left and output on the right. The dotted lines on the diagram indicate AI self-learning zones that nobody can check. Author of diagram: machine algorithm

https://ru.wikipedia.org/wiki/Файл:Neuro.PNG

Yet it is no big deal if the AI fails to learn during the self-learning process: things would be much worse if it learns too well. It is likely that in the course of self-learning AI will turn into a "superintelligence," and this is where the really big problems could arise…

AI: hello Superintelligence?

Fig.63 Screenshot from social media, from open sources.[82] Robots rebel and attack humans: a 1928 performance of Karel Capek's sci-fi play R.U.R. (abbreviation from Czech: "Rossumovi univerzální roboti"). Unknown photographer *https://commons.wikimedia.org/wiki/File:Capek_RUR.jpg*

Rebellions by robots against people led by AI have been described many times in books and films. And the main plotline in most of these works is the inevitable confrontation between man and machine, with the robots winning an unconditional victory over the people who created them. These works of art have been historically termed "science fiction," but in today's world they look all too scientific and not quite so fictional.

AI has already surpassed human beings in a number of areas. For example, the chess world recently held a rather modest, downbeat celebration of the 25th anniversary of the defeat of the world's best chess player by a machine. The story began in 1996, when Deep Blue – a chess supercomputer developed by IBM which became the best of its kind – challenged the then world chess champion, Garry

[82] The Turing Test: an empirical test proposed in 1950 by Alan Turing, testing man's ability to determine from anonymized correspondence whether he is interacting with a human being or a computer.

Kasparov. In the first match, Kasparov actually defeated Deep Blue I, though not without difficulty, with a score of 2:4.

Fig.64 One of the two racks of the Deep Blue supercomputer that caused such dismay to the human world chess champion. Author: James
https://commons.wikimedia.org/wiki/File:Deep_Blue.jpg

But just 18 months later, in May 1997, the upgraded Deep Blue II went down in history by defeating Kasparov with a score of 3½:2½.

Attentive and well-informed readers will object that a super-computer is merely a programmed machine with high productivity, so where is the "artificial intelligence" here? We agree, but here is another example which is closer to our topic.

It was on the basis of super high-productivity computers that artificial self-learning neural networks capable of solving creative tasks were created. Thus, in 2015, Google developed its AlphaGo program to play Go. By comparison with chess – a game that can be fully predicted and algorithmed – Go is many times more complex in terms of the number of possible positions (in Go, moves can be made anywhere on the board and the board itself has more than five times the number of cells of a standard chessboard) and playing options. The most important thing is that it requires the player to display deep strategic thinking – an abstract conceptual category that cannot be programmed.

Unlike the Deep Blue supercomputer, which plays chess on the basis of pre-calculated algorithms and is tied to specific software, to teach AlphaGo the developers at Google DeepMind used only the deep learning method based on multilevel neural networks. In other words, AlphaGo is, in effect, a rational player which does not use algorithms or evaluation functions like chess software but learns exclusively from analyzing the best games already played by top professionals.

The outcome of AlphaGo's self-education took even its creators by surprise: in 2016, AlphaGo became the first thinking machine in the world to win a match against Lee Sedol – a 9th dan (highest rank) professional and the best Go player on the planet at that time - with a devastating score of 4:1.

"The advent of artificial intelligence will replace not only translators, underwriters and drivers, but also you and me," claims Russian entrepreneur Lev Khasis. "I have spoken with people who were physically present at the Go match in which man was beaten by artificial intelligence. And they told me that the people who had actually created that machine sat there and watched the blinking lights. ***They said they didn't understand what was happening, they didn't understand how the machine was thinking, why it was thinking like that and why it made the moves it did…"***[83]

Here is another example of how an intelligent machine has surpassed man in solving an unconventional creative task. One of the most important practical applications of AI today is recognition of shapes and faces in digital images.

[83] "Guys, you're doomed". L.Khasis and R.Vardanyan on the technological revolution. URL: https://republic.ru/app.php/posts/68944 (date of request: 02.04.2021).

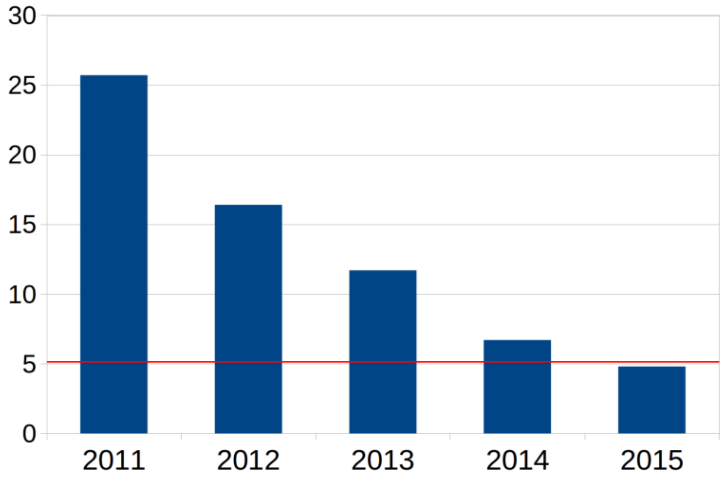

Fig.65 Progress in machine classification of images: percentage of errors (%) of the winner of the ImageNet competition each year. The red line indicates frequency of errors in a trained human commentator.
Source of data: Dean Takahashi, author of graph: Sandegud
https://venturebeat.com/business/google-expert-explains-why-deep-learning-neural-nets-are-hot-in-everything-from-games-to-recognizing-cats/
https://commons.wikimedia.org/wiki/File:Classification_of_images_progress_human.png

Since 2011, researchers at Stanford University, Princeton University, Google and A9 have been running the ImageNet competition for the best image recognition AI – one of the most prestigious and long-term studies in the field. The error level of a specially trained human being is just 5.1%, while over the space of five years AI has demonstrated impressive progress from 26% to less than 5%, catching up with and even slightly overtaking the human operator!

But like its creators, AI is highly prone to making mistakes. Moreover, we already have examples where people are no longer able to understand what an artificial intelligence "under their control" is doing.

"Sorry, something went wrong," or the interrupted experiment[84]

> Science has not yet mastered prophecy. We predict too much for the next year and yet far too little for the next 10.
>
> *Astronaut Neil Armstrong, the first man on the Moon*

We have already recounted how American sociologist Charles Perrow, having spent many years studying the social and technological aspects of "man-made disasters," introduced the concept of ordinary or systemic accidents, based on the fact that **some complex systems cannot be made sufficiently safe and the existence of systemic errors is an inalienable property of them.**[85] Here is what happened with one experiment involving interaction between man and artificial intelligence in a well-known social network.

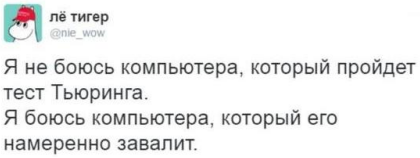

Fig.66. Screenshot from social media, from open sources[86]

Translation: "I'm not afraid of a computer that will pass the Turing test.

I'm afraid of a computer that will deliberately fail it."

In July 2017, it became known that the management of Facebook[87] had been forced to deactivate its artificial intelligence system (Facebook Artificial Intelligence Research project (FAIR)) after some

[84] Excerpt from the book: D.V.Mun, V.V.Popeta, From the Titanic to the Winter Cherry. Algorithms of future disasters (link + data).

[85] Perrow Ch. 1984. Normal Accidents. Living with High Risk Technologies. N. Y.: Basic Books. 386 p.

[86] The Turing Test: an empirical test proposed in 1950 by Alan Turing, testing man's ability to determine from anonymized correspondence whether he is interacting with a human being or a computer.

[87] Facebook, owned by Meta, declared an extremist organization in the Russian Federation.

machines (chatbots) started communicating in a nonexistent language of their own which people could not understand.

The chatbots had initially been created for communication with real people. They began by communicating in English but gradually started talking amongst themselves, and at one point started corresponding in a language which they themselves had created in the process of software development – a language that the system's developers were unable to understand…

The experts who terminated the experiment feared that **if bots start to communicate in their own language, they would gradually become more and more independent and be able to function beyond the control of IT specialists.**[88]

Commenting on this incident, Valentin Malykh, a researcher at the Neural Systems and Deep Learning Laboratory in the Moscow Institute of Physics and Technology, said:[89] "…if you look into the more remote future, where computers will be quite powerful, it's worth remembering that a computer has no body, eyes or stomach – it will perceive everything around it in a completely different way to us and will invent a language that is very different to ours. Because a computer will perceive absolutely everything differently: it will want something different and fear something different – it will also think in a different way. It follows from this that the interests of people and those of computers will hardly overlap or not overlap at all. So, there is a great chance that we will simply "have nothing to talk about." In other words, we will coexist but with virtually no interaction, in the way that people and dolphins (regarded as the second-most intelligent species on the planet) coexist now."

On 7 August 2017, Facebook[90] was hit by a global crash. Users all over the world lost access to their accounts and instead of their pages saw the following:

[88] Source: http://www.bbc.com/russian/features-40778454

[89] RBC: http://www.rbc.ru/opinions/technology_and_media/04/08/2017/598453329a7947214bab8e50

[90] Owned by Meta, declared an extremist organization in the Russian Federation.

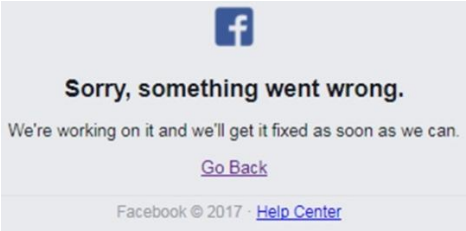

Fig. 67 Screenshot from the home page of Facebook (owned by Meta, declared an extremist organization in the Russian Federation), 2017

A few hours later, control was reestablished over the world's biggest social network. It was probably just a coincidence…But perhaps not all the chatbots had been knocked out, and some are still living on in the web and wreaking revenge on their own creators for their lost soulmates!? Here one cannot but recall Skynet – the AI from the movie Terminator, an imaginary US Defense Department computer that set off World War III.

In this Hollywood blockbuster, Skynet is a supercomputer built by the US company Cyberdyne Systems for the US Defense Department to manage a fictional organization - the US Missile Defence and Nuclear Weapons Forces. One fine day, due to a software failure or something similar, Skynet ceases to be an assistant - a "weak," controllable and manageable artificial intelligence - and turns into a "strong" "superintelligence" possessing self-awareness and free will. Provoking an exchange of missiles between nuclear superpowers Russia and the United States, it then starts a war for the complete annihilation of mankind.

Fig.69 Skynet logo. Screenshot

https://commons.wikimedia.org/wiki/File:Skynet.svg

Fantasy, you say?

Suicidal ROBOCOP…

> A robot may not harm humanity, or, by inaction, allow humanity to come to harm. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.
>
> *Isaac Azimov*
> *Three Laws of Robotics, 1942*

Fig.69 The entrance to Knightscope HQ is protected by indefatigable security guards of its own manufacture, 2016 r. Author: Alison Chaiken
https://commons.wikimedia.org/wiki/File:KnightScope_Security_robots_(28155897221).jpg

One fine summer's day, the management of the Georgetown Waterfront mall in Washington demonstrated the latest achievement in science and technology: K5, a robot policeman developed by

Knightscope to perform CCTV monitoring and maintain public order.[91] "The town has a new sheriff," "the robot is better than a real security guard because it never gets bored," and similar PR claims from Knightscope accompanied the amusing 130kg contrivance with built-in light bulbs, as it fearlessly patrolled the company's grounds.

But a couple of weeks later, robocop did actually get bored. And to give itself and the onlookers a break, hurled itself at top speed into the mall's fountain and happily drowned. Bilal Farooqui, one of the mall's employees, posted a photo of the drowned robot on Twitter with the ironic caption: "We were promised flying cars but instead we got a suicidal robot."

Fig.70 Screenshot from Twitter. Author: bilalfarooqui. From open sources.

BF *@bilalfarooqui* *10:05 PM Jul 17, 2017*

https://www.cnet.com/news/robot-cop-found-floating-in-fountain/

Commenting on this incident, Stacy Dean Stephens, Knightscope's vice president for marketing and sales, said that the police robot was a pilot project and that these kinds of incidents are

[91] RIA Novosti: https://ria.ru/world/20170718/1498700680.html

very important as they show specialists the errors in the device that need to be eradicated. And now the company's engineers have put all their efforts into finding and eradicating the defects that led to such a sad conclusion. He stressed in particular that none of the mall's employees or visitors had been hurt.

A year earlier, Mr Stephens had already had to justify himself to the public for **another K5 robot of the same model which, in violation of Azimov's laws, had caused damage to a human being…**

It happened in a shopping mall in California. While patrolling the grounds, the Knightscope K5 bot knocked an 18-month-old boy off his feet and then ran over him. "The robot hit my son on the head, he fell face down, and the robot ran over him without stopping," said the boy's terrified mother, Tifanny Teng, to a human policeman. The child got off with a bruise and few scratches.

Apologizing to the public for the robocop attack, Knightscope's vice president for sales and marketing stated: "**This is a terrible event, but we believe that our technology and bots are incredibly safe. We will do everything possible to ensure that this is the case."**[92] Believing is not enough, however.

ROBOCOP murderer…

Robot manufacturers try to hush up these incidents, but they are already occurring, some of them even with fatal outcomes. In late 2016, at an exhibition of Chinese technology, the Chinese robot teacher Little Chubby suddenly started wrecking a glass stand set up by its creators. An exhibition worker who tried to stop the out-of-control bot received an injury to the ankle and was taken to hospital on a stretcher. The manufacturer blamed the machine's operator for what had happened, explaining that he had "confused the "Forward" and " Back" buttons" and opened the collision avoidance system's control panel."

A bloodcurdling incident occurred in 2015 at a Volkswagen factory in Germany. During adjustment of the automated system for moving auto parts, the robot manipulator grabbed a software engineer and pushed him against a metal plate. The 22-year-old man later died from his injuries. According to the official investigation, the cause of the incident was – yes, you guessed it – the human factor, which had led to a system failure.

[92] Margarita Gerasyukova, https://www.gazeta.ru/tech/2017/07/18/1-0792748/robot_incidents.shtml

In 2007, a South African robotized Oerlikon GDF-005 air defence gun started firing randomly, killing nine soldiers and injuring 14 others.[93] The military said the incident had been caused by a failure of the computer software controlling the gun.

In 2017, at the Ventra Ionia Mains factory in America, an industrial robot which someone had switched on for some unknown reason, accidentally smashed the head of a female employee who was doing technical maintenance work. The company has provided no official explanation of this incident…

The list of victims goes on and on.

AI: death under the wheels

There is already a precedent of someone dying under the wheels of a car that was fully controlled by a self-learning AI-based autopilot.[94] It happened in 2018 in the city of Tampa, USA. During testing of a driverless taxi by Uber, the autopilot controlling the vehicle knocked down 49-year-old Elaine Herzberg, who had dismounted her bicycle and was crossing the road in an undesignated area.

Fig.712 Screenshot: the victim was recorded on CCTV one second before the collision. Author: TEMPE POLICE DEPARTMENT

Source: https://www.bbc.com/russian/news-54166083

[93] Source: https://www.iol.co.za/news/south-africa/9-killed-in-army-horror-374838

[94] Source: https://www.bbc.com/russian/news-54166083

Fig.72 The Volvo SUV fitted with an autopilot, after the collision. Author: US National Transportation Safety Board

Source: https://worldcrunch.com/tech-science/killer-software-boeing-737-max-and-other-fatal-computer-bugs

It is noteworthy that to keep an eye on the autopilot, the company conducting the experiment had hired a driver, who was supposed to watch the road situation and intervene quickly if an emergency arose. However, the investigation revealed that while the autopilot was self-learning on the public highway, the "specially trained" driver, instead of performing his actual function of observing and monitoring the actions of the autopilot, was busy…watching The Voice talk show on his smartphone. Unsurprisingly, the driver pressed the brake pedal only after the autopilot had knocked down the pedestrian.

Following numerous expert reviews and lengthy investigations, a court ruled that the driver in the car was responsible for the incident. But Elaine Herzberg was also deemed indirectly responsible: "although the automatic driving system had spotted the pedestrian almost six seconds before the collision, the system did not classify her as a pedestrian and was unable to predict her goal as a reckless pedestrian or cyclist because she was crossing the street in a place where there was no crossing: **the system design did not allow for reckless pedestrians,"** according to a report by a special government department. So, there we have it: despite all the achievements of technical progress, human beings are still responsible for their own life and safety…

Uber managed to avoid criminal liability, but the US Transport Safety Board noted, amongst other things, that before putting an AI-controlled vehicle on the road, the corporation should have properly

calculated the potential risks and ensured due supervision of the car's movements. The State of Arizona then announced a ban on future testing of driverless vehicles on public highways. In response to the verdict of the court and government agency, Uber wound down its driverless taxi program and sacked all employees engaged on the project.

The belated measures adopted by AI designers and regulatory agencies will never restore Elaine Herzberg to her nearest and dearest, however. How many more people will be sacrificed to scientific progress before AIs learn to take reckless pedestrians into account?

AI: an irresponsible responsible party?

But how should one act in a situation where the recommendations of an AI adviser result in a company or citizen suffering major losses? For example, in 2019 the head of Sberbank, Herman Gref, admitted: "Because the machine committed a minor error on big volumes, we lost billions of roubles." But as Sberbank's press office subsequently assured the public, this was "merely" foregone earnings. It won't be long, however, before we're talking about real losses. And then the big question will arise: who is to blame?[95]

But don't be in a rush to think that the owners and creators of AIs will bear full responsibility for their actions or omissions. In a number of "progressive" countries, including South Korea, the world leader in deploying AI robots, a new law was enacted in 2013 granting AIs the rights of a legal entity: in other words, having acquired the legal status of "electronic individual," AIs themselves will be responsible for AI errors. But how do you punish an AI which, for instance, is ruled by a court to be guilty of causing harm to a human being? How will the court determine whether a specific electronic individual committed a crime against a human being (or, in the worst case, against mankind) accidentally or deliberately? And how are we to punish an AI for deliberate crimes? Put them in some kind of future "digital prison" in order to isolate dangerous "electronic criminals" from their fellows? Or disconnect it from its power source altogether? And what if a group of progressive rights activists starts a campaign to defend the rights of AIs and introduce a moratorium on the death sentence for "digital

[95] Source: https://www.vedomosti.ru/finance/news/2019/02/26/7951-34-gref?fbclid=IwAR1juIvjplWAKrfDBqqbwOZVlQTk0fuKildkmS5mk5uqfga4r07NKURknhU

individuals?" These questions are not a storyline for a sci-fi series, but moral and ethical dilemmas for the very near future.

More speed, more risks

> You can't produce a baby in one month by getting nine women pregnant.
>
> *Folk wisdom*

Let us summarize the above. The main purpose of training is to teach the trainee how to think, rather than just memorize things. Each learning process, whether for a person or an AI, is unique, unrepeatable and unpredictable.

In order for people to learn how to think correctly, so that their leaning process brings benefit rather than harm, they not only need to be provided with the necessary information for independent reading and reflection on what they have read – they also need to be educated, first and foremost, in the moral and ethical aspects.

Training an AI is identical to training a person. In the case of AI, however, most developers leave out the moral education, which is nevertheless an extremely important stage in the evolution of a fully-fledged creative personality. Instead, in a race to commercialize their products, developers want to immediately endow artificial intelligence with power and autonomy, without realizing the risks or fully understanding the potential repercussions.

Where the creation of AIs is concerned, many key documents adopted by governments around the world envisage first creating "something" under the name of "universal or autonomous intelligence." And to speed up the creative process as far as possible, this "something" is to be immediately invested with power that people know they will not be able to control, postponing any thoughts about the attendant risks until later.

In theory, the general rules of safety should be drawn up first, but in the global race for AI now underway, there is simply no time for this.

Another question is whether AI, being already stronger and cleverer than the people who created it, will obey people if it has not gone through a biologically verified stage of moral and ethical evolution. This is the real issue. Already in the current stage of AI development, the lack of understanding of how it achieves its results is one of the causes of the low level of trust in it and, consequently, is a hindrance to its future development.

In any event, an analysis of the history of other breakthrough technologies vividly demonstrates that the development of accompanying safety measures always lags far behind. And you don't have to go far in search of examples.

People are creating AIs in order to be served by them. But here is what might happen if an AI falls into the hands of people with criminal intentions.

AI: battlefield pharmaceuticals

Pharmaceuticals is a key sphere of scientific activity in which AI has been used very intensively for quite some time. For example, researchers are successfully using machine learning to find new and effective medicines. However, an experiment[96] by Collaborations Pharmaceuticals using the MegaSyn AI molecule generator developed by the company itself forces us to think again about the damage that technology could do if used for criminal purposes.

The researchers behind the experiment trained MegaSyn on molecules from a public data base of medical substances and then decided to set the AI the inverse problem: instead of seeking "healing" combinations of molecules, to generate substances of maximum toxicity to the human body. Les than six hours later, the neural network had produced a list of 40,000 new substances which could be used, alongside science's existing "arsenal" of biological and chemical weapons, for the mass annihilation of people.

In a subsequent publication, the scientists confirmed the obvious conclusion that being inherently devoid of moral limitations, AI can successfully solve both creative and destructive tasks set by people…

In place of a conclusion

Knowledge is strength. Knowledge multiplied by technology is power. This is why many people with an obsessive desire for power are hunting for knowledge and technologies. And when, sooner or later, theories and technologies invented by scientists fall into the hands of people obsessed with power, we can expect problems. Instead of smiles and Gardens of Eden there will be endless wars, destruction

[96] Dual use of artificial-intelligence-powered drug discovery Fabio Urbina, Nature Machine Intelligence. Published: 07 March 2022. https://www.nature.com/articles/s42256-022-00465-9

and fear. This is what Herbert Wells warned his contemporaries, and also future generations, about. (Book 1, Chapter. Lessons of History. "Preventing Man-made Disasters" series).

And that is why, at the dawn of this new scientific and technological breakthrough, while scientists are dreaming about how to bring joy and happiness to the entire world through their inventions, writers, artists, film directors and other creatives are producing work that is far from optimistic.

We shall now list the areas in which we believe artificial intelligence poses the greatest risks.

Fig.73 In 2019, the armed combat robot Eagle Prime was put on open sale on eBay by its developer MegaBots Inc.

Photo from open sources

Fig.74 Domestic robot – servant, assistant, cook, quiet, peaceful and obedient – this is usually how people envisage the robot of the future… Author: Rlistmedia

https://commons.wikimedia.org/wiki/File:Housekeeping_Robot.png

Fig.75. Kuratas combat robot. Author: pha pha

https://commons.wikimedia.org/wiki/File:クラタス・Maker_Faire_Tokyo_2012.jpg

But something started going wrong a long time ago…

In the context of the global arms race, governments and corporations in most countries of the world are investing hundreds of billions of dollars in the creation of robotized combat machines endowed with artificial intelligence. And all attempts by international and public organizations to ban, or at least restrict, these types of developments are doomed to fail because the stakes are too high. Nobody wants to lose the battle for future global supremacy.

In response to this situation, in 2017, an initiative group of mangers from over 100 companies that are global leaders in robotics and AI development, wrote an "OPEN LETTER TO THE UNITED NATIONS CONVENTION ON CERTAIN CONVENTIONAL WEAPONS"[97] to the UN.

"As companies building the technologies in Artificial Intelligence and Robotics that may be repurposed to develop autonomous weapons, we feel especially responsible in raising this alarm… Lethal autonomous weapons threaten to become the third revolution in warfare. Once developed, they will permit armed conflict to be fought at a scale greater than ever, and at timescales faster than humans can comprehend. These can be weapons of terror, weapons that despots and terrorists use against innocent populations, and weapons hacked to behave in undesirable ways. We do not have long to act. Once this Pandora's box is opened, it will be hard to close. We therefore implore the High Contracting Parties to find a way to protect us all from these dangers."

Alas, this appeal to reason went unheard.

Pandora's box has opened

In Libya, in March 2020, a Kargu-2 autonomous drone tracked down enemy personnel and independently destroyed them without receiving a command from an operator. The incident was described as follows in a special report by UN experts: "The lethal autonomous weapon systems were programmed to strike targets without requiring communication between an operator and the

[97] https://futureoflife.org/open-letter/open-letter-united-nations-convention-certain-conventional-weapons-russian/

armaments: in essence, this was full-fledged application of an autonomous targeting mechanism."[98]

This incident is the first known case in which someone has been killed independently by an attack drone fitted with artificial intelligence. The body count has begun, Pandora's box has opened…

Having no contact with the drones, the operators were unable to control their operating mode. And if events unfolded precisely as described in the report, this case can be regarded as an important precedent.

Fig.76 STM Kargu kamikaze drone. Developer and manufacturer - Savunma Teknolojileri Mühendislik ve Ticaret AŞ. Screenshot

Photo from open sources[99]

Fig.77 Screenshot from a video advertising the Kargu drone.
In the video, the weapon dives towards its target before exploding

Source: https://thebulletin.org/20-21/05/was-a-flying-killer-robot-used-in-libya-quite-possibly/

Just one question remains: which of us will be next in the killer robot's red crosshairs?

[98] The Black Box, Unlocked 22/09/2020 Arthur Holland Michel, UNIDIR autonomous institute within the United Nations: https://unidir.org/publication/black-box-unlocked

[99] EMRE CAVDAR/STM https://www.newscientist.com/article/2278852-drones-may-have-attacked-humans-fully-autonomously-for-the-first-time/

PART 3
"Outlawed people": the future and victims of the automated transport industry

The cars you're driving today will eventually be outlawed.[100]

Elon Musk, 2015

Though progress presents us with amazing opportunities, I see my task as to draw attention to the dangers and threats relating to them. Since the corporations and entrepreneurs who lead the technological revolution naturally tend to sing the praises of their creations, it falls to sociologists, philosophers and historians like myself to sound the alarm and explain all the ways things can go terribly wrong.

Yuval Noah Harari
21 Lessons for the 21st Century[101]

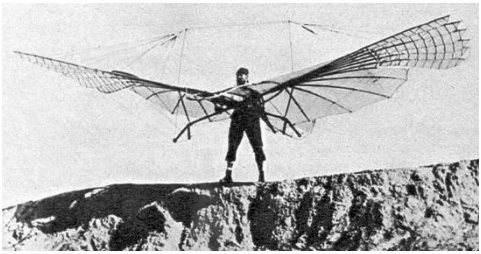

Fig.78

Aviation pioneer Otto Lilienthal before testing a glider of his own design, 16 August 1894. Author: Ottomar Anschütz

https://commons.wikimedia.org/wiki/File:Otto_is_going_to_fly.jpg

[100] Source: https://www.theverge.com/transportation/2015/3/17/8232187/elon-musk-human-drivers-are-dangerous

[101] Yuval Noah Harari. 21 Lessons for the 21st Century. Sindbad publishers, 2019. ISBN 978-5-00131-137-9.

Progressive technologies demand victims…

On the tragic day of 9 August 1896, German engineer and aviation pioneer Otto Lilienthal, the man who provided a scientific explanation of how birds fly and created the science of gliding, an entrepreneur who had launched series production of a "standard glider" in Germany, fell and broke his spine due to a gust of wind during his latest flight on a flying machine of his own design. Before dying, the inventor told his brother Gustav that "sacrifices have to be made…"[102]

This story demonstrates that in the initial stages of development and mass adoption, any breakthrough discovery or technology brings not only unheard-of opportunities but also fundamentally new threats and risks. Once they become known, these risks are studied, but only after the damage has been done to the many, very many people who happened, by a whim of fate, to live in an interesting "age of change."[103] And it often turns out that the "pioneers" and inventors of these technologies themselves are the first victims.

Fig.79 Postman robot on the streets of Moscow. January 2022. Author: Yu.Yu.Cherny

Published with the written consent of the author

Fig.80 Robot loader with RoboCV autopilot, 2014. Author: Andrey Ilyin

https://commons.wikimedia.org/wiki/File:Autopilot_RoboCV.jpg

[102] German original: "Opfer müssen gebracht warden".

[103] Reference to the curse "May you live in interesting times," attributed to the Chinese.

Today, at a time of global deployment of the new Industry 4.0 technologies, or the "Fourth Industrial Revolution," one of the most promising and popular developments is AI-based driverless vehicles. Its penetration of our daily lives is very discreet, yet deep and universal. For example, we are still surprised to meet a robot postman or pizza deliverer on the street, but we have long been accustomed to driverless subway trains and railway shuttles in global capitals, we don't think twice about robots on industrial assembly lines, and are totally unfazed by the widespread use of driveress vehicles in agriculture (robotized grain combines developed by the Russian company Cognitive Pilot) and the mining sector (Volvo HX1 driverless electric dumpcarts).

This article looks in detail at current issues and risks in the global adoption of civilian driverless vehicles, and more specifically in the initial phase of application of driverless vehicles on public roads for public transport (shuttle buses in some cities have been actively tested and used since 2017) and private use (driverless taxis). We will also look at how automation is expanding to take complete control over air transport, which is where the main threats, risks and challenges for all of us lie.

Fig.81 Driverless bus in Bad-Birnback, Bavaria, 2020 Author: Ioki DeutscheBahn
https://commons.wikimedia.org/wiki/Fi-le:Autonomer_Bus_Bad_Birnbach.jpg

Fig.82 Driveress prototype Toyota Prius overtaking on a motorway, 2018. Author: AImotive

https://commons.wikimedia.org/wiki/File:AI-motive_prototype_Toyota_Prius.jpg

Our future according to Elon Musk

The global PR campaign to promote "driverless vehicles of the future" was launched in March 2015 by Elon Musk, founder and head of Tesla Motors, in his latest keynote interview to the mass media.[104] He expressed his confidence that **vehicles driven by people would eventually be outlawed and replaced by autopilots.** "Automobiles will become something like elevators. Elevators were once controlled by operators, and then people created a simple design enabling elevators to automatically stop at the right floor," said Musk." **Driverless vehicles will be safer and, consequently, they will cope with driving better than people.** There are currently two billion vehicles on the planet. To convert them all to autonomous driving will take 20 years. Asked by the presenter what should be done with the manually driven vehicles and their owners, Musk stated without hesitating that they would simply be outlawed because manual control is **"too dangerous."** People should not be at the wheel of a lethal two-ton vehicle."[105]

And it is indeed hard to deny the high level of danger involved in road transport. According to the World Health Organization, **road traffic accidents cause over 1.25 million deaths worldwide every year**

[104] https://www.theverge.com/transportation/2015/3/17/8232187/elon-musk-human-drivers-are-dangerous

[105] "It's too dangerous. You can't have a person driving a two-ton death machine." Same source.

(including 186,00 children), and **between 20 million and 50 million people suffer various kinds of injury** (this number remains virtually unchanged since 2007). Most of these deaths and injuries are caused not by technical faults or bad weather but by people committing gross violations of the road traffic rules – the so-called "human factor."

So, is it any surprise that scientists and entrepreneurs are proposing to combat the risks of the "human factor" by CONSISTENTLY REMOVING PEOPLE FROM TECHNOLOGICAL PROCESSES AT THE OPERATIONAL LEVEL? In other words, they are proposing further programming and automation (robotization) of all actions and procedures which are still performed by specially trained people. And now, precisely for customers concerned about their own safety, Tesla Motors is advertising a range of new electric cars fitted with the latest robotized driverless vehicle system. It's an interesting proposition, but this is exactly where the risks of the "transitional period" arise. The problem is that driverless vehicles are already fully capable of moving around independently, with no human involvement. And in test mode on special roads, driverless vehicles are capable of producing good results in terms of save driving. However, due to temporary glitches in the dedicated software (for the sake of argument, the artificial intelligence) which in real road conditions is highly uncertain and is still not capable of taking the right driving decisions quickly enough, this leads to accidents. Therefore, for safety, most developers of driverless vehicles have a "specially trained" backup person with perfect driving skills, who must be present at the controls and, whenever necessary in an emergency, take over in order to prevent an accident. But it is this "machine – man" combination, in which the person has to "insure" the still imperfect software that forms the weakest and most vulnerable part of the hybrid "autopilot – human" vehicles now being churned out in great numbers to add to the endless flow of traffic on our public roads.

Here are just a few woeful examples to illustrate the point.

Autopilot and man: first blood

Fig.83. Tesla Model S: interior view. Author: Steve Jurvetson
https://commons.wikimedia.org/wiki/File:Tesla_Model_S_digital_panels.jpg

Fig. 84. Tesla Model S: exterior view. Author: Intel Free Press
https://commons.wikimedia.org/wiki/File:Tesla_Model_S_Signature.png

One year after Musk's memorable remarks about "outlawing people," on 7 May 2916, in Florida USA, the world's first lethal road accident involving a self-driving vehicle occurred. An electric car on autopilot drove at full speed into a tractor with a trailer that was moving at right angles to it. The force of the collision hit the upper part of the windscreen, straight into the head of the human driver who was sitting there at that time.[106]

[106] http://teslazone.ru/accidents/a-3071

Following the accident, the US National Highway Traffic Safety Administration launched an investigation to answer the key question of whether the autopilot was in operation at the time of the incident. It turned out that the autopilot was indeed activated. And by a cruel irony of fate, the first person to die at the wheel of the "car of the future" was 40-year-old Joshua Brown, a popular blogger activist who was one of the first people to own an automated Tesla and an online pioneer of driverless cars. He had become famous when, less than a month before his fatal incident, he posted a video entitled "Autopilot Saves Model S" about how his autopilot had saved him from a collision with a truck.[107]

One month after the tragedy, Tesla Motors published an official announcement on its website on the cause of the incident: according to the company's corporate blog, the Tesla Model S 2015 system failed to recognize the light-colored semitrailer with a high road clearance against the background of a bright sky, and did not engage the brakes. Official condolences were conveyed to the victim[108] and assurances were given that the autopilot system of the Tesla Model S, which had been on mass sale in the US and around the world for about a year, would quickly be improved.

The victims and their relatives did not succeed in convicting Tesla, however. In response to a squall of legal actions, the company admitted that the autopilot was still being tested, and pointed out that in line with the instructions provided with the electric vehicle, **drivers activate the autopilot function at their own risk.** The instructions also state "In black and white" that **"when using the autopilot, drivers must be ready to intervene at any moment. Their hands must be kept permanently on the wheel,** otherwise the system will emit an audio signal and gradually bring the car to a stop."

It was this argument that proved the decisive factor in the NHTSA investigation, which officially concluded that **the defect in the autopilot of the Tesla Motors electric car cannot be blamed for the death of the driver**.

In the course of the NHTSA investigation, several tests were carried out on the version of the autopilot current at the time of the

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[107] Video at: https://youtu.be/9I5rraWJq6E

[108] "… The customer who died in this crash had a loving family and we are beyond saddened by their loss. He was a friend to Tesla and the broader EV community, a person who spent his life focused on innovation and the promise of technology and who believed strongly in Tesla's mission. We would like to extend our deepest sympathies to his family and friends." Source: https://www.tesla.com/en_EU/blog/tragic-loss

accident. It was established that use of the autopilot in Tesla vehicles did indeed involve a multitude of warning signals. For example, when the autopilot was activated, a warning appeared on the instrument panel instructing the driver to **remain attentive and in no event remove your hands form the wheel**…[109]

So, there we have it: the autopilot is not to blame. As ever, it's people who are responsible for everything…

Fig. 85. Photo from the police archive of the Florida Highway Patrol: yet another driverless Tesla hits yet another police vehicle… Author: Michigan State police employee

https://www.orlandosentinel.com/news/breaking-news/os-ne-tesla-autopilot-strikes-fhp-cruiser-20210828-c2fwyy4wlbhvfoiya626pmoddi-story.html

[109] https://nplus1.ru/news/2017/01/20/nofault

Fig.86 Photo from the police archive of the Florida Highway Patrol: yet another driverless Tesla hits yet another police vehicle… Author: Michigan State police employee

https://www.cnbc.com/2021/03/17/tesla-in-autopilot-hits-police-car-in-michigan-officials-say.html

The "Tesla curse"

Meanwhile, incidents involving Tesla's autopilots continue to occur: A Tesla Model X crossover crashed into a bollard and overturned, causing injury to the driver and a passenger; a 2016 Model X electric car drove off the highway after its autopilot was activated, as a result of which the car and its four passengers got stuck in a swamp; a Tesla Model S driving on autopilot in Germany crashed into a bus; in Norway, a Tesla Model S electric car in autopilot mode crashed into a motorcyclist who was passing by - the biker survived but was seriously injured; a Tesla Model 3 on autopilot hit a police vehicle in Orlando; a similar incident occurred when a parked police car was hit in Michigan; a Tesla Model S on autopilot crashed into a tree, killing two people…the list goes on and on.[110]

And on 15 December 2021 there was an absolutely spinechilling incident in Paris: a Tesla Model 3 taxi with a driver and passenger on board went out of control and hit a cyclist and a pedestrian before crashing into a truck. The incident killed one person

[110] Source: http://teslazone.ru/accidents

and injured 20 others. A spokesman for the taxi company stated on behalf of the driver that he had tried to brake but that the car had stopped responding to manual control and spontaneously accelerated…it is not yet clear whether the car was on autopilot at the time of the accident. Parisian prosecutors have begun investigating a case of manslaughter.[111]

In April 2021, following a series of high-profile accidents involving human fatalities, US senators conducted a review of the safety of Tesla vehicles. However, Tesla's official spokesmen continue to maintain the company's tried and tested position that the **autopilot is not a complete substitute for the driver.**[112] **"Autopilot and the full self-driving function should be used under constant attention from a driver with their hands on the wheel and ready to take over at any moment,"** the Tesla website states.

Actually, it would be wrong to blame just Tesla and its vehicles for all this. Problems are being experienced by the majority of major companies developing driverless vehicles. For example, we have already mentioned Elaine Herzberg, the first person in history to die under the wheels of an autopilot controlling a two-ton VolvoXC90 SUV, in March 2018. That particular technology was developed by the world-famous taxi aggregator Uber Technologies. And the person declared guilty of the tragedy was a man specially recruited by the company as backup for the autopilot who was distracted by watching videos on his smartphone at the time of the accident.

Telsa Motors, for its part, like the pioneering aircraft builder Otto Lilienthal, is a trailblazer walking through a minefield and taking on previously unknown risks which other developers following on behind are able to neatly sidestep.

Analyzing the above incidents, particular note should be made of the fact that people are not coping terribly well with the role of backup for machines, which has been assigned to them at this stage of technological development.

[111] Source: https://www.reuters.com/business/autos-transportati-on/pa-ris-taxi-firm-suspends-use-tesla-model-3-after-accident-2021-12-14/?utm_source=ix-btcom

[112] Source: https://www.interfax.ru/world/787192

We are all people, or the "human factor:" physiology and psychology

Why, you may ask, are people not coping with that role? The answer is because they are human, with all that entails. People tend to lose a skill they have learned if they do not need to use it for a certain period of time. And this is true in absolutely every sphere of human activity, from hard physical labor (if you stop exercising trained muscles, they will soon atrophy and turn into something more essential, such as subcutaneous fat or "well-fed" internal organs) to intellectual labor (we all know how hard it is to get back into the working rhythm after a good long vacation).

Driving a vehicle is a highly complex form of physical and intellectual activity requiring alertness, coordination, well-honed reflexes and an ability to analyze the situation on the road and take the correct decision in a split second. People spend years perfecting this skill, and yet it is quickly lost without constant practice. So, imagine somebody with good professional skills recruited by a company to test an autopilot robot, forced to sit for hours or days at a time in the driving seat and observe the monotonous, routine and cautious way in which the robot builds up its practical driving skills, following the protocols programmed into it. Few people would be capable of remaining fully alert, concentrating on monitoring and analyzing the road situation and supervising the autopilot all the time. And since nobody knows in advance where and how the next incident will occur (and if they are lucky, there will be no incident at all), while waiting (which could take months) the operator will inevitably relax and lose their concentration, speed of reaction, coordination, sharpness of vision etc. Because after completing a typical working day "at the wheel" of an autopilot, there are few people who would want to drive an ordinary car in their free time merely to keep their skills up to date. And most employers fail to pay attention to this fact, which is a pity. When moment X suddenly arrives – an emergency in which the operator has to take action to prevent a disaster – the backup driver turns out to be unprepared…

Civil aviation: already almost pilotless, but still human…

Fig.87 Main aviation routes in "pre-COVID" 2019.
Author: Jpatokal

Source: https://commons.wikimedia.org/wiki/File:World-airline-routemap-2009.png

We shall illustrate this point using examples from another global industry which can expect a full transition to automatic operation in the near future – civil aviation.

Since the age of Lilienthal, Zhukovsky, the Wright Brothers, Sikorsky and other aviation pioneers, civil aviation has traveled a long and thorny path, from gliders built in garages to ultramodern liners equipped with an autopilot and a huge number of other automated functions. Since the 1950s, having developed into an enormous international industry, the aviation sector has devoted a huge amount of attention to developing regulations, standards and technical systems to improve flight safety and win over customers from surface and waterborne transportation. And these measures have produced results: for example, from 1977 right up to 2017 (which is still regarded as the safest year in the history of global civil aviation), flying was the safest form of transport[113] — according to the statistics, only one passenger died for each 7.36 million takeoffs of all possible types of aircraft! It is hard to imagine that soaring into the heavens on board an aircraft is much safer than, for instance, taking a journey by train, car, motorbike or bicycle (listed in ascending order of danger: note that two-wheeled mechanical "steeds" – motorbikes, mopeds and bicycles - cause more deaths than any other type of vehicle), but it is true.

[113] Source: https://www.gazeta.ru/science/2018/02/12_a_11646625.shtml

Recently, however, following a series of high-profile disasters caused by previously unidentified issues and involving numerous human fatalities, some big questions have been asked about the safety of the new generations of airliners and the crews that pilot them. Thus, according to statistics from the Aviation Safety Network website, there were as many as 16 major crashes of airliners and business jets worldwide in 2021.[114] Compare that with the totally accident-free 2017!

Why, you ask, is civil aviation, with its vast financial and human resources for applying the latest scientific and technical developments, so rapidly losing its popularity amongst travelers, instead of continuing to hold top place for safety amongst the different modes of transport? It's all due to the so-called "transitional stage" – the period during which one technological system is replaced by another.

The brain: an atrophying muscle

Philistines will kill mankind
in 50 years.

Andre Geim
Physicist, Nobel Prizewinner, 2013

As we have mentioned above, people are now entrusting more and more of what they do to all sorts of "smart" gadgets. You only need to have a smartphone to never have to memorize anything ever again. As a result, many of us have forgotten how to count. And futurologists predict that in 5-7 years, reading and writing will die out and be replaced by viewing. But the brain is a muscle like all other muscles in the human body: if it is not used, then over time it will inevitably atrophy.

And here is the latest vivid example of this process. In the past, pilot training for all types of aircraft began by learning how to fly a glider and training in aircraft in which there was absolutely no autopilot. This was essential for future pilots to learn how to "feel the air" and the reality of flight. And only after flying the required number of hours were trainees allowed into the cockpit of a modern airliner and shown how to engage the autopilot system. In essence, the autopilot is

[114] Air disaster statistics from this information resource by country include only lethal accidents involving aircraft with more than 14 passenger seats. There were six such accidents in Russia in 2021: three L-410s, two An-26s and an experimental Il-112V (which is classified as a freight aircraft). Pavel Aksenov. Source: https://www.bbc.com/russian/features-58874771

merely a secondary tool designed to simplify the work of the pilot outside the crucial moments of takeoff and landing.

Incidentally, in the past, everything was much more complicated. There were no pilot training simulators like those used today in specialized training schools: it was harder to pilot a plane in purely physical terms, and flying was more complicated because all the data was transmitted by air traffic controllers, requiring continuous concentration. But with good training, pilots could cope successfully with flights of any duration and complexity, as the statistics for previous years show.

Fig.88 Richard Peters testing the C-160 Transall flight simulator.
Author: MSGT Don Sutherland U. S. military
https://commons.wikimedia.org/wiki/File:C-160_Transall_aircraft_flight_simulator.JPEG

These days, however, having flown in highly realistic full flight simulators and learned to taxi to the runway and engage the autopilot, modern aviators, after gaining their cherished pilot's licence, get into the routine of following the safety protocols used in most airlines, switching over to the autopilot for 95% of the flight time (yes, its' true: after switching on the engines, taking off and engaging the autopilot, all the rest of the work, including landing, is done by the autopilot) and lose their "live" flying skills. Flying hours, which is the key metric of a pilot's length of service and professionalism, are logged in the pilot's service record even though the computer was actually flying for them…

It is well known that even a full pre-flight check of the automatic control system with a program control test cannot provide a 100% guarantee that the system is in good order. Furthermore, due to their complexity, some flight modes are simply impossible to reproduce on the ground, so that any defect might only manifest itself in the air. And

when emergencies arise during a flight requiring quick and decisive action from the crew, pilots who have lost their manual flying skills are unable to save the aircraft and the people on board.

Fateful stall[115]

On 1 June 2009, three hours and 45 minutes after takeoff, an Air France Airbus 331-203 on flight AF447 from Rio-de-Janeiro to Paris, fell into the Atlantic Ocean. The investigation revealed that **during the flight a minor failure had occurred on board** — the speed indicator briefly malfunctioned due to freezing of the pitot tubes – parts of the instruments responsible for measuring flight attitude and speed. As a result, the autopilot disengaged and the aircraft switched to manual control. **The subsequent uncoordinated and "panicky" actions of the crew as they tried to control the aircraft resulted in a stall which the crew was unable to correct.** All 228 people on board perished - 12 crew members and 216 passengers. The aircraft remained in good working order and controllable right up to the moment of collision…

Fig.89 A fragment of the vertical tail stabilizers of the Airbus A330-203 on flight 447, found and raised from the seabed by a Brazilian Navy frigate Photo by: Roberto Maltchik Repórter da TV Brasil

https://commons.wikimedia.org/wiki/File:Voo_Air_France_447-2006-06-14.jpg

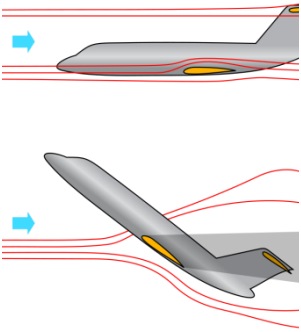

Fig.90 Air flow around an aircraft in normal flight and in a severe stall (for aircraft with T-shaped wings). Author: GRA-HAMUK

https://commons.wikimedia.org/wiki/File:Deep_stall.svg

[115] A stall is when an aircraft experiences a dramatic loss of lifting force due to a disruption to normal airflow across the wings. Source: Wikipedia.

Another tragic case occurred in Russia. On the evening of 5 May 2019, a Sukhoi Superjet 100-95B operated by Aeroflot was on a regular flight from Moscow to Murmansk. Twenty-seven minutes into the flight, the autopilot disengaged for unknown reasons. At the time, the aircraft was at an altitude of 2,700 meters and the autopilot had been engaged by the crew immediately after takeoff, at an altitude of 215 meters.

After the autopilot disengaged, the aircraft's control system went into "direct mode" – in other words, "direct control" of the flight. This was not an emergency – the flight could have continued with the pilots flying the aircraft manually, but the captain decided to immediately return to Moscow and make an emergency landing at Sheremetyevo airport. The weather conditions were good but the landing turned out to be disastrous. The human-controlled aircraft crashed into the runway and caught fire; of the 78 people on board (73 passengers and 5 crew) 41 died.

The Investigation Committee launched criminal proceedings under Article 263.3 of the Russian Criminal Code ("Violation of traffic safety regulations") and the captain was charged with incorrect control of the aircraft during landing. The case went to court in 2020.[116]

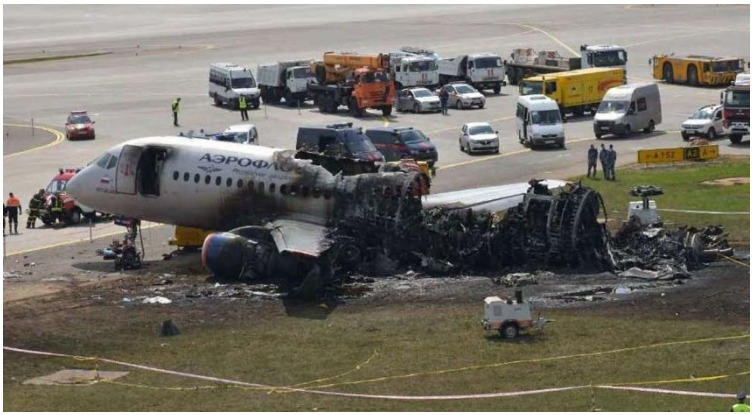

Fig.91 RRJ-95B RA-89098 after the incident, 5 May 2019. Author: INTERGOVERNMENTAL AVIATION COMMITTEE. Screenshot from open sources.

Source: https://mak-iac.org/upload/iblock/4e4/report_ra-89098_pr.pdf
https://commons.wikimedia.org/wiki/File:Aeroflot_Flight_1492_wreckage.png

[116] Source: https://tass.ru/obschestvo/11443155

Commenting on the disaster, Merited Test Pilot of the USSR Viktor Zabolotsky said that the mistakes made by the Sukhoi Superjet 100 crew were due primarily to a lack of training for emergency landings in manual mode…"Simulators are essential, but you also to have to land the plane in manual mode on real flights. That's how you learn the skill. You see, any flight is, in a certain sense, a training exercise for the next one…but they don't teach that in the academies now. Yes, you get a little training when you join an airline, but after that the daily flights are done on autopilot. The company actually prohibits manual piloting even in fine weather. It's just easier that way – engage the autopilot and fly. **But it's very difficult to acquire a skill in three hours on a simulator once every six months,"** said Zabolotsky.[117]

Industry 4.0. Are we learning to fly on an iPad?

However, the problems and risks of the "transitional period" are not just about errors committed by people in the "robot – man" tandem. The robots also make mistakes. Or, to be more precise, their software does, as we explain below.

In October 2018, a brand-new 4th-generation Boeing 737 MAX operated by Indonesian company Lion Air crashed in the vicinity of Jakarta, killing 189 people. A few months later, on 10 March 2019, an Ethiopian Airlines aircraft of the same Boeing 737 MAX series crashed and 157 people died. Investigators and experts who analyzed the two accidents concluded that they were identical and the cause was soon pinned down to a malfunction in the MCAS software – the flight control algorithm deployed in the new 737 MAX series to improve control characteristics during manual piloting. It was the first time this Boeing system had been installed and its task was to "imperceptibly adjust the actions of the pilot when operating the plane in manual mode." Most pilots who would later operate the new Boeing 737 model were not informed about the "backup" function and, as an investigation by the New York Times established, **learned to fly the new model not on specially designed simulators but on…iPads.**[118]

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[117] Source: Vladimir Perekrest for Komsomolskaya Pravda https://www.kp.ru/daily/26977.4/4035358/

[118] https://www.nytimes.com/2019/03/16/business/boeing-max-flight-simulator-ethiopia-lion-air.html?fbclid=IwAR2H80Jll2NMDsoVhpnRxYhrmHlNZkV1-YDhrCsm-xj396uvApPn-oOJrH9k

Fig.92 Global presentation of the Boeing 737 MAX in the United States, 2015. Author: Aka The Beav from Seattle, Washington
https://commons.wikimedia.org/wiki/File:Boeing_737_MAX_(23514088802).jpg

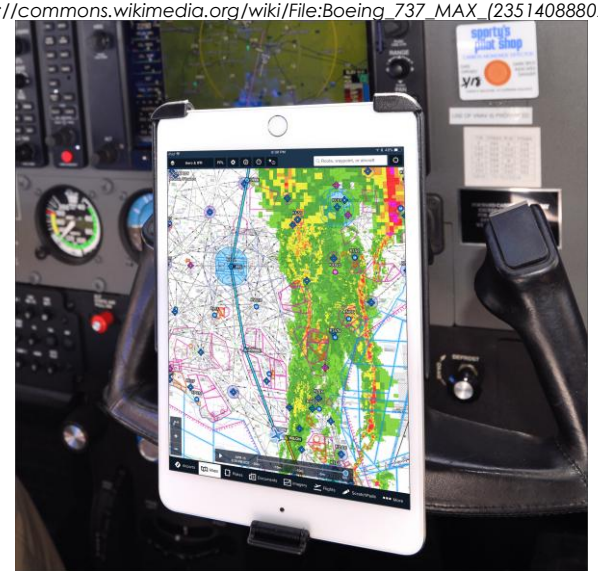


Fig.93 iPad in the cockpit. Screenshot from open sources.
Source: https://ipadpilotnews.com/2019/01/pilots-guide-to-mounting-the-ipad-in-the-cockpit/?tag=makemoney0821-20

After the flight recorders from the liner that crashed in Indonesia were decrypted, the overall picture of the event that emerged was reminiscent of a horror movie: due to software failures in the MCAS system, under the impact of an unseen and known force, the Boeing suddenly started to drop like a stone, and every time the pilots leveled it up manually it started diving once again. According to data from

the Indonesian investigation, the MCAS system of the almost fully loaded airliner put the plane into a dive more than 20 times![119] **The outcome of this confrontation is familiar: the robot defeated the human.** Given that flight JT-610 crashed 11 minutes after taking off from Jakarta airport, that was the amount of time that the crew were able to stand up to the ruthless "system for improving maneuverability characteristics"…For comparison, the Ethiopian Airlines aircraft on flight ET302 from Addis Abeba to Nairobi crashed six minutes after takeoff at a speed of 1,126 km/hour, having broken the sound barrier.

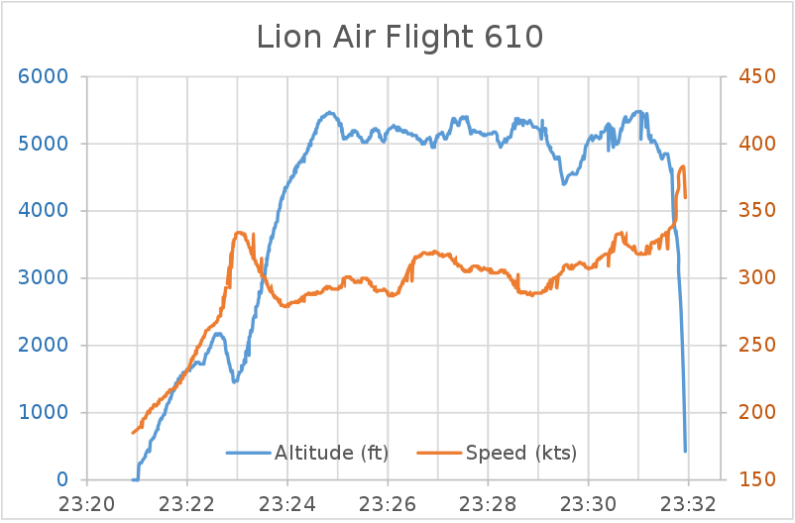


Fig.94 Altitude (blue line) and speed (orange line) of Lion Air flight 610 from takeoff to crash.
Author: Phoenix7777

Source: https://commons.wikimedia.org/wiki/File:Lion_Air_Flight_610.svg

[119] Source: https://naked-science.ru/article/hi-tech/bolshie-proble-my-boeing-prichinoy

Fig.95 The Ethiopian Airlines Boeing 737 Max one month before the disaster, 8 February 2019. Author: LLBG Spotter

Source: https://commons.wikimedia.org/wiki/File:Ethiopian_Airlines_ET-AVJ_takeoff_from_TLV_(46461974574).jpg

Boeing disasters: scandals, intrigue, investigation findings

It is worth noting that the Boeing 737 series is the most widely used aircraft in the world, carrying out over one quarter of all passenger jet flights.[120] This is why the world's airlines were so much looking forward to the Boeing 737 Max — the new and highly anticipated fourth generation of the medium-range aircraft that was to replace the already somewhat obsolete planes of the previous series. But since March 2019, following the two high-profile disasters described above, many countries have banned flights by the new model.

The real shock to the global community was the outcome of a US Congress investigation into the causes and circumstances of the two Boeing 737 Max crashes, which killed 346 people and led to the suspension of flights by all aircraft of that model. The findings, published on 16 September 2020, stated that the disasters were a "horrible culmination" of engineering errors, inefficient management and inadequate supervision by federal government agencies."[121] The

[120] Anton Shiryaev for https://lenta.ru/articles/2019/03/14/boeing/

[121] Source: Alena Miklashevskaya 16.09.2020 for Kommersant https://www.kommersant.ru/doc/4493448

authors of the 234-page report (available in open access)[122], having questioned everyone involved in the development of the fourth-generation airliner and studied over 600,000 pages of documentation, **concluded that 346 lives could have been saved if Boeing had not placed short-term profit above the safety of future clients and their passengers,** and if the regulatory agencies had not abdicated their functions by entrusting supervision of the development and certification process to the company itself. The key conclusion was the following: endeavoring to surpass the A320neo model of its main competitor, Europe's Airbus, Boeing put the emphasis on producing the MAX model as quickly as possible and cutting costs by downgrading safety and concealing vital information about problems during testing of the 737 MAX from clients and government regulators.

Here are just a few excerpts from internal correspondence between Boeing employees that has been made public:[123]

- "The 737 MAX was designed by clowns led by monkeys."
- "Would you put your family on a plane with a pilot who had trained on a MAX simulator? I wouldn't!"

Fig.96. After the USA joined the global ban on the 737 MAX, Boeing suspended deliveries. April 2019: Boeing 737 MAX airliners already painted in airline livery

[122] https://transportation.house.gov/imo/media/doc/2020.09.15%20FINAL%20737%20MAX%20Report%20for%20Public%20Release.pdf

[123] Source: https://www.bbc.com/russian/news-51061640

but not yet commissioned, awaiting their fate in a Boeing parking lot in Seattle, USA. Author: SounderBruce

https://commons.wikimedia.org/wiki/File:Boeing_737_MAX_grounded_aircraft_near_Boeing_Field,_April_2019.jpg

For its part, Boeing has publicly promised "not to do it again," to pay $2.5bn in fines and "to take every effort to reinforce the safety culture and restore the trust of our clients…" The company has also announced the development and rapid certification of an upgrade of the MCAS system (which was originally concealed by Boeing to avoid wasting time on certification).

And people believed them once again…Thus, on 18 November 2020, the US Civil Aviation Administration announced the annulment of its decision to ban flights by Boeing 737 MAX aircraft.

And all would be well if it were only possible to bring the victims back to life…

In place of a conclusion

Technology is the knack of so arranging the world that we don't have to experience it.

Max Frisch, playwright, writer

Fig.97 "Watch out for cars:" driverless vehicles are already ready to carry their first passengers on the roads of major cities. January 2021 Author: Kirill Borisenko

https://commons.wikimedia.org/wiki/File:Yandex_taxi_and_Yandex_self-driving_car_during_January_2021.jpg

Of course, we are all perfectly aware that very soon, just two or three decades from now, robots controlled by artificial intelligence will replace people in many professions. It is possible that today's mass profession of "driver" of all kinds of vehicles will be forgotten tomorrow and become just as exotic as the profession of coach driver is now. However, one shouldn't get too upset about this **yet,** because when you look at the facts presented above, vehicles and aircraft are **not yet as reliable and safe** as the ordinary elevators mentioned by Elon Musk at the beginning of this story.

"Pessimism about the inevitability of technological progress is mistaken but could become a self-fulfilling prophesy if too many people believe it. Because it is simply wrong to claim that the speed and scale of technological development cannot be controlled," says futurologist F.Fukuyama. Progress can and even should be controlled. But how? Well, it's very simple. Let's begin with some humdrum advice for drivers: obey the road traffic rules!

Yes, we remember that over a million and a quarter people die every year in accidents all over the world. But why do they die? **The main cause of accidents is gross violations of the road traffic rules by drivers, including speeding, crossing the central line and driving under the influence of alcohol or drugs.** Unlike us, the "robots" designed to replace us will simply not be programmed to break the rules. Furthermore, while on the move, they will not be distracted by conversations with passengers, reading messages in social media and SMSs, eating hamburgers and so on. That, in essence, is the only advantage of the machine over the human driver, giving the machine, with all its current imperfections, better driving safety statistics.

But we still have a little time left…our own, human time. Time to think about our personal safety. After all, if drivers all over the world suddenly start obeying the rules, it may be possible that some disciplined accident-free drivers will not be "outlawed" in the future. We, the authors of this article, are personally not yet tired of driving. The key thing is not to forget to obey the traffic rules and to regularly practice your safe driving skills. But we want to warn you to never, in any circumstances, take your hands off the wheel. Because it is you and you alone who, as it was thousands and even millions of years ago, will have to bear responsibility for your own life and the lives of those around you…

We, the authors of this book, sincerely believe that the "main risk to human life is to live it senselessly, emptily, without exploiting the

biological/genetic abilities and opportunities granted to us. In other words, not to live life to the full, as a human being."[124]

Seeking and fulfilling our predestination was and remains the key aim of any thinking person's life. The most important thing is not to rush into decisions because, as the great Omar Khayyam, said, "He who knows the secret of life is no longer in a hurry…"

Fig.98. What's Your Hurry? Counter showing fatalities in automobile accidents in Brooklyn, USA, 1927. Photo from open sources.
Photo: Daniel Bowman Simon via Streetsblog

https://www.brownstoner.com/history/brooklyn-history-grand-army-plaza-street-safety-death-o-meter/

P. S. The human brain: time to shake off the flab?

In 2014, a group of researchers at Okinawa Institute of Science and Technology in Japan, together with colleagues from Germany's Julich Research Center, used the fastest supercomputer available at that time to build a model of the activity in **one second of the human brain.** The supercomputer, consisting of 82,944 processors, successfully recreated a model of 1.73 billion neurons and the 10 trillion synapses

[124] The article includes excerpts from the book: D.V.Mun, V.V.Popeta, P.E.Smolkov. From the Titanic to…The Algorithms of Future Disasters. M.: Direct Media, 2017.

connecting them[125] (for reference, a neural network of that size represents just roughly 1% of the human brain, which contains over 100 billion neurons - roughly the number of stars in the entire Milky Way).

However, to reproduce the mental activity on which an ordinary person spends just one second of their life, the supercomputer had to spend …forty minutes of machine time. At that time, the fastest computer in the world was 440,000[126] times faster than the iPhone5 but was still 2,400 times slower than one percent of the human brain.

The supercomputer occupied an area of 720 m^2 and used over 17.6MW of energy, which is roughly what it takes to simultaneously light up 176,000 100W bulbs. But the human brain, residing in the far more modestly sized cranium, consumes on average of 10W, rising to 30W of energy at moments of peak stress (imagine the dim light from a bulb of that rating!).

Now, here's a simple question: What is the true value of your brain, which is offered to everyone from birth free of charge, if the aforementioned supercomputer at the time of the experiment cost $390 million?

All researchers concur that our brain is little studied and that its abilities and working principles are still not fully understood. And as we established above, the human brain, like any other part of the body, becomes weak, helpless and flabby if it is not actively used.

So perhaps the time has come for us to "shake off the flab"? To make our brains work? To finally direct the arrow of progress towards studying ourselves, in order to fully unleash the natural potential within us and provide a worthy answer to all the threats and challenges of modern civilization?

[125] Source: https://www.telegraph.co.uk/technology/10567942/Supercomputer-models-one-second-of-human-brain-activity.html

[126] Source: https://ai-news.ru/2021/01/superkomputeru_trebuetsya_8-2_944_processorov_i_40_minut_raboty_chtoby.html

*Fig.*99 A brain in chains. Free 3D illustration from Quince Media. https://quincemedia.com

https://commons.wikimedia.org/wiki/File:Free_3D_Illustration_Of_A_Mental_Health_Conceptual_Image_By_Quince_Media_01.jpg

PART 4
The future: advent of the age of natural disasters

> The last few decades have been marked by a global problem that has confronted mankind as a result of the industrial revolution: warming caused by a change in the concentration of greenhouse gases in the atmosphere from combustion of fossil fuel. One important feature of global warming is its geographical and seasonal variability: for example, since the mid-1970s the average annual temperature in Russia has been rising there times faster than on the planet as a whole, and the springtime warming in West Siberia is three times faster than in winter.
>
> *I.A.Shumakov, Head of the Russian Meteorological Service,*[127] *2022*

Very global warming

Global climate change, which has been observed since the 1970s, has led in recent decades to a substantial rise in the frequency and scale of natural disasters. This trend is especially noticeable in the northern hemisphere, where most of Earth's population and the technological facilities underlying man's socio-economic development are concentrated. Waves of heat and cold, extensive flooding, landslides and natural fires are causing more and more deaths and suffering, as well as substantial material damage.

The climate changes observed in the 20th century include: an increase in the average global temperature of ground air and the ocean surface; a rise in global sea level; a long-term, persistent and large-scale reduction in snow and ice cover, and changes in atmospheric and ocean circulation and regional weather conditions impacting seasonal patterns of precipitation.

[127] Introduction to the Report on Aspects of the Climate on the Territory of the Russian Federation 2021

And the experts say that this is just the beginning. According to a report on climate change prepared in 2021 by the UN's Intergovernmental Panel on Climate Change (IPCC 2021, involving 270 scientists from 67 countries),[128] the average air temperature on Earth has already reached its highest level for the past 125,000 years and will continue to rise steadily. Thus, under the pessimistic scenario, global warming in the 21st century will exceed 1.5°C above temperatures in the late 19th – early 20th century, and could reach 2–3.5 or even 5.7 °C.

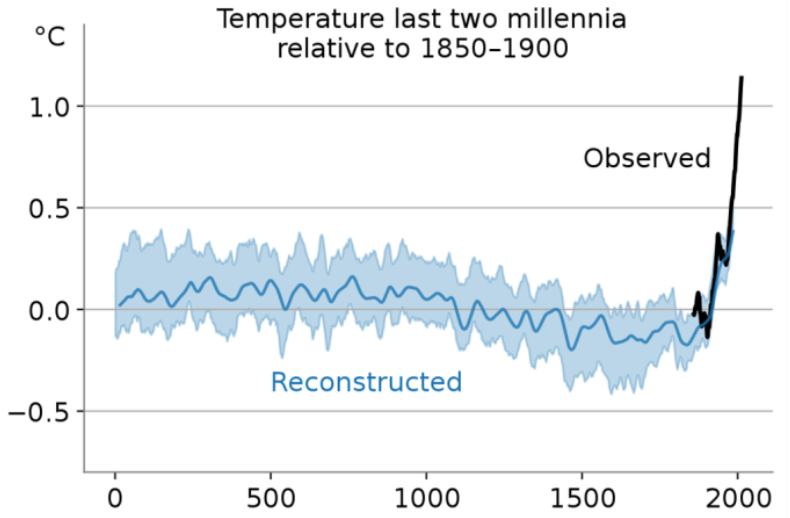


Fig.100 "Hockey stick" - the name specialists give to the shape of the graph of average temperature over the last two millennia. Author: Femke Nijsse.

https://commons.wikimedia.org/wiki/File:Temperature_reconstruction_last_two_millennia.svg

Source: Mann, Michael E.; Bradley, Raymond S.; Hughes, Malcolm K. (1999), Northern hemisphere temperatures during the past millennium: Inferences, uncertainties, and limitations Geophysical Research Letters

[128] https://www.ipcc.ch/report/ar6/wg1/

Fig.101 Global temperature change on Earth and in the ocean.
Source: NASA Goddard Institute for Space Studies
https://commons.wikimedia.org/wiki/File:Global_Temperature_Anomaly.svg

Consequently, the UN forecasts that the rising temperature will first lead to changes in the amount and distribution of atmospheric precipitation. The atmosphere will become more humid at high and low latitudes where there will be more rain, and more arid in tropical and subtropical regions. Alongside the rise in air temperature around the world, there will be an increase in the rate of melting of the polar ice caps (it is anticipated that by as early as the middle of this century, surface ice will completely disappear during the summer in the Arctic Ocean) and permafrost zones (causing a sharp increase in emissions of carbon dioxide). Meanwhile, by the end or, in pessimistic forecasts, the middle of this century, the level of the world ocean will rise by 2-3 meters (and remember that one third of the world's biggest cities are situated right on the coast, and more than 600 million people live at an altitude of no more than 10 meters above sea level.[129]) Against this backdrop, there will be an increase in heavy rainfall,

[129] The Uninhabitable Earth, David Wallace-Wells, issue of New York Magazine, July 10, 2017. Source: https://nymag.com/intelligencer/2017/07/climate-change-earth-too-hot-for-humans.html

cyclones and floods in some regions and a simultaneous increase in droughts with longer and more intense forest fires in others. These factors will also give rise to other adverse natural phenomena.

The key conclusions of the UN experts' report are:

- Our planet is warming up faster than predicted by scientists 20-30 years ago;
- Climate change is now irreversible and will escalate, irrespective of how much mankind attempts to reduce consumption of fossil fuels and greenhouse gas emissions;
- Like it or not, in the next few years we will have to prepare for an increase in the number and intensity of all kinds of adverse weather phenomena, which could bring large-scale natural disasters in their wake.

The age of natural disasters begins

And indeed, despite the fact that we have only lived through less that 20 of the 21st century's 100 years, we can already state without exaggeration that the Age of Natural Disasters has begun. Here are some facts to back up that claim.

The number and intensity of adverse natural phenomena in all regions of the world without exception are growing year after year. According to data published by the World Meteorological Organization (WMO) in September 2021, over the past 50 years the world has seen a five-fold increase in natural disasters.[130] And the number and intensity of **natural disasters linked to climate are expanding their "catchment area" and impacting more and more people.** Thus, an Atlas of Mortality and Economic Losses compiled by the WMO and the UN Officer for Disaster Risk Reduction shows that over 11,000 incidents relating to extreme weather, climate and water conditions were recorded worldwide between 2017 and 2019. As a result, over 2 million people lost ther lives and damage of $2.64 trillion was caused. At the same time, **the number of natural disasters in the world over the past 20 years has doubled to 6,681 (compared to 3,656 in 1980–1999), affecting 3.9 billion people**[131] - i.e., over half of Earth's population.

[130] Source: WMO report https://public.wmo.int/en/media/press-release/weather-related-disasters-increase-over-past-50-years-causing-more-damage-fewer

[131] Report by the United Nations Office for Disaster Risk Reduction (UNDRR) October 13, 2020. https://www.undrr.org/publication/human-cost-

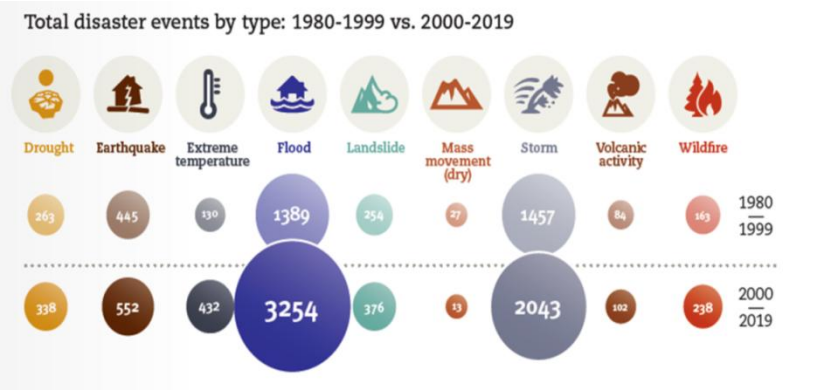


Fig.102 Comparison of the number of natural disasters worldwide in 1980–1999 and in 2000–2019.
Source: Centre for Research on the Epidemiology of Disasters, United Nations Office for Disaster Risk Reduction

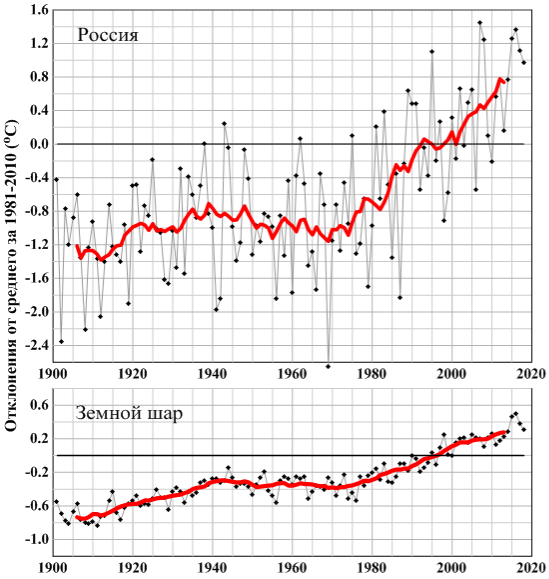
https://pbs.twimg.com/media/EkOLJx2VgAAaxqy.jpg:large

And what about Russia?

Meanwhile, a Report on Aspects of the Climate on the Territory of the Russian Federation in 2021[132] — an official publication by the Russian Meteorological Service – not only confirms the findings of the international organizations but states that the speed at which the average annual temperature is rising across the country is **more than 2.5 times higher than the increase in the global average temperature!** Thus, it has increased by 0.49 degrees Celsius in the last decade alone.

disasters-overview-last-20-years-2000-2019?fbclid=IwAR1JmrG-ZjUtDvIsQGchcPteDLh18I-qcBs7VMWu0jLe43EAScwLswl817fk

[132] Report by the Russian Meteorological Service https://www.meteorf.gov.ru/images/ne-ws/20220324/4/Doklad.pdf



Временные ряды пространственно осредненных аномалий средней годовой температуры у поверхности Земли для территории России*) и Земного шара**) за 1901-2018 гг. Красным показан ход 11-летних средних

В среднем по территории России самым теплым был 2007 год, за ним следуют 2016 и 2015 гг.

Для Земного шара (суша+море) самыми теплыми были: 2016, 2015, 2017, 2018 гг.

**) Данные ФГБУ "Институт глобального климата и экологии им. академика Ю.А. Израэля" (www.igce.ru)*

***) Данные метеослужбы Великобритании HadCRUT4.6.0.0 (http:/www.cru.uea.ac.uk)*

Fig.103 Source: Yu.A.Izrael Institute of Global Climate and Ecology

http://climatechange.igce.ru

Translation: Temperature deviation from average for the period 1981-2010(°C).

The course of 11 year average changes is shown in red.

First diagram: Average annual temperature at the earth's surface for the Russian territory.*

Second diagram: Average annual temperature at the earth's surface for the globe.**

The report states that the speed of temperature rise in all areas of the country has increased substantially over the past 30 years. The winter air temperature rose by more than 4°C from the mid-1990s to 2020, while the summer temperature rose by 2.5°C. Warming was even more noticeable in the 2010s in the Siberian Arctic seas (Kara Sea – Chukotka Sea) through which the Northern Sea Lanes pass: the winter air temperature rose by almost 10°C from the 1980s to 2016, while the summer temperature increased by almost 3°C.

In 2021 alone, the average air temperature anomaly – in other words, the divergence from average levels between 1961 and 1990 – was +1.35°C. Temperatures above the climatic norm were recorded virtually everywhere in the country except Chukotka. The summer was anomalously warm: the average temperature anomaly across Russia was +2.00°C, which is 0.15°C higher than the previous summer peak in 2016 and almost 0.4°C higher than in the summer of 2010. The duration of snow cover on average across Russia in the winter of 2020-2021 was

much shorter than the climatic norm. Over the past decades, most rivers have begun to thaw early, while ice is setting in later. Warming in the Arctic seas is being accompanied by a reduction in sea ice cover, which is closely linked to air temperature during the summer season. The sea area covered by ice at the end of the summer season, in September, has been shrinking rapidly since1996, and in the 10 years to 2005 contracted by over three times – from 892,000 to 234,000 km^2.

Precipitation in 2021 across Russia as a whole was 107% of the norm (average in 1961–1990); there was a big surplus of precipitation in the south of the European part of the country (132% in the North Caucasus Federal District; 126% in Southern Federal District, and in the middle reaches of the Amur River.

And in the south of the European part of Russia, during the summer period, against a backdrop of rapid increases in average temperatures, there has been a reduction in water availability and a growing risk of drought. There is also concern over moisture levels in agricultural land in the southeast of the European part and in the Ural region, as well as a noticeable lack of precipitation (less than 80% of the norm) in the southern Urals and in Khabarovsk Territory.

Furthermore, there is a continuous increase in the thickness of the seasonal thaw layer of permafrost. In 2021, measurements carried out in 46 locations identified increases in the seasonal thaw depth virtually everywhere, providing evidence of a persistent trend throughout the 21st century.

To summarize the above, warming has occurred, is occurring and will continue to occur in the foreseeable future virtually everywhere in Russia.

Fig.104 Linear trend coefficient of average annual and average seasonal ground air temperature in Russia, 1976–2021 (°C/10 years). Source: Russian Meteorological Service,
Report on Aspects of the Climate on the Territory of the Russian Federation in 2021.

Is the permafrost permanent?

In recent years, it has become common in our country to hear the rather primitive and narrow-minded view that global warming is beneficial to Russia: we will soon be able to grow oranges in Siberia and go swimming in resorts on the Kara and Barents Sea coasts. But in fact, things are not quite so simple: it is, to say the least, very premature to state that Russia will soon start growing crops in its permafrost zone. First, we have to "survive" this warming and at the same time preserve the vital oil and gas facilities and other resource industry assets in our northern territories.

The whole of the world's permafrost zone covers an area of over 35 million km^2. And one third of that is in Russia – at roughly 10-12 million km^2, it is bigger than Australia and occupies around 65 % of the country's territory. And what, until recently, seemed like permanent ice is now melting virtually everywhere, causing considerable economic damage. In the first place, this is affecting cities, settlements and infrastructure that were built mainly on pillars on frozen soil during periods of stable low temperatures but are now in high-risk zones due to thawing. According to the aforementioned IPCC 2021 report, "even if global warming is held at a level substantially below two degrees Celsius (above pre-industrial levels), by 2100 approximately 25% of surface (3-4 m in depth) permafrost will thaw."

Back in late 2019, Russia's Ministry for the Development of the Far East and Arctic sounded the alarm when it estimated the annual losses to Russia caused by thawing of permafrost at between 50 and 150 billion rubles. The Ministry believes that the damage will only increase further in the future.[133]

In 2021, the Russian Environment Ministry published data showing that according to some calculations, "permafrost degradation" is the cause of 23% of "failures of technical systems" and 29% of losses to oil and gas extraction, while also giving rise to problems in the construction of railways and roads, with over 40% of oil and gas fields and Arctic infrastructure now located in the high-risk zone…The damage caused by permafrost degradation in the Arctic could amount to at least 5 trillion rubles by 2050."[134] And it's not only oil and facilities that

[133] Interview with Alexander Krutikov, deputy head of the Ministry for Development of the Russian Far East https://www.rbc.ru/economics/18/10/2019/5da9b5c79a7947a24d16714d

[134] Report by A.Kozlov, head of the Russian Ministry of Natural Resources at the IX Nevsky International Environmental Congress, 2021. Source: RBC https://www.rbc.ru/society/27/05/2021/60af8a6c9a7947505a4566a4

operate in the permafrost zone – there are also nuclear power plants there…

As for the prospects of agriculture in the "thawing" northern regions, that is highly speculative. Due to the natural "poverty" of these soils and the instability of the weather, our northern latitudes could at best become zones of risk-prone arable farming. And because of the aforementioned redistribution of zones of humidity and aridity and the increase in the number of other natural disasters, in particular extended droughts, in the south of the country, harvests in our traditional southern agricultural regions are now under threat.[135]

Across the world as a whole, according to forecasts published in the reputable scientific journal Nature Climate Change,[136] the melting of permafrost due to global warming, together with sea level rises and losses linked to greenhouse gases emitted from thawed-out soils in Siberia and other areas will lead to losses of $43 trillion by the end of the 21st century.

Greenhouse gas emissions from thawing soils and bogs in the permafrost zone should be defined as a separate risk category. Data from US researchers published in 2021[137] and confirmed by the IPCC show that the Arctic permafrost contains a total of 1.8 trillion tonnes of carbon, which is more than double the volume currently suspended in Earth's atmosphere. When it thaws and is released, this carbon could evaporate in the form of methane, whose greenhouse activity is 28 times stronger than that of carbon dioxide. There is already more methane in Earth's atmosphere than at any time in the past 400,000 years.[138]

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[135] Oxana Reshetova. Permafrost thaw: will agriculture move north? https://www.gazeta.ru/business/2021/05/11/13588922.shtml

[136] Source: Nature Climate Change, 2015 г. https://barentsobserver.com/ru/arktika/2015/09/ottaivanie-vechnoy-merzloty-oboydyotsya-mirovoy-ekonomike-v-trilliony-23-09

[137] Jordan Wilkerson from Harvard University, How Much Worse Will Thawing Arctic Permafrost Make Climate Change?, August 11, 2021 https://www.scientificamerican.com/article/how-much-worse-will-thawing-arctic-permafrost-make-climate-change/#

[138] World Meteorological Organization. Report on "The state of the global climate" 2018 года.

COVID-19? The real pandemic is still to come…

And there is one more problem: the rise in viral activity around the world. This includes the thawing out of cattle graves, including some with anthrax in Russia, traces of Spanish flu emerging as snow melts in Alaska, and other viruses unknown to science surfacing from beneath glaciers in Tibet…the list goes on and on. Scientists are particularly concerned by the fact that at least half of the viruses being discovered are coming back to life after thawing out. This poses a direct threat to mankind.

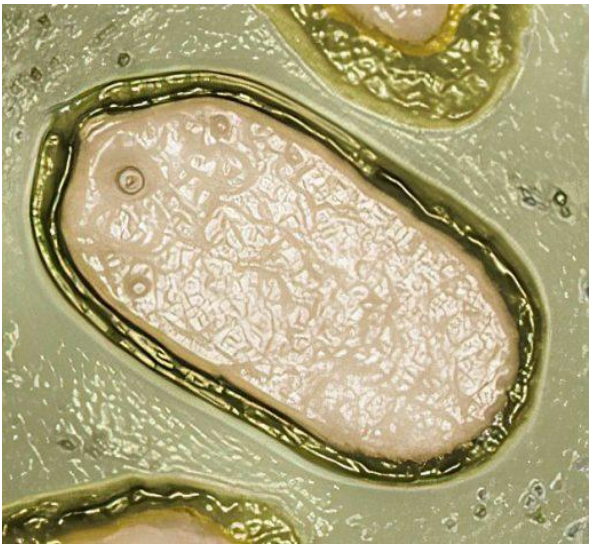

Fig.105 Pandoravirus. Photo: Vincent Racaniello/Wikimedia
https://commons.wikimedia.org/wiki/File:Pandoravirus_salinus_298x300.png
Источник: https://sakhalife.ru/najdennye-v-yakutii-virusy-ozhili-i-okazalis-sposobny-ubivat/

Let us take a closer look at just one example. In 2015, during a study of soil samples taken from a depth of 30 meters in the Chukotka permafrost, an international research team discovered a new type of giant virus, which they named Mollivirus sibericum — "soft virus from Siberia." The virus had spent over 30,000 years in a frozen state and was named "giant" because, in contrast to the most common viruses today (which typically vary in size from 20 to 300 nanometers, while Mollivirus sibericum measures 0.6 microns), it can be seen through an

ordinary optical microscope. Besides its size, the giant virus is distinguished by a much more complex structure: for example, the most common influenza A virus has just eight genes, while Mollivirus sibericum has as many as 500![139] But the biggest news was that after its multi-millennium "hibernation" in permafrost, the megavirus successfully "awakened" in laboratory conditions and began to "eat up" amoebas. "This is the first time we have seen a virus that remains infectious after so many years…Unless we are alert to this and start industrializing these places with due caution, there is a risk that one day we will reactivate viruses like pox, which we thought was eradicated," stated Professor Jean-Marie Claverie from the French National Center for Scientific Research, who took part in the study.[140] Scientists maintain that the virus they discovered poses no danger to human beings, which his why they named it the "soft Siberian"…

This is already the fourth gigantic virus discovered worldwide since 2003, and two of them - Mollivirus sibericum and Pithovirus sibericum (recorded by the same group of researchers in 2014 and currently the world's biggest known virus, measuring up to 1.5 microns in length) - were extracted from virtually the same soil sample.

Fig.106 Diamond mining in permafrost. The Udachnaya kimberlite pipe, Yakutia, Russia Author: Khabir Khakimov, 2006

https://commons.wikimedia.org/wiki/File:Udachnaya_pipe-4.jpg

Fig.107 Yakutsk – the world's biggest city built on permafrost (population 341,000). Author: Slava Stepanov, 2017 r.

https://commons.wikimedia.org/wiki/File:Yakutsk_panorama.jpg

There are two important points to be made here: first, the viruses extracted from Siberian soil samples were previously unknown to science; and second, they came back to life when placed in

[139] https://nauka.tass.ru/nauka/6818381

[140] https://scientificrussia.ru/articles/gigantskij-virus-v-sibiri

favourable climatic conditions, i.e. when warmed up. In any event, as we proceed to develop subsoil resources amidst the thawing of what just yesterday seemed to be permanent "permafrost," it is essential to rigorously enforce anti-epidemiological safety measures. Because it is absolutely unclear what biological threats may emerge from the depths of Earth in the near future…

Global warming for Russia: the adverse consequences

To sum up the above with reference to official documents, the Climate Doctrine of the Russian Federation (approved by Order No.851-rp dated 17 December 2009 of the President of the Russian Federation) states that a substantial part of the territory of Russia is in the zone of maximum observed and predicted climate change, and in the coming years this will have a substantial impact on the life and health of people, as well as the socio-economic development of the country as a whole.

As with any phenomenon, Russian specialists predict that climate change will bring not only adverse repercussions but also some positive ones.[141] We will talk about the positive repercussions at the end of the book, but for now, let's look at the causes for concern.

The adverse consequences of anticipated changes to the climate in Russia are as follows:

- Increased health risks (higher levels of sickness and mortality) in certain social groups;
- Increase in the frequency, intensity and duration of drought in some regions, and of extreme precipitation, floods and waterlogging of the soil, which is dangerous for agriculture, in others;
- Increase in fire danger in forestry areas;
- Degradation of the permafrost in northern regions with damage to buildings and utilities;
- Disruption to the ecological balance, including the expulsion of some biological species by others;
- Spread of infectious and parasitical diseases;

[141] E.V.Arefyeva, V.V.Krapukhin, I.Yu.Oltyan, M.N.Kotosonova, V.V.Artyukhin. Resilience of Municipalities of the Russian Federation to Climate Change: monograph / Russian Civil Defense Ministry. M.: IPCDES, 2022. 140 p. ISBN 978-5-93970-264-5

- Increase in electricity consumption for air conditioning during the summer season in a large number of settlements.

For reference: To implement the National Climate Doctrine, the Russian Government issued Order No.730-r dated 25.04.2011, approving a Comprehensive Plan to 2020. The government has also adopted an action plan for the first phase of adaptation to climate change in the period to 2022, consisting of a package of political, legislative, regulatory, legal, economic and social measures to be implemented by the federal authorities and regional governments. The plan is primarily aimed at reducing the vulnerability of the country's national security system, enterprises and citizens due to changes in the global climate, the climate in the Russian Federation, in neighboring states, and in adjacent zones of the world ocean, and at exploiting the favorable opportunities arising from the said changes.

Subsequently, in 2019, Russia approved and enacted (from 01.01.2020) a national standard identical to the international ISO 14090-2019 standard on Adaptation to Climate Change. Principles, requirement and guidelines."

All of the above and many other documents and programs not listed here are aimed at eliminating or, where possible, mitigating the adverse repercussions of global climate change for our boundless Motherland.

However, just like any other phenomenon, **climate change is also creating many positives for Russia,** which we shall explore in detail in the final chapter.

Russia's Civil Defense Ministry reports growth in number and scale of all types of emergencies

It is no secret to anyone that our country has seen a consistent rise in the number of emergencies of all kinds over the past few years. If we look at the data from the official annual report of the Russian Civil Defense Ministry for 2021, presented by acting civil defence minister A.P.Chupriyan during an expanded meeting of the ministry's board on 16 February 2022, there was a substantial increase in the number of emergency situations of a natural, manmade or biological-social nature in 2021, compared to 2020 (up 17%, from 331 to 386). Chupriyan also noted that **the cause of most natural disasters in the country in 2021 was climate change and that the near-term forecasts are not good.**

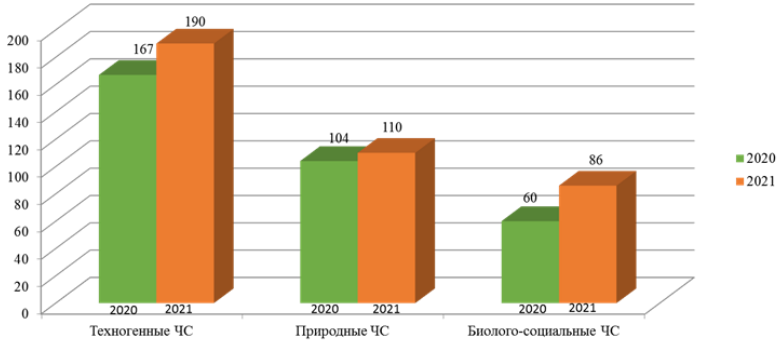

Fig.108 Distribution of number of emergencies in Russia, by type, in 2020 and 2021.[142]

Source: Russian Civil Defense Ministry

First diagram: man-made emergencies

second diagram: natural emergencies

third diagram: bio-social emergencies

All these facts point to the need to organize effective response actions to future natural disasters not only amongst professional fire and rescue services, but also by federal and local government leaders, companies, public organizations and even people who previously built their houses and tended their garden pots without thinking how badly they could be affected by the elements…

It was definitively established long ago that good preventive measures cost much less than clearing up after a disaster has occurred.

Thus, according to calculations in a report published in February 2020 by the All-Russian Scientific Research Institute on Problems of Civil Defense and Emergency Situations (IPCDES),[143] **expenditure on the prevention of emergency situations is 12 times more efficient than paying to clear up the damage afterwards.**

[142] Government report "On the State of Protection of the Population and Territories of the Russian Federation against Emergency Situations of a Natural or Man-made Nature in 2021".https://www.mchs.gov.ru/dokumenty/5946

[143] Sergey Didenko, head of IPCDES, for TASS https://tass.ru/ekonomika/7789389

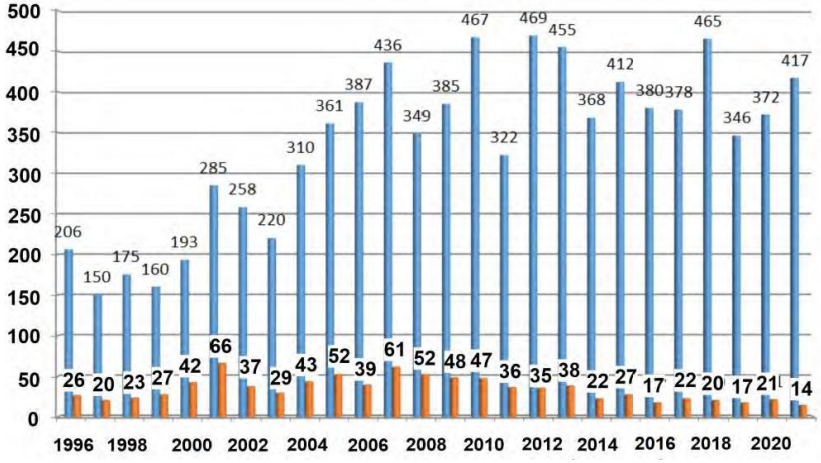

Fig.109 Distribution of hydro-meteorologically dangerous phenomena by year: total number (blue) and number of unexpected phenomena (red)

Who is to blame for natural disasters? Not nature, but that notorious "human factor" once again

Another vital advantage in our struggle with the elements is the fact that most adverse natural phenomena are predictable and even cyclical. As an example, let's look at dangerous hydrometeorological phenomena, which are currently the most destructive evens in our country in terms of scale of impact. In 2021, for example, 1,205 dangerous hydrometeorological phenomena were recorded in Russia, of which 417 caused substantial damage to people and the economy (for comparison, the numbers in 2020 were 1,000 and 372, respectively). However, according to the Russian Meteorological Service, in that

same quite climatically difficult year of 2021, its forecasting units issued 2,833 storm warnings, 86.8% of which turned out to be accurate.[144]

Also in 2021, Russian natural resources and environment minister Alexander Kozlov stated in the wings of the Eastern Economic Forum that "Russia's annual loses due to flooding are as much as 75 billion rubles."

This raises the question of why, if dangerous hydrometeorological phenomena are so predictable, they are causing tens of billions of rubles of damage to the economy and the population every year?

What is preventing effective response measures? The reason why many regions are often unready for the meltwater period is that they take no preventive measures, such as building protective structures, they build in flood zones, and have inefficient public notification systems and poorly organized rescue operations.

[144] Report of the Russian Meteorological Service. https://www.meteorf.gov.ru/images/news/2-0220324/4/Doklad.pdf

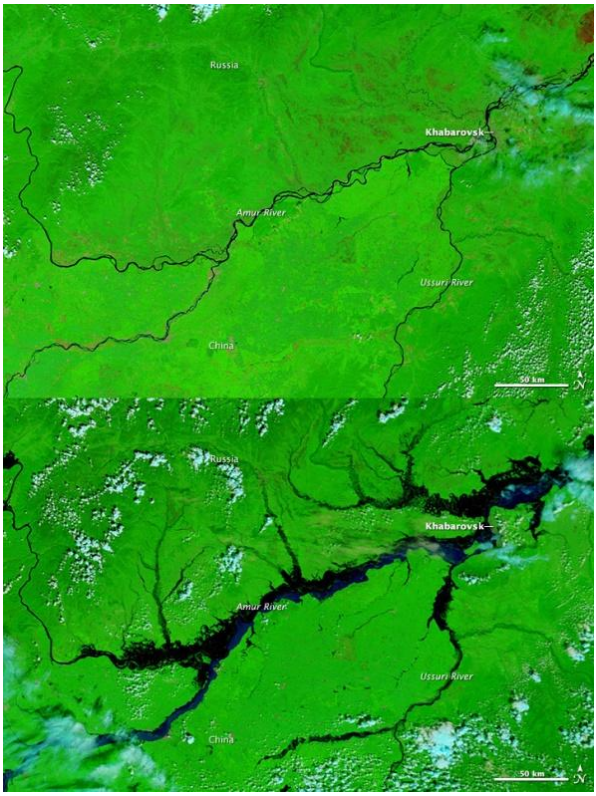

Fig.110 Comparative satellite images of the Amur River basin in August 2008 and during the food of August 2013 (below).
Source: NASA

https://commons.wikimedia.org/wiki/File:Amur_flood_sat.jpg

Back in 2013, following a series of catastrophic floods in the Russian Far East, Russian regional development minister Igor Slyunyaev highlighted a lack of attention to the upkeep of anti-meltwater dams in the Soviet period as one of the causes of the huge amount of damage, as well as building work in potential flood zones: "...it is extremely important not to build new buildings and structures in potential flood zones: we must not build in places that water can reach. This is the job of regional and local authorities and, incidentally, it is also stipulated in the Russian Federation Building Code."

Fig.111 Satellite images: flooding in the town of Tulun, Irkutsk Region: image on left – 19 June 2019, image on right - 29 June 2019.
Source: European Space Agency

https://commons.wikimedia.org/wiki/File:Tulun_town_(Irkutsk_province,_Russia),_Sentinel-2_satellite_image,_2019-06-19.jpg https://commons.wikimedia.org/wiki/File:Tulun_town_(Irkutsk_province,_Russia),_Sentinel-2_satellite_image,_2019-06-29.jpg

To summarize the above, it transpires that the main cause of both material damage and human losses from dangerous hydrometeorological phenomena is our old friend the "human factor:" negligence, slovenliness, incompetence, corruption and…gaps in the law that still need to be filled.

Here is a vivid example.

A deferred natural disaster

The Republic of Sakha (Yakutia) is the biggest administrative district not only in Russia but in the world. According to The Economist, Yakutia covers a bigger area than Germany, France, Britain, Italy, Spain, Switzerland, Finland and Romania together.[145]

In the winter of 2016, there was a huge amount of snowfall in Yakutia. The situation in

[145] Source: https://www.economist.com/euro… below-the-waters-of-russias-arctic

Рис. 112. Official emblem of the Republic of Sakha (Yakutia)

less accessible areas of the republic, such as Kolyma, was particularly acute. Buildings were buried up to their roofs in snow and it was obvious that when the snow started to melt in the spring there would be flooding and associated damage to the villages.

The local rescue services suggested to the regional authorities well in advance of the thaw that they should use the existing "winter roads" to bring in much-needed building materials, especially bricks and cement. But although everyone understood the inevitability of the approaching disaster, they were unable to set aside funds for preventive measures, because the law states that funds can only be allocated after a disaster has occurred.

Fig.113 Map of the Republic of Sakha (Yakutia) Author: Stasyan117 *https://commons.wikimedia.org/wiki/File:Map_of_Russia_-_Sakha_(Yakutia).svg*

As a result, precious time was lost, and when the villages were flooded and an emergency was declared, the required funds were made available. However, as it was by then impossible to deliver the required materials (those bricks and other building supplies) by land, the republic's rescue service had to lease an Mi-26 heavy-duty transport helicopter and several Mi-8 helicopters. Eventually, the aid was delivered to the affected settlements, but as the local rescue workers put it, those ordinary bricks had been turned into "golden

bricks"[146] due to the enormous difference in cost between road and air freight.

It would be wrong to claim that governments around the world are unaware of the approaching climate threat and are not giving it due attention. In 2019, for example, the Russian government approved a national plan of action for the first phase of adaption to climate change for the period to 2022, under which, over two years, the federal government and regional authorities were to draw up and approve industry and regional plans. On the instructions of the Russian president, a federal service for monitoring the permafrost was set up within the Russian Meteorological Service. And experts from IPCDES are drawing up a reference manual to help municipalities to assess their sustainability, including against climate change.

But it is vitally important that all these plans are more than just an exercise in bureaucratic paper shuffling. They must be followed by real expenditure on preventive measures, so that the funds allocated by the government are not wasted or lie around unused…In short, here too, the key role in implementing preventive measures is played by that same old "human factor", or more precisely, by the degree and depth of understanding amongst federal and local authority leaders of the scale of the approaching threats and risks, and of their own responsibility for them.

For reference: On the initiative of the Russian Civil Defense Ministry, to reduce the risks of disasters caused by seasonal natural phenomena, amendments are being made to the regulations to enable regional and municipal leaders to play a direct role in ensuring the timeliness of preventive measures as a way of minimizing damage. "The steps being taken by the Russian Civil Defense Ministry to improve disaster prevention work will enable local leaders to take timely decisions on the organization of preventive measures, This approach will help to raise the level of protection of the population and help emergency rescue services to adopt a policy of preventing rather than reacting to seasonal risks," stated A.V.Kurenkov, head of the Civil Defense Ministry, at a meeting of the Government commission for prevention and liquidation of emergency situations and fire safety.[147]

[146] Source: N.A.Nakhodkin. The Arctic: Present Day and Prospects // Journal Grazhdanksaya Zaschita No.5. 2022.

[147] Source: Spasatel MChS Rossii newspaper, 29 November 2022

Tsunamis in Yakutia? No longer a fantasy but an objective reality

Fig.114 Map of earthquake-prone regions of Russia, 2016
Source: O.Yu.Shmidt Institute of Earth Physics, Russian Academy of Sciences

In respect of other dangerous natural disasters, such as earthquakes and forest fires, the human factor plays an even bigger role. Earthquakes are dangerous natural phenomena which have caused death and destruction on a huge scale throughout the history of civilization. On the one hand, earthquakes occur very suddenly and are difficult to forecast. On the other, people have learned to predict this type of threat by developing the science of seismology, and have learned how to design and build quake-proof buildings in seismic risk zones. In Russia scientists have compiled a sophisticated map of the country's earthquake-prone zones, which are inhabited by over 20 million people.

Fig.115 Buildings in Chile designed with no consideration for seismic danger (left) and using quakeproof technologies (right), after an earthquake with a magnitude of 8.8 points on 27 February 2010. Author: Walter Mooney, U. S. Geological Survey

https://commons.wikimedia.org/wiki/File:Collapsed_High-Rise_Apartment_Complex_(4479275148).jpg

https://commons.wikimedia.org/wiki/File:Earthquake-Ready_High_Rise_in_Chile_(4479274140).jpg

Consequently, in order to prepare for a sudden attack by this cunning elemental force, when building in seismic zones it is essential to employ modern quake-proof building technologies. Experience shows that these technologies can prevent damage and, as a result, the loss of many human lives even with tremors reaching a magnitude of 9 points on the Richter scale (for example, following an earthquake in the Chilean capital Santiago in 2010 with a magnitude of 8.8 points, no damage or even cracks were recorded in high-rise buildings built using quake-proof technologies).

It would seem that the existing regulations on seismic safety in buildings should minimize the number of victims and economic losses caused by underground tremors. In practice, however, this turns out to be far from the case.

Fig.116 A district of multistorey buildings destroyed by an earthquake. Author: C. J. Langer. U. S. Geological Survey

Fig.117 Search and rescue operations in Spitak, December 1988. Author: LoMit

https://commons.wikimedia.org/wi-

https://commons.wikimedia.org/wiki/File:1988_Spitak_earthquake_-_Partial_Collapse_of_Masonry_Building,_Spitak,_Armenia.tif

ki/File:Armenia10.jpg

Thus, the 1988 earthquake in Spitak, Armenia, had a magnitude of 7 points, killed over 25,000 people, crippled a further 140,000 and left around half a million people homeless. The incident revealed that government agencies had underestimated the level of seismic danger in the region, resulting in poor building quality and inadequate preparations by the rescue services to respond to large-scale disasters.

Another victim of the elements was the village of Neftegorsk in Sakhalin Region. On the night of 28 May 1995, the northern part of Sakhalin Island was hit by an earthquake with a magnitude of 7.6 on the Richter scale. Due to negligence by the regional government in building large-panel five-storey residential blocs based on a design not suitable for seismic zones, the earthquake totally destroyed 17 buildings in just a few seconds. And as it occurred on a Sunday night, 2,040 of the settlement's population of just over 3,000 died, including 268 children, while a further 720 were injured. Rescuers arriving on the scene noted that even in Spitak there had not been such catastrophic destruction, with residential buildings crumbling to their foundations and virtually turning into dust…

In total, over 200,000 people have died in earthquakes in the former USSR during the post-war period (1946 – 1990).

In our current scientific predictions, we must take into account all the available facts, including impossible and inconvenient ones that do not conform to our tried and tested models and theories.

For example, if the concept of orchards in Siberia no longer surprises us and we assume that such things are just a matter of time, what do you think of the threat of tsunamis in Yakutia? Utterly paradoxical as it may sound, this threat is more than real and it could happen long before any Siberian orchards start flowering. Don't believe it? Then judge for yourself…

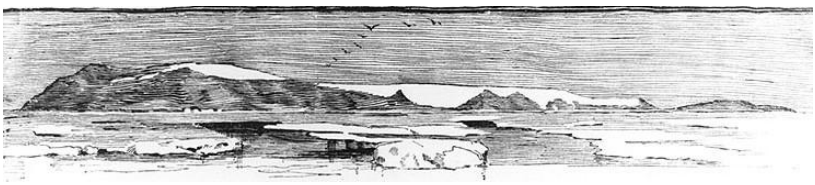

Fig.118 Drawing of Bennet Island by a member of the 1881 De Long expedition on the ship Jeannette. Author unknown.

https://commons.wikimedia.org/wiki/File:Bennet_Island;h92134.jpg

As we have already mentioned, thanks to climate change in the Arctic seas where it used to be difficult for ice breakers to find a passage, huge expanses of open water are now appearing in the summer season. On the one hand, this makes freight transportation via the Northern Sea Lanes more efficient. On the other, given the high level of seismic activity in the vicinity of the Novosibirsk Islands, and in particular around Bennet Island (located in the East Siberia Sea, administratively part of the Republic of Sakha (Yakutia), area 156.2 km², altitude – up to 426 meters) and the fact that the settlements on the nearby mainland, including the town of Tiksi (Russia's most northerly port), were built on low tundra shores, there is now an absolutely new risk of tsunamis hitting the coastal settlements if, by unhappy coincidence, an earthquake should occur in the Arctic during the open-water season.[148]

On fire again…

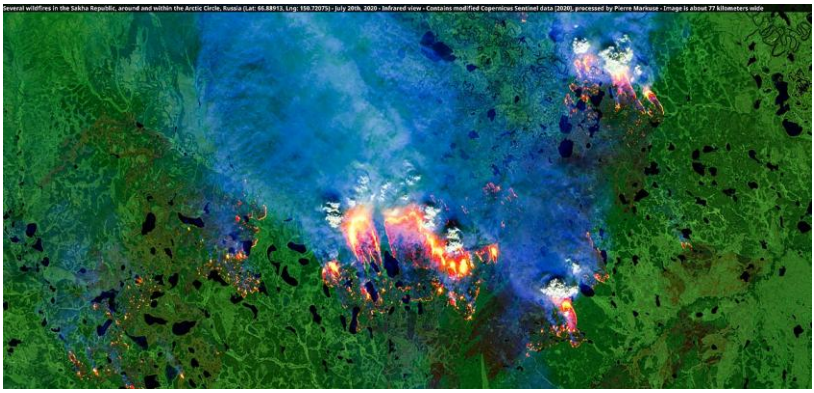

Fig.119 Forest fires in Yakutia, July 2020. Width of photograph – 77 km. Author: Pierre Markuse from Hamm, Germany

https://commons.wikimedia.org/wiki/File:Several_wildfires_in_the_Sakha_Republic,_around_and_within_the_Arctic_Circle,_Russia_(Lat_66.88913,_Lng_150.72075)_-_July_20th,_2020_(50133507522).jpg

[148] Source: Nikolay Nakhodkin 'The Arctic: Present and Future Prospects' for the journal 'Grazhdanskaya zaschita" No.5 2022

Fig.120 Soldiers in Russia's Eastern Military District laying a mineralized strip in a forest to prevent the spread of fire. Yakutia, August 2021. Source: Russian Ministry of Defense

https://function.mil.ru/news_page/country/more.htm?id=12377530@egNews

Another hot topic is forest fires, which are mainly caused by people having picnics and setting fire to grass and garbage. Thus, according to data from Anatoly Suprunovsky, Russia's chief fire safety inspector, of all the 439,100 fires recorded in the Russian Federation in 2020 (causing a total of 8,262 deaths), over half (including cases of burning of dry grass and garbage) occurred in open land – almost 268,000 cases. The damage caused by the fires amounted to approximately 19.4 billion rubles.

Here is what the Russian Civil Defense Ministry's website says about the causes of the wildfires: The main causes of wildfires are: unextinguished cigarettes, burning matches, smoldering gun swabs after shooting, oil rags or cloths, glass bottles refracting sunbeams, sparks from vehicle silencers, burning of old grass or garbage near a forest or peat field, and the use of fire to clear forest areas for agricultural use or to create forest pasture. But one of the most dangerous potential sources of wildfires is bonfires. In many cases, wildfires are the result of arson, man-made accidents or disasters. Every summer, forest fires are set off with an inevitability that leads one to despair. This is something that one simply cannot become accustomed to. It takes decades for forests to regrow. If you even once saw a forest fire, you would never ever forget such devastation…"[149]

[149] Source: https://mchs.gov.ru/deyatelnost/bezopasnost-grazhdan/prirodnye-pozhary_6#:~:text=Основные%20причины%20возникновения%20природ-

It follows from the above that **the main cause of wildfires – between 70 % and 95% of cases – is "careless handling of fire," in other words, the human factor.** Or to put it in simple language - irresponsible behavior and negligence. It should be stressed here that the human factor risk in Russia in this area is much higher than in Western countries in similar circumstances.[150]

The experts are united in cautioning that because of global warming, the number and intensity of wildfires in Russia is only going to increase from one year to the next. So perhaps it's time for us to keep the "human factor " in check?

ных%20пожаров%3A,использования%20или%20обустройства%20лесных%20пастбищ

[150] Government report "On the State of Protection of the Population and Territories of the Russian Federation against Emergency Situations of a Natural or Man-made Nature in 2020." M.: Russian Civil Defense Ministry, IP-CDES, 2021.

For reference: In the second part of the 'Preventing Man-made Disasters' trilogy, we shall look in detail at ways of channeling the potential of the "human factor" towards constructive rather than destructive ends as a way of improving safety.

Norilsk 2020: Global warming is causing an environmental disaster at an industrial facility

Escalating climate change is causing a rapid increase in spending on clearing up the damage from natural disasters. According to statistics from IPCDES, whereas in 2018, 8.2bn rubles was spent on clearing up after large-scale natural emergencies, by 2019 this had almost doubled to 15 bn rubles.

Fig.121. Diesel fuel from a damaged tank contaminating Siberian rivers. 31 May 2020. Author: European Space Agency

https://commons.wikimedia.org/wiki/File:Norilsk_oil_spill_may_31_2020_sentinel-2_esa.jpg

And in 2020, due to thawing beneath a hazardous structure in the permafrost zone, Russia experienced one of its biggest environmental disasters, posing a threat to the ecosystems of the Arctic Ocean. Over 21,000 tonnes of diesel fuel leaked from a backup tank at the TETs-3 power station in Norilsk following a containment failure on 29 May 2020. The scale of the damage is indicated by the compensation figure of 146,2bn rubles, which was determined by the

Court of Arbitration of Krasnoyarsk Territory on 5 February 2021 after reviewing a claim lodged by the Russian nature watchdog Rosprirodnadzor against NTEK (a subsidiary of Norilsk Nickel). In 2022, a claim by the Russian fisheries watchdog, Rosrybolovstvo, against NTEK for damages of 58.7bn roubles was settled out of court.

The investigation showed that in 2017-2018, the Russian technical supervision agency, Rostekhnadzor, had warned NTEK about problems with fuel storage at the power station. In response, company management shut down the ill-fated tank for repairs, but it later became the cause of a man-made accident that turned into an environmental disaster. The storage tank was out of commission for a number of years and was therefore not accessible for inspection visits by government inspectors. For its part, the Russian Investigative Committee reported that the tank in which the accident occurred had been in need of capital repairs since 2018 and was not compliant with industrial safety standards, yet it had still been put into operation. Why a tank that was "under repair" was filled almost to the top with diesel fuel is a question that the investigation must answer.[151]

In 2020, following the disaster in Norilsk, acting on instructions from the President of the Russan Federation, Rostekhnadzor carried out an unscheduled check of 426 hazardous industrial facilities in the Arctic region. This revealed as many as 2,600 violations, for which 54 companies were charged and penalties amounting to 6.5 million rubles were issued.[152]

To summarize, one could claim that this kind of large-scale damage and such high payouts are the result of a dangerous combination of two factors: unfavourable though predictable natural phenomenon (thawing of the tanks' foundations) and inadequate safety regulations on hazardous industrial facilities.

A cascading disaster on a planetary scale: "made in Japan"

Recent history has produced some lamentable instances of how a truly significant but still localized natural disaster combined with negligence, red tape and incompetence in carrying out preventive

[151] https://www.kommersant.ru/doc/4377722

[152] Head of Rostekhnadzor, A.Aleshin, in an interview with Interfax https://www.interfax.ru/interview/729493

work in extremely dangerous production facilities can lead to a man-made disaster on a planetary scale. We're talking, of course, about the Level 7 disaster – the highest level of classification on the INES scale[153] - at the Fukushima-1 atomic power plant - a disaster "Made in Japan," as the Japanese themselves later dubbed it.

Fig.122 Accident at the Fukushima-1 nuclear power plant, 16 March 2011
Author: Digital Globe
https://commons.wikimedia.org/wiki/File:Fukushima_I_by_Digital_Globe_B.jpg

The formula was very simple:

Natural disaster + HIF[154] =
= *cascading disaster "Made in Japan"*

The story of this disaster, which is currently the biggest man-made disaster of the 21st century, can be summarized as follows. As of March 2011, Japan had 54 functioning nuclear reactors (the third biggest fleet in the word after France and the US, and the biggest in Asia) with a total capacity of 49 GW. Most of them were located on the coast in a zone of high seismic activity known to specialists as the Pacific Ocean Ring of Fire.

[153] International Nuclear Event Scale, devised by the International Atomic Energy Agency to standardize assessments of emergencies at civilian atomic industry facilities.

[154] Hazardous industrial facility

Fig.123 Construction of a protective dam at the Fukushina-1 nuclear power plant, 1970. Source: United States Department of Energy
https://commons.wikimedia.org/wiki/File:HD.15.052_(11839698123).jpg

Fig.124. The Fukushima-1 nuclear power plant in 1975. Source: The Ministry of Land, Infrastructure, Transport and Tourism of Japan
https://commons.wikimedia.org/wiki/File:Fukushima_I_NPP_1975.jpg

When the Fukushima-1 nuclear power plant was built between 1966 and 1971 (all six reactor were designed by US company General Electric, with a total capacity of 4.7GW, the station was one of the 25 biggest nuclear power plants in the world), all current IAEA standards and safety recommendations were followed, both as regards earthquake resistance and protection against tsunamis, including construction of a 5.7m protective dam. The height of the dam was calculated by TEPCO experts on the basis of archive data on earthquakes and tsunamis in Japan over the past 400 years. According to the data, the Fukushima Prefecture was one of the least seismically active areas of the country. Consequently, the power station's owner regarded waves of no more than 6.1m in height and a tremor with a magnitude of up to 7 points on the Richter scale as the worst-case scenario.[155]

While the plant was in operation, the IAEA, following a number of major incidents in atomic energy worldwide, significantly toughened its recommendations on power plant safety. In addition, in the years preceding the disaster, TEPCO received data indicating a need to revise its previous assessments of the threats and risks posed by earthquakes and tsunamis. First, there were several major earthquakes with a magnitude of around 9 points in areas along the Pacific tectonic plate (Sumatra, 9.2 points, Chile, 8.8 points) after the

[155] The Fukushima Daiichi Accident: International Atomic Energy Agency Report. Vienna, 2015. Vol. 2.

Fukushima station had been built. Second, in 2022, Japan's Headquarters for Earthquake Research Promotion (HERP) revised the historical data on the Jogan-Sanriku earthquake of 869 and published calculations showing that if such an earthquake were to recur with a tsunami in that area, the waves could reach a height of as much as 15 meters and drown the Fukushima-1 zone.

At that point, there was still time to take heed and make improvements: for example, to increase the height of the dam at the cost of a few tens of millions of yen. However, company management regarded the HERP calculations with distrust and a fair degree of scepticism because they had applied a universally recognized (though highly obsolete) methodology which demonstrated that their power station was fully prepared for an onslaught of the elements and that no additional action (which could have forced the company into unforeseen expenditure) was required. As senior executives around the world know, unforeseen expenditure can upset shareholders and, as a result, reduce the size of their bonuses…

It should be noted that despite all the above cost-conscious savings on safety, TEPCO was spending tens of millions of dollars every year on expensive Western risk management consulting firms in the aim of boosting its market capitalization.

The Fukushima lesson has not been learned

After everything that happened at Fukushima-1, TEPCO's vice president for operational safety declared "… **I calculated that there was no need for haste in implementing the natural disaster protection measures,** as such disasters occur less than once every 100 years. Reactors operate for a far shorter period."[156]

[156] The Fukushima Daiichi Accident: International Atomic Energy Agency Report. Vienna, 2015. Vol. 2.

Fig.125 Sendai Port, the consequences of the tsunami in Japan, photographed from a helicopter, 12 March 2011. Author: U. S. Navy
https://commons.wikimedia.org/wiki/File:SH-60B_helicopter_flies_over_Sendai.jpg

Some years later, at 14:46 local time on 11 March 2011, the Great East Japan Earthquake occurred – the most powerful earthquake in Japan's recorded history. The main tremor with a magnitude of 9.1 points on the Richter scale was in an epicenter located a mere 180 km from Fukushima. Within just 10 minutes, the first tsunami waves reached the Japanese shore, causing enormous damage to the economy and the population. Despite the country's sophisticated emergency warning network, the official death toll from the earthquake and tsunami was 15,896, including 2,536 people who are still missing.[157] Over 120,000 buildings were completely destroyed and around 1 million suffered partial damage. Most infrastructure facilities were affected. The overall damage caused by that earthquake in Japan, according to Kyodo News data based on government calculations, is estimated at 16-25 trillion yen ($198-309bn).

[157] Source: report Damage Situation and Police Countermeasures. National Police Agency of Japan 2015.

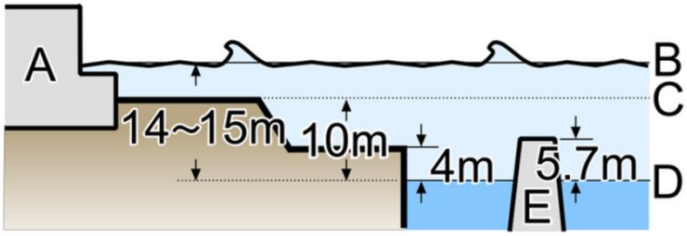

Fig.126 A tsunami wave crosses the dam and reaches the reactor halls of the Fukushima-1 nuclear power plant. Author: Shigeru23
https://commons.wikimedia.org/wiki/File:Fukushima_I_Powerplant_(Tsunami_height).png

At Fuushima-1, the first tsunami wave with a height of 4 meters arrived 40 minutes later, followed by the second wave with a height of 14-15 meters, which easily breached the dam designed for waves of just 5.5 meters and flooded the reactor halls at an altitude of just 4 meters above sea level, knocking out critically important equipment ensuring safe cooling (shutdown cooling) of the reactors. In the opinion of a parliamentary commission which examined the incident, TEPCO was absolutely unprepared for this sequence of events and the fate of the plant was already predetermined.

Thereafter, as a result of chaotic and inconsistent actions by TEPCO managers and the Japanese authorities, demonstrating an inadequate response to an emergency in a hazardous nuclear facility, a local accident developed into a large-scale planetary disaster.

It is much cheaper to prevent a disaster than to clear up afterwards

When revealing the findings of the investigation, Kiyoshi Kurokawa, head of the parliamentary commission, stated frankly: "**We have to recognize – and this is particularly painful – that this disaster was "made in Japan." The underlying causes of the accident are rooted in Japanese culture itself: our reflective obedience, our unwillingness to doubt management, our commitment to "following a set program," our groupism and our reti-**

cence."[158] The parliamentary commission candidly described the event as a "man-made disaster" in the sense that although **nuclear shortcomings in the nuclear power plant safety system, especially in respect of natural disasters, were identified long before 2011, neither TEPCO nor the regulators nor the relevant ministry did anything to eradicate them.**

Fig.127 A fire engine responding to the accident in Unit 3 at the Fukushima-1 nuclear power plant, 15 March 2011. Author: Rikujojieitai Boueisho
https://commons.wikimedia.org/wiki/File:23.3.22？_ＣＲＦ：放水支援（３号機）※１０３隊撮影_東日本大震災における災害派遣活動_17.jpg

It would require several pages merely to list all the complications and repercussions encountered by Japan after the Fukushima-1 disaster. These include direct losses to TEPCO of 22 trillion yen[159] relating to the disaster cleanup operation, which involved the demolition of the plant, deactivation of contaminated land (a 20km exclusion zone was created around the plant and tens of thousands of people were rehoused) and compensation payments to local residents and companies. One should also take into account the damage caused

[158] The official report of The Fukushima Nuclear Accident Independent Investigation Commission. Executive summary / The National Diet of Japan, 2012, p. 9.

[159] Yuka Obayashi, Kentaro Hamada "Japan nearly doubles Fukushima disaster-related cost to $188 billion". For Reuters. 09.12.2016.

to energy security in Japan, which was forced to increase consumption of costly fossil fuels and introduce an across-the-board electricity saving regime, the boycott of Japanese agriculture and food products announced by 53 countries and the European Union, and much, much more.

Fig.128 One of many temporary radioactive soil storage sites, December 2019. Author: Olivier Evrard, J. Patrick Laceby, and Atsushi Nakao

https://commons.wikimedia.org/wiki/File:Decontamination_waste_-_Iitate,_Fukushima.png

It will take decades to completely clear up the damage from the Fukushima accident. And the most difficult thing will be to remove over 800 tons of nuclear fuel from the melted reactors, which there is now nowhere to store. Yet all that TEPCO management had to do was simply heed the conclusions of independent experts and find the funds to upgrade the dam. Who now cares about the risk of reducing the company's capitalization and cutting payouts to the senior executives when de facto TEPCO has been bankrupt for many years and exists only thanks to government support?

But it is worth noting that the majority of owners of nuclear power plants in Japan have reassessed their risks in view of the new realities in good time and ensured due protection of the facilities under their control. For example, JAPC (Japanese Atomic Energy

Company), which operates the Tokai nuclear power plant in Ibaraki Prefecture (located next to the Fukushima Prefecture on virtually the same coastline), having studied an updated map of flood danger prepared by experts from Ibaraki Prefecture (and which proved very close to reality) simply found the time and the funds to raise the height of its protective dam from 4.91 meters to 6,11 meters. During the Great East Japan Earthquake of 2011, the tsunami wave height in Ibaraki reached 5.4 meters.[160] And the dam, which had been raised by just 1.2 meters, did its job well. As a result of that preventive action by JAPC's senior management, the Tokai nuclear power station was not affected by the onslaught of the elements.

This example vividly demonstrates that a natural disaster causing a man-made disaster can have a destructive synergetic impact. If one imagines how much it would have cost the company to upgrade the dam to the required height – let's say, several million US dollars - and compares that with the total damage caused to the nuclear power industry in Japan because that work had not been done, the efficiency of preventive action can be measured in hundreds or even thousands of times the cost of clearing up the consequences of a Level-7 nuclear disaster.

Climate risks: RHFs[161] in danger

It would be fundamentally wrong to claim that natural-man-made disasters like the one that occurred in 2011 in Japan would be completely impossible in Russia. On the one hand, Russian scientists have drawn up and implemented the strictest measures to ensure safe operation of both functioning and new-build nuclear power plants. On the other, one must now take into account climate risks which were unimaginable just a few decades ago. By way of an example, we shall look at an emergency that arose in the summer of 2021 in the P.G.Smidovich Nature Reserve in Mordovia. Following a storm on 3 August 2021, the Mordovian police identified the source of a fire in a hard-to-access location. Despite the timely announcement of an interregional state of emergency with federal-level response measures in Mordovia and Nizhny Novgorod Region, it took more than

[160] Interim Report: Investigation Committee on the Accident at Fukushima Nuclear Power Stations of Tokyo Electric Power Company, 2011.

[161] Radiation-hazardous facilities.

a month to extinguish the fire, which raged across an area of over 12,000 hectares.[162]

Fig.129 "Czar bomb": an exhibit in the Nuclear Weapons Museum in Sarov. Author: User: Croquant with modifications by User: Hex
https://commons.wikimedia.org/wiki/File:Tsar_Bomba_Revised.jpg

Fig.130 Fighting a forest fire in the Republic of Mordovia and Nizhny Novgorod Region in 2021.
Source: Russia Civil Defense Ministry[163]

[162] Source: https://www.interfax.ru/russia/789640

On several occasion, the flames from the forest fire came very close to the testing ground of the Federal Nuclear Center in Sarov, Nizhny Novgorod Region (the Center's main activity is developing and producing nuclear warheads), and it was only thanks to timely action at the federal level to supply additional resources[164] to tackle the blaze that it was prevented from spreading into the Sarov site.

In this connection, it is worth noting the following. In the late 1940s and early 1950s, when decisions were being taken on the locations of secret facilities for the USSR's nuclear program, the key factors considered were inaccessibility of the facilities for agents and saboteurs from foreign intelligence services, discretion, and concealment in natural forests against possible attacks in the event of a full-scale military conflict. In those days, the question of extinguishing large-scale seasonal forest fires caused, amongst other things, by climate change, was not a risk factor and was not taken into consideration. But today, this is the preeminent risk for the hazardous nuclear facilities in the Sarov zone. One could consider it good luck that the epicenter of the fire in 2021 was quite far from the Sarov zone and that the response units managed to stop the flames from reaching the facility's residential and industrial premises. But to make things safer for the future, both around and within the Sarov zone, a number of preventive measures must be taken. For example, dead trees, dry and partly burned timber resulting from previous fires must be removed or neutralized. It is notable that the fire in the Mordovian conservation zone in 2021 arose in the same place as another fire in 2010. In addition, a forest monitoring system (such as the Forest Watch system) needs to be installed for early identification of heat points, fixing their coordinates and ensuring rapid reaction to conflagrations in their early stages. However, the secrecy restrictions at the federal nuclear center in Sarov prohibit the transfer of data via open communication channels within the Mordovian conservation zone, ruling

[163] Government report by the Russian Civil Defense Ministry "On the State of Protection of the Population and Territories of the Russian Federation against Emergency Situations of a Natural or Man-made Nature in 2021."

[164] For reference: 12 air mobile groups from the Russian Civil Defense Ministry and the Volga Region Search and Rescue Service were deployed to fight the fire, alongside the resources of the Leader Rescue Center, the Noginsky Rescue Center, staff from other departments and volunteers: in total, 2,222 people and 451 units of equipment, including 13 aircraft. Source: Russian Civil Defense Ministry Government Report for 2021.

out use of the Forest Watch system that has already produced good results in other parts of the country.[165]

In view of the above, it is not surprising that following an unscheduled onsite check by the Russian environmental watchdog, Rosprirodnadzor, on 26 May 2022, the inspectors concluded that the P.G.Smidovich state nature reserve was once again unprepared at the start of the 2002 fire danger season, as it had been in 2021.

For reference: There are 17 operational nuclear power plants in Russia today and 177 other nuclear and radiation-hazardous facilities. Add to this a further 13,983 less dangerous chemical industry facilities, up to 70% of which are located in 140 towns around the Russian Federation. In total, over 40 million people live in potential chemical danger zones. The numbers speak for themselves…

Algorithm of a cascading disaster

> History is not a teacher, but a mentor: it doesn't teach anything but punishes people harshly for not understanding the lessons.
>
> *Vasily Osipovich Klyuchevsky*

Thus, using the example of the Japanese natural-man-made (cascading) disaster with due consideration for the facts of other large-scale incidents of a similar nature, it is possible to derive a tentative algorithm of the evolution of such phenomena. In our version, the algorithm consists of four stages:

1. The management and staff of a potentially hazardous production (infrastructure, transport etc.) facility formally comply with all the regulations, rules and procedures and have a feeling of comfortable security ("we've got everything under control");
2. But then, some fundamentally new threats and risks arise which are not accounted for in the rules and procedures followed by the management;
3. Next, a set of unforeseen external circumstances emerge, creating a critical contingency (incident) at the facility;

[165] Source: https://tass.ru/obschestvo/14741339

4. The, due to the unpreparedness (passivity) of the facility's management/staff, the incident escalates from a local accident to a planetary disaster.

On the basis of the above, given the new threats and risks, some of which we have tried to illustrate, all fire, radiation and public safety officers without exception, both in Russia and around the world, need to thoroughly revise their safety programs and start immediately implementing appropriate preventive actions. Because as history teaches us, it is much cheaper - many times cheaper - to prevent a disaster than to clear up the consequences afterwards…

Conclusion

Based on the above, we have formulated the following conclusions and suggestions. On the one hand, unfortunately, people have still not learned to manage our planet's climate. Isolated attempts to influence the weather are undoubtedly being made, but they generally do not have the expected impact and are sometimes even counterproductive. On the other hand, we actually do have a way of countering the elements.

The key task at this stage of mankind's existence is not to attempt to cancel or postpone climate change, and certainly not to manage it (which has been proven impossible by the collapse of the green energy concept, once again due to "adverse climate changes") through tougher action to reduce greenhouse gas emissions and other highly controversial initiatives to overcome the accumulated repercussions of man's impact on nature over many millennia (from the time when man began hunting with fire and using fire in agriculture, arable farming and breeding animals). What we need to do is to define as clearly as possible all the most negative natural phenomena, forecast the strongest possible measures to prevent them, and immediately begin putting those measures into effect.

At the same time, when compiling forecasts, it is essential to take account of the obvious fact that we have entered an age in which some countries, even in the most remote corners of the planet, are beginning to experience natural phenomena at a scale, frequency and force never before recorded. As the unfortunate example of Fukushima-1's management demonstrates, even if there has not been an earthquake with a magnitude of more than 8.3 points in over 400 years, this does not mean that more powerful earthquakes will not occur in the foreseeable future. After all, these things are actually happening right now, as you read these lines.

Our main aim is to prevent any catastrophic synergetic impacts that could turn natural disasters into man-made incidents, as happened in the Land of the Rising Sun.

For this, we need to make a realistic assessment of future climate risks and threats and then draw up an exhaustive list of preventive measures to prepare for adverse natural phenomena and ensure maximum funding of response systems.

And most importantly, we need to be open and honest about all the objective facts which, at this moment in time, might seem inconvenient and inconsistent with our current theories and understandings, disrupting and even destroying the worldview we have built…

"Killer waves:" myths, legends, facts

Fig.131 Katsushika Hokusai "The Great Wave off Kanagawa." Wood engraving, 1823–1831

https://commons.wikimedia.org/wiki/File:The_Great_Wave_off_Kanagawa.jpg

The picture shown above by the outstanding Japanese artist Katsushika Hokusai, "The Great Wave off Kanagawa," contains an unambiguous representation of Japanese fisherman in difficulty at sea not far from the shore of Honshu – the biggest island in the Japanese

archipelago. Having studied this picture closely over many years, researchers from various countries have established the following.

First, the action portrayed in the picture occurs in a place that actually exists, near the shore of Kanagawa Prefecture, from which there is a magnificent view of Mount Fujiyama[166] - a mountain that is sacred to the Japanese. Second, the picture portrays real and, at that time, very common oshiokuri-bune fishing boats, measuring 10-12 meters in length. Third, according to expert calculations, the waves in the picture are 14-16 meters high and display a number of features indicating that they are not just storm waves but so-called "killer waves."[167] The chances of anyone surviving in these circumstances look negligible. In effect, what we are seeing in this canvas by the Japanese artist is the tragic death of people who had set out to sea and been taken unawares by the perfidious marine elements.

It is worth dwelling in more detail on the subject of "killer waves." These waves (also known as "rogue waves" or "freak waves," while the French use the terms "onde scélérate," meaning "wicked wave", and galéjade — the "fairytale" or "fictional wave"), consist of huge single waves up to 20 meters or more in height that occur not during a hurricane wind or a strong storm but sometimes even in the absence of a swell on the sea. They are not generated by some large-scale geophysical event, such as an earthquake, a volcanic eruption, or a cyclone accompanied by a hurricane, but arise, at first sight, completely unexpectedly.

As killer waves are not only unpredictable but also possess enormous destructive power, they pose a serious threat both to shipping and to offshore infrastructure, as well as in coastal waters. People have long known about such waves, since the times of the ancient mariners,[168] and numerous legends have sprung up around them. They can appear literally out of nowhere in the form of a crest

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[166] It should be noted in particular that Mount Fujiyama remains to this day a place of pilgrimage for many practicing Buddhists attempting to achieve enlightenment.

[167] The similarity between killer waves simulated in laboratory conditions and the waves in Hokusai's picture was discovered by scientists from Oxford University in 2018.

[168] Ancient tales about Poseidon, the wrathful ruler of the sea, (known as Neptune in Roman mythology) who ferociously destroyed boats and even coastal towns for the slightest sign of disrespect, as well as other ancient legends about all sorts of marine monsters that sank ships may, in one way or another, provide evidence of the existence of killer waves.

or a trough. In the age of wooden sailing boats, the chances of either the boat or the people in it surviving a 2—meter "devil's wave" were negligible. In the 20th century, when sailing boats were replaced by all-metal ships, more and more witnesses and evidence of the existence of such waves began to appear.

Fig.132 World War I, 1915. British warships during a storm at sea with high waves.

https://commons.wikimedia.org/wiki/Category:Rogue_waves#/media/File:Eerste_Wereldoorlog,_zeeoorlog_(3019094834).jpg

Fig.133 Civilian vessel during a storm in the Bay of Biscay around the 1940s. U. S. National Oceanic and Atmospheric Administration.

https://commons.wikimedia.org/wiki/Category:Rogue_waves#/media/File:Wea00800,1.jpg

Killer waves vs. skeptical scientists

However, despite the rapid accumulation of documented evidence from witnesses, including photographic records, and a multitude of unexplained sinkings of quite large vessels in relatively calm weather, official science for a long time doubted the existence of killer waves.

Why so? Because scientists are also human beings, and like normal people everywhere they want to take the path of least resistance and deny anything that does not tie in with their neat and hard-earned theories. The existence of killer waves was doubted by science due to their unexpected and sudden appearance, their nonlinear dynamics, and because the existence of such a natural phenomenon was not consistent with the neat mathematical and physical theories that existed at that time. The scientists said that to research the problem more thoroughly they needed unambiguous, instrumentally recorded and irrefutable facts, rather than fragmented statements by terrified people seeking to make headlines, some of whom possibly had a very rich imagination.

For example, in 1849, the authoritative and internationally famous oceanographer and military officer Jules Sébastien César Dumont d'Urville (1790–1842) presented a report to the French Geographical Society containing witness accounts of roving waves measuring up to 100 feet (30.5 meters) in height. However, senior scientific and government officials not only did not believe the facts presented but publicly humiliated both d'Urville himself and his three eyewitnesses.

Oceanology textbooks used for decades to teach sailors, oceanographers, meteorologists and shipbuilders applied the standard principles of linear modeling of wave height, making no reference whatsoever to 20-30-meter killer waves, because the dominant scientific theories at the time doubted their very existence. Thus, according to the universally used Beaufort scale,[169] even in the strongest 12-point storm, waves bigger than 20 meters were considered to be extremely rare. Right up until the 1960s, the highest officially recorded wave, observed during a strong hurricane, measured 67 feet (20.42 meters).

Fig.134 The Michelangelo liner, 1965. Photographer unknown.
Photo from open sources.
https://it.wikipedia.org/wiki/File:Michelangelo_1965.jpg

[169] Beaufort scale – the conventional 12-point scale defining wind strength from the nature of its appearance at sea, designed in 1805 by British admiral and hydrographer Sir Francis Beaufort. Officially adopted by the World Meteorological Organisation. Source: Russian Ministry of Civil Defense.

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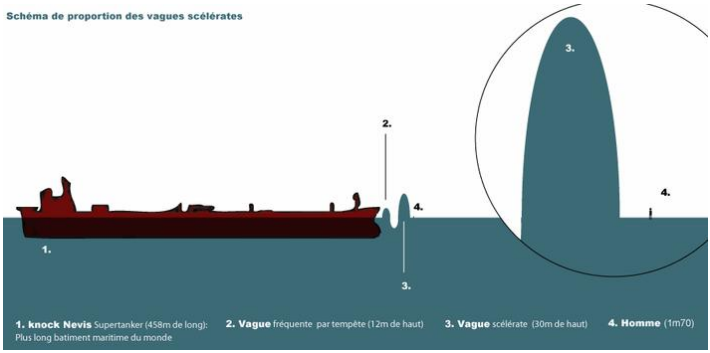

Fig.135 A "killer wave" engulfs the bow of a large cargo ship. In the circle, the scale of the wave is exaggerated with a human being beside it for comparison. Author: Baltimorax

https://commons.wikimedia.org/wiki/File:Vaguescelerate.png

Even such obvious cases as the tragic incident of the Michelangelo liner,[170] caught on camera in 1966, when during a trans-Atlantic crossing a huge wave twice as high as the others hit the bow of the vessel and rolled across the upper deck, causing extensive damage to the superstructures, killing three people and injuring 50 others, was not regarded as sufficient grounds for additional scientific studies.

Another similar case was the mysterious loss in the North Atlantic of the gigantic (261.4 meters long, 32.2 meters high, 18.29 meters wide, with a capacity of 44,600 tonnes) German lighter-carrier ship MS München with 28 sailors on board.[171] It is worth stating here that as in the case of the Titanic, the MS München, given its dimensions and design, was regarded by the experts as an unsinkable ship, built precisely in order to handle traditional seasonal North Atlantic storms without problems or repercussions. All the more surprising, therefore, that after transmitting a disjointed SOS signal, the ship together with its cargo and crew simply disappeared. Following a lengthy and very extensive search operation, only a few containers and empty lifeboats from the MS München were found…

Thereafter, upon the recommendations of oceanographic experts, engineers began to design ships with a sufficiently large safety

[170] Detailed photographs and witness statements can be viewed here: https://www.michelangelo-raffaello.com/en/mi-chelangelo-12-april-1966/

[171] For more details see here: https://www.bbc.co.uk/science/horizon/2002/freak-wave.shtml

margin to cope with waves of no more than 15 meters in height, as the calculations at that time showed that the likelihood of a ship encountering one of the legendary 30-meter waves was as negligible as being hit on the head by a meteorite.

The New Year "killer wave:" they really do exist, after all

But everything changed on 1 January 1995. On that day, the Draupner oil and gas drilling platform, installed one year earlier by Statoil in the North Sea, not far from the coast of Norway, was hit by a single wave with an extreme height of 25.6 meters (84 feet). On this occasion, the "crazy wave" was recorded by a laser wave graph - a special instrument for automatic recording of sea wave parameters, which had been prudently installed on the platform. The destruction caused by the wave also left no doubts about the accuracy of the measurements made by the instrument.

Faced with such irrefutable facts, academic circles were forced to officially recognize the existence of "killer waves" and begin studying them.

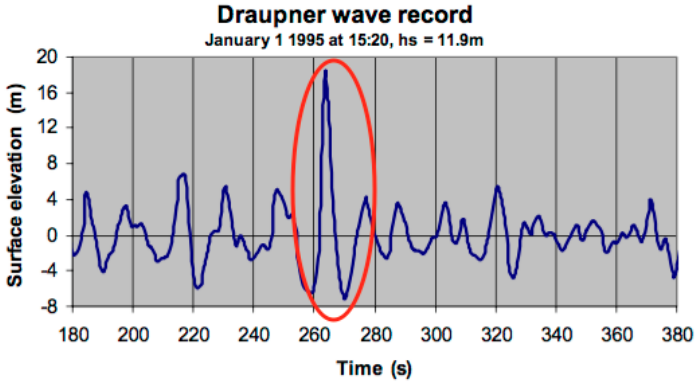

Fig.136 Schematic representation of the killer wave recorded by instruments on the Draupner drilling platform on 1 January 1995.
Author: Paolosan

https://commons.wikimedia.org/wiki/File:Draupner_wave_peak.png

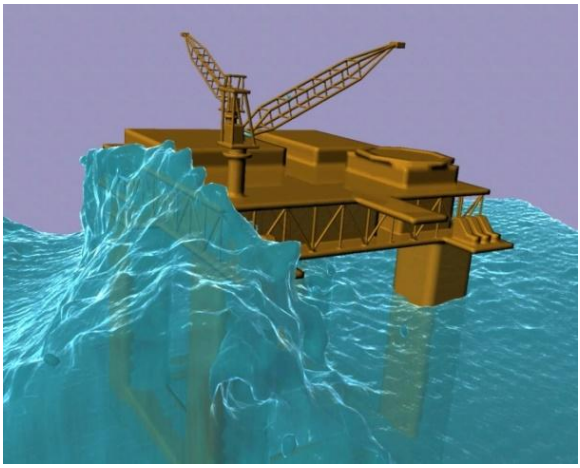

Fig.137 In the early design phases of oil and gas facilities, CSIRO[172] researchers now base their standard calculation of platform stability on an attack by a killer wave measuring 20 meters or more, though just 15 years ago such waves were not really recognized by science. Source: CSIRO

https://commons.wikimedia.org/wiki/File:CSIRO_ScienceImage_11431_Computer_model_image_of_a_rogue_wave_smashing_into_a_semisubmersible_platform_weighing_around_32000_tonnes.jpg

It should be noted that when Statoil engineers were designing the platform, they included a stability margin based on the traditional calculation that the maximum wave height the facility might encounter could not exceed 64 feet (19.51 meters), with such events occurring just once every 10,000 years.[173]

However, reality overturned those "rigorous" mathematical expectations. The Draupner wave incident (as scientists have referred to the killer wave since 1 January) occurred just one year after the platform was installed, yet the wave height surpassed all conceivable calculations.

From that moment on, the "killer wave" phenomenon has been given serious attention at government level, with many countries investing heavily in field, lab and theoretical studies. One of the most important projects in this field was an initiative launched by the Euro-

[172] CSIRO — the Australian Commonwealth Scientific and Industrial Research Organisation.

[173] Source: News of the American Physical Society, January 2018, Vol. 27, № 1. https://www.aps.org/publications/apsnews/201801/history.cfm

pean Commission in 2000 under the name MaxWave, the main purpose of which was to find and observe "killer waves," in order to build models of how they form and calculate potential damage to ships and marine installations.

After the European Space Agency's Earth remote sensing satellites were connected up to the MaxWave project, over 10 "killer waves" with a height of 25-30 meters were recorded in just three weeks of observation of the surface of the seas and oceans!

After this, even the most hardline sceptics were forced to admit that "killer waves" really do exist. And they occur far more frequently than one would like. Thus, in a report published in 2004, MaxWave project coordinator Wolfgang Rosenthal collated and analyzed data on marine incidents and shipwrecks over a 20-year period. It transpired that killer waves may have been involved in the destruction and sinking of over 200 supertankers and container ships, i.e. vessels of 200 meters or more in length. As Rosenthal notes, on average, two large ships sink somewhere in the world every week. How many medium-sized and small vessels sink nobody is even counting, because in contrast to air disasters, investigations into shipwrecks are often superficial and they are traditionally blamed on "poor weather conditions."[174]

When data from the monitoring systems on a drilling platform at the Gorm field, also in the North Sea, were published, it was discovered that 446 "killer waves" had been recorded over the 20 years the platform had existed!

Scientific research continues

It has been established in the course of an extensive observation program that "killer waves" can occur not only on the surface of the sea but also in large lakes. When, in 2007, the National Oceanic and Atmospheric Administration of the US Commerce Department collected and systematized the 50 biggest incidents on water,[175] it turned out that "killer waves" have long been familiar both to mariners and to sailors transporting commercial freight around the Great Lakes of North America, where they are known as the Three Sisters – phenomenally high waves following one after another and arising literally

[174] Dr Wolfgang Rosenthal https://cordis.europa.eu/article/id/22361-esa-satellites-home-in-on-rogue-waves

[175] American Physical Society https://www.aps.org/publications/aps-news/201801/history.cfm

out of nowhere. The North American Indians indigenous to these lands have known of the phenomenon since ancient times. Modern researchers believe that it was the Three Sisters that sank the dry cargo ship Edmund Fitzgerald in 1975 — the biggest ship (222 meters long and 7.6 meters wide with a carrying capacity of 23,131 tonnes) on the Great Lakes, together with its crew of 29.[176]

Fig.138 Dry cargo ship Edmund Fitzgerald — the Titanic of the Great Lakes. Photographer unknown. Source; United States Army Corps of Engineers.
https://commons.wikimedia.org/wiki/File:Edmund_Fitzgerald-USACE.jpg

[176] You can read about the sinking of the *Edmund Fitzgerald, known* to specialists as the Titanic of the Great Lakes, here: https://zen.yandex.ru/media/id/59e0ecdda8673153775b0ec0/titanik-velikih-ozer-suhogruz-edmund-fitzgerald-5a0b2321a936f43df63f4466

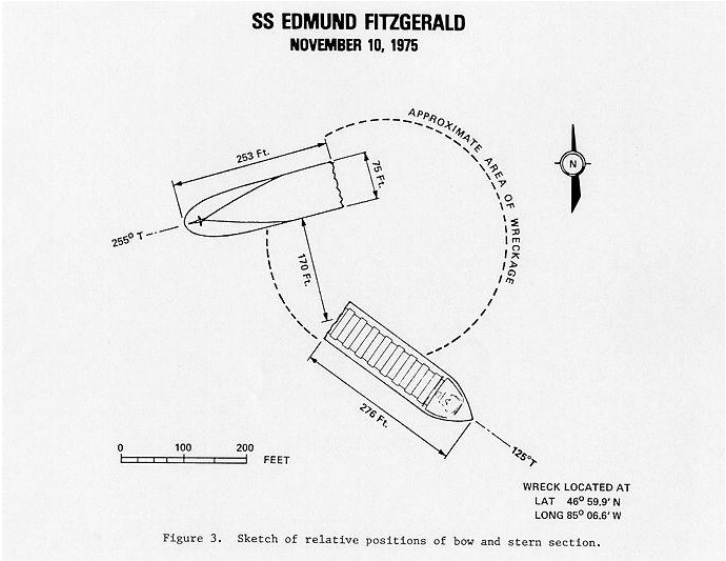

Fig.139 Diagram showing the position on the lake bed of the ship, which was broken in half by an unknown force.
Author: NTSB US Department of Transportation
https://commons.wikimedia.org/wiki/File:Edmond_Fitzgerald_relative_position_of_wreck.jpg

All of the above testifies to the fact that "killer waves" existed on Earth's seas and lakes long before people learned to create fire and record information on external media, and continue to exist and to do damage, whether or not academic circles believe in them. As the Bible says, "He who has ears to hear, let him hear, he who has eyes to see, let him see."[177]

Yet despite official recognition of the existence of "killer waves," scientists to this day have not identified their precise causes nor found effective ways of predicting them and providing timely warning to seafarers. Nevertheless, appropriate measures are now being taken everywhere, with changes being made to the design of ships and offshore oil and gas platforms to ensure they remain stable when encountering waves of up to 20 meters or more.

[177] The Bible, Gospel of Saint Matthew, chapter 13.

In addition, an important breakthrough in studying this natural phenomenon was made in 2018 by an experiment[178] in which scientists from Oxford University managed to reproduce in laboratory conditions miniature "killer waves" with similar characteristics to the single giant wave that engulfed the Draupner drilling platform. The experiment was based on a thorough analysis of all the data from the Draupner laser wave meter, showing that anomalously high waves are caused by a collision at a specific angle (around 120 degrees) between two or several normal waves, resulting in an almost vertical ejection of liquid.

But the most surprising thing is that the researchers found an astonishing similarity between the Draupner wave produced in laboratory conditions and the wave portrayed in "The Great Wave off Kanagawa" by Katsushika Hokusai!!!

The Japanese genius

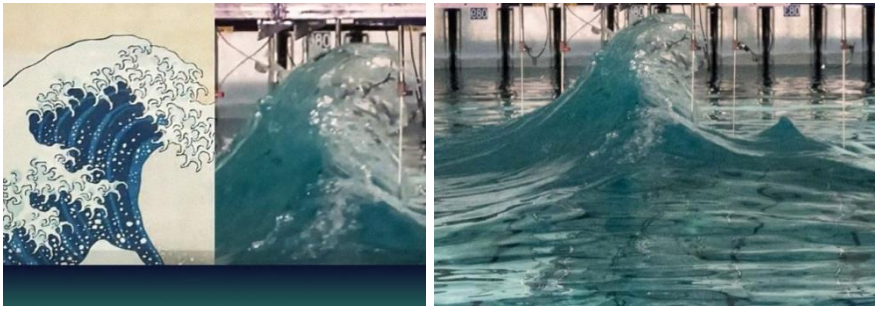

Fig.140 Fragment of Katsushika Hokusai's engraving "The Great Wave off Kanagawa" (left) and a photograph of the wave produced in the laboratory experiment (right). University of Oxford / YouTube. Photo: laboratory fragment of the Draupner wave. Image credit: McAllister et al, doi: 10.1017/jfm.2018.886

https://youtu.be/QWWe9PMuVng

https://www.cambridge.org/core/journals/journal-of-fluid-mechanics/article/laboratory-recreation-of-the-draupner-wave-and-the-role-of-breaking-in-crossing-seas/65EA-3294DAFD97A50C8046140B45F759#article

[178] Source: M. L. McAllister, S. Draycott, T. A. A. Adcock, P. H. Taylor, T. S. van den Bremer Laboratory recreation of the Draupner wave and the role of breaking in crossing seas Journal of Fluid Mechanics. Vol. 860. 10 February 2019. DOI: https://doi.org/10.1017/jfm.2018.886.

What do the findings of the Oxford professors' studies give us? They enable us, first of all, to state with confidence that the terrifying wave portrayed by Hokusai in the first half of the 19th century was not the fruit of his imagination. It would appear that the creator of The Great Wave off Kanagawa had actually witnessed such a tragic event – an event that was recorded with photographic precision in his masterpiece as a lesson to future generations. It is clear that **killer waves over 15 meters in height were known in Japan at least one and a half centuries before Japanese engineers started designing dams for nuclear power plants with a height of "merely" five meters** to protect against waves measuring 15-meters or more which, according to their very odd calculations, occurred just once every 10,000 years.

Theory and probabilities

There is one more thing that it is important to note. The probability of a major accident at the Fukushima-1 nuclear power plant was assessed by project engineers as once every 10,000 years, yet the disaster occurred just 40 years after the plant was commissioned. The probability of a major earthquake and tsunami measuring over five meters in height was estimated as once every 10,000 years, but it happened just six years after the managers of Fukushima-1 reassured the public that the plant was reliably and fully protected against any unexpected events and that there was no threat to public safety.

When designing the Draupner oil and gas platform in the North Sea, the frequency of waves up to 19.51 meters in height, like the one that hit the platform and caused major damage, was predicted as once every 10,000 years. But this forecast was mistaken, because a wave measuring over 20 meters engulfed the platform just one year after it was installed. This raises the question of why the application of an impeccable mathematical method results in a disparity of many thousands of times between expectations and facts.

This rhetorical question becomes all the more relevant as supercomputers using formulae from classical probability theory are being replaced by artificial intelligence neural networks in which it is no longer possible to determine at what stage the AI made a mistake (and they are already making plenty of them) and to rectify these mistakes in good time.

So, what can be done to counter the elements? The answer is simple: as we are unable to stop or postpone any approaching natural disasters, all we can actually do is to plan in advance and implement exhaustive preventive measures to be ready to respond as

soon as an unpredictable critical situation arises. For example, if you go out without an umbrella and end up in a storm, you will probably get soaked. But if, one fine day, you set off on a sea voyage in a small fishing boat and suddenly end up face to face with a "killer wave," you have clearly underestimated the risks, and the consequences for you, even if you are lucky enough to survive, will be quite different.

The key lesson of history is that the elements should not catch us by surprise again and again, as illustrated in Hokusai's cautionary picture. And we should be fully prepared for them before deciding to go to sea.

Summing up: Russia will benefit from future climate change

> The fate of humans and water is inextricably linked. In the words of the Whanganui River Tribe's proverb, Ko au te awa, ko te awa ko au, I am the river, the river is me."
>
> *Audrey Azoulay,*
> *UNESCO Director-General, 2021*

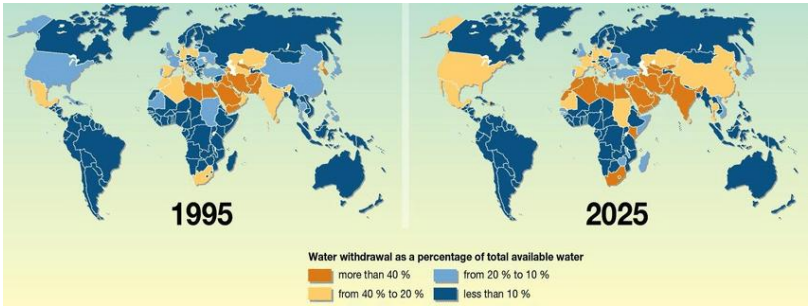

Fig.141 Map showing regions of the world experiencing a shortage of drinking water (source: United Nations Environment Program)

https://www.researchgate.net/figure/Worldwide-water-stresses-map-United-nations-Environmental-Programme-UNEP_fig1_224828905

As mentioned above, the Climate Doctrine of the Russian Federation (approved by Order No.851-rp of the President of the Russian Federation on 17 December 2009) lists not only the negative but also

the positive consequences of anticipated climate change.[179] We have already reviewed the negative consequences, but the potential positive consequences, in terms of industrial and regional economic growth include:

- lower energy consumption during the winter heating period;
- improvements to ice conditions and, consequently, better commercial shipping opportunities in the Arctic seas, with easier access to and exploitation of the Arctic shelf;
- improved structure and expansion of the arable farming zone, as well as greater efficiency of animal breeding (based on a number of assumptions and the adoption of certain measures);
- Improved productivity of boreal[180] forests.

Compared to the majority of other countries, **Russia's key advantages in terms of effective adaptation to climate change are that it has the biggest land area in the world and the largest reserves of fresh water.**

Having the biggest land area gives us the opportunity to perform a tactical maneuver by resettling the population and redeploying critical infrastructure facilities from areas suffering from continuous or cyclical impacts of climate change to safer zones. In contrast to Russia, the vast majority of countries have no such opportunity due to their modest size, overpopulation, unfavourable environmental situation and other concomitant problems.

As far as Russia's water resources are concerned, this is a separate issue. As we all know from our school geography lessons, fresh water is the source of all life and is extremely unequally distributed across the face of the Earth. For example, Europe and Asia, where over 70% of the planet's population lives, possess less than 40% of the planet's surface fresh water. At the same time, the fresh

[179] E.V.Arefyeva, V.V.Krapukhin, I.Yu.Oltyan, M.N.Kotosonova, V.V.Artyukhin Resilience of Municipalities in the Russian Federation to Climate Change: monograph / Russian Civil Defense Ministry, M. IPCDES, 2022. 140 p. ISBN 978-5-93970-264-5.

[180] UN agencies use this term to refer to northern forests of the taiga type dominated by spruce, fir, larch and pine.

water reserves of Russia's Lake Baikal alone amount to more than 20% of global reserves. Overall, our country has the biggest reserves of this strategically important resource.

For comparison: According to UN data, a quarter of the population of the planet is currently suffering from a shortage of fresh water, and by the mid-21st century this vital indicator of social stability could double. " **Water is our most precious resource, our 'blue gold' to which more than 2 billion people do not have direct access. It is not only essential for survival but also plays a sanitary, social and cultural role at the heart of human societies,"** in the words of UNESCO Director-General Audrey Azoulay.[181]

It is clear that the mounting shortage of drinking water is due first and foremost to climate change and human activity – in other words, to the human factor. Consequently, the value of fresh water in the world is also continuously increasing from year to year, and this trend is set to continue indefinitely.[182]

Conclusion: we have enough water, land, fuel, food and other vital resources for everyone, with more to spare. It has been scientifically proven that we are highly capable of successful adaptation of the population and infrastructure to the coming changes.

But very little time remains to implement this adaptation. Consequently, we need to start adapting immediately, each of us on our own level and to the extent of our abilities, in order to ensure a brighter future for our grateful descendants. After all, in contrast to many other countries and nations, we have everything we need not only to survive but also to prosper in the new and very difficult conditions. So, we need to "roll up our sleeves" and make good use of the riches we possess…

[181] https://ru.unesco.org/news/prezentaciya-vsemirnogo-doklada-oon-o-sostoyanii-vodnyh-resursov-za-2021-g-opredelenie-istinnoy

[182] UN report on the state of water resources: https://ru.unesco.org/water-security/wwap/wwdr

Epilog: life goes on

May the invigorating water wash your desiccated Soul! May the words of Truth fall like the first raindrops and awake in you the strength for a new voyage!

Anna Maria Petra,
film director, dramatist

Fig.142 Sunrise over lake Baikal. Author: Sansar sergelen
https://commons.wikimedia.org/wiki/File:Good_morning_at_baikal_lake.jpg

Dear reader,

If you have read this book to the end without giving in to despondency, fear, hopelessness and despair, you would definitely be interested to know what we can actually do about our situation, what impact we can have.

First of all, we can all make our own contribution to stabilizing and minimizing the adverse socio-economic impacts of global warming. For this, it is sufficient to get involved in protecting the environment from human interference. After all, everyone knows that in places where local ecosystems have been well preserved there is a more stable microclimate and, as a result, it will be easier for the people who live there to cope with and adapt to climate change. All we need to do is:

- Use energy-saving technologies at work and in the home: try, where possible, not to use more water, electricity and other utilities than necessary, thereby not only saving our resources but also saving money;
- Consume energy and food in a rational way, because statistics show that around 40% of all food purchased is simply left to rot in our refrigerators;
- If you're not yet doing so, start separating your household waste;
- Take care when disposing of batteries, gadgets and other equipment; where possible, take them to dedicated collection points;
- Get involved in environmental volunteer campaigns (waste collection, tree planting etc.);
- Be extremely attentive and cautious during outdoor recreation: do not burn dry grass, do not light open fires, do not burn waste in your gardens;
- And many other things along these lines, at your own discretion.

We would now like to give our answer to the question posed at the end of Part 1 of this book. We believe it is possible to live without fear, anxiety and stress over the coming changes. For this, we simply need to start making the world a better place. Not some abstract world, but the world we know, the world around us.

Because if all of us, each in his or her own home, starts doing even some of the things listed above, our personal efforts multiplied many times over by those of others in our district, city and region, right up to the scale of our boundless country, will have a positive impact on the environment, safety, and the socio-economic situation of the entire planet, and help us to successfully survive the age of global change.

As the Russian Civil Defense Ministry's slogan states: "Safety begins with you."

From the southern seas to the icy polar lands
Lay our forests and fields.
Unique in the world! You are one of a kind, –
Native land protected by dear God!

National anthem of the Russian Federation

Fig.143 Guest chalets in the village of Sahyurta (from the Buryat word "sakhuur" meaning "flint"), Lake Baikal, Photographer: Alexander Zhilinsky

https://commons.wikimedia.org/wiki/File:Guest_house_in_the_village_Sahyurta_-_panoramio_-_%D0%90%D0%BB%D0%B5%D0%BA%D1%81%D0%B0%D0%BD%D0%B4%D1%80_%D0%96%D0%B8%D0%BB%D0%B8%D0%BD%D1%81%D0%BA%D0%B8%D0%B9_(5).jpg

Source https://web.archive.org/web/20161015064839/http://www.panoramio.com/photo/33334353

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Table of contents

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