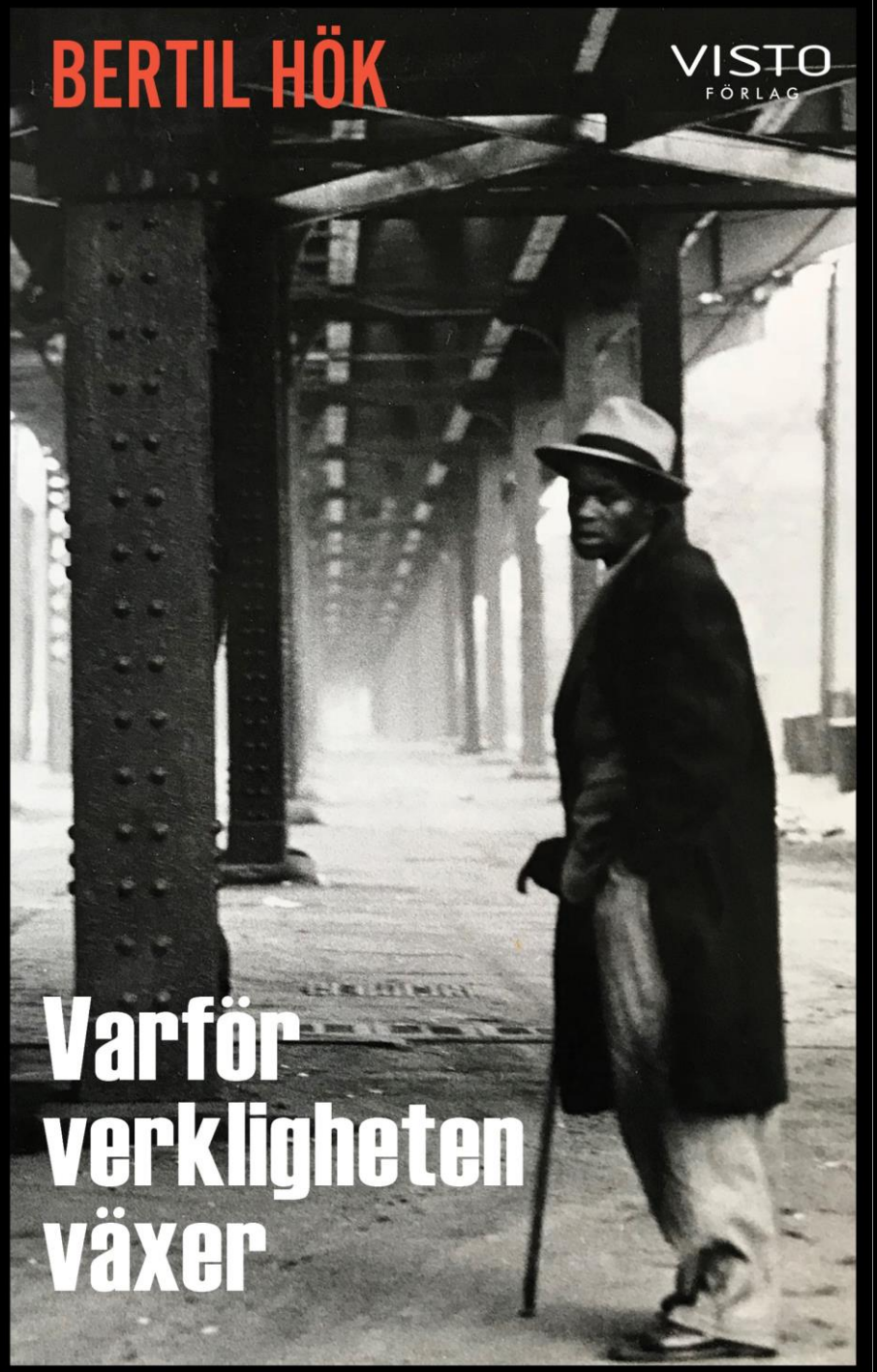
WHY REALITY GROWS

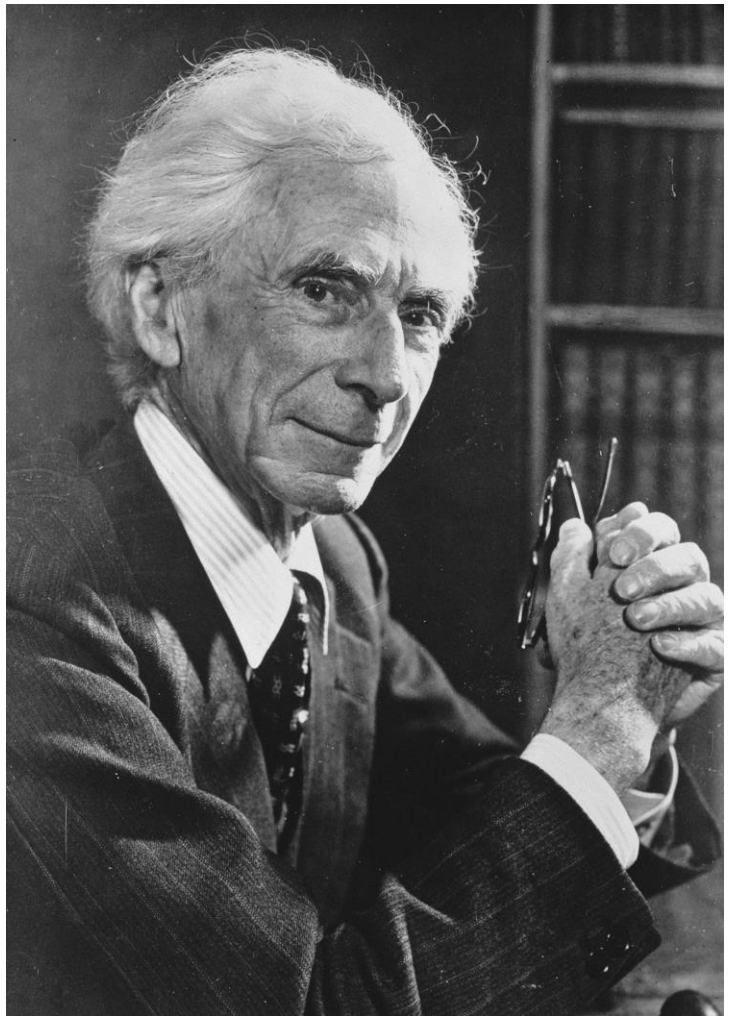
A presentation by Bertil Hök



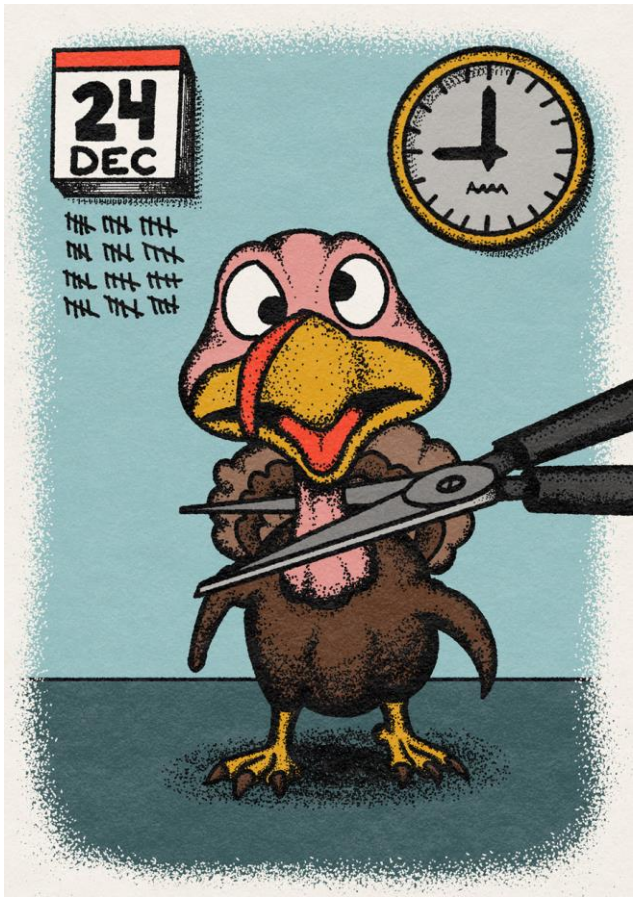
Reality is undescribable, but …

- Can reality be hijacked? — Philosophy
- The big picture invites big questions — Astronomy
- Small is beautiful — Physics
- Are very small objects unpredictable? — Physics
- There's plenty of room at the bottom — Physics
- Are nuclear weapons a threat to humanity? — Physics
- Are prime numbers haphazard? — Maths
- Believe me, I'm a liar — Maths
- The tree of mathematics — Maths
- Complexity of life on earth — Life
- The relations and evolution of species — Life
- The sixth extinction – can it be stopped? — Life
- One emergent phenomenon followed by another — Life
- Realism vs deep thinking — Philosophy
- The return of deep thinking — Philosophy
- Behind the digital revolution — Technology
- Heroes of the 20th century — Political
- "Blinded by the light" — Religion
- An island in the sea of the unknown — Philosophy
- Global growth indicators — Economics
- The existential risks are growing — Political
- If reality grows, why? — Political
- Humanity's greatest challenge — Political
- The rising sun is a call for action — Political

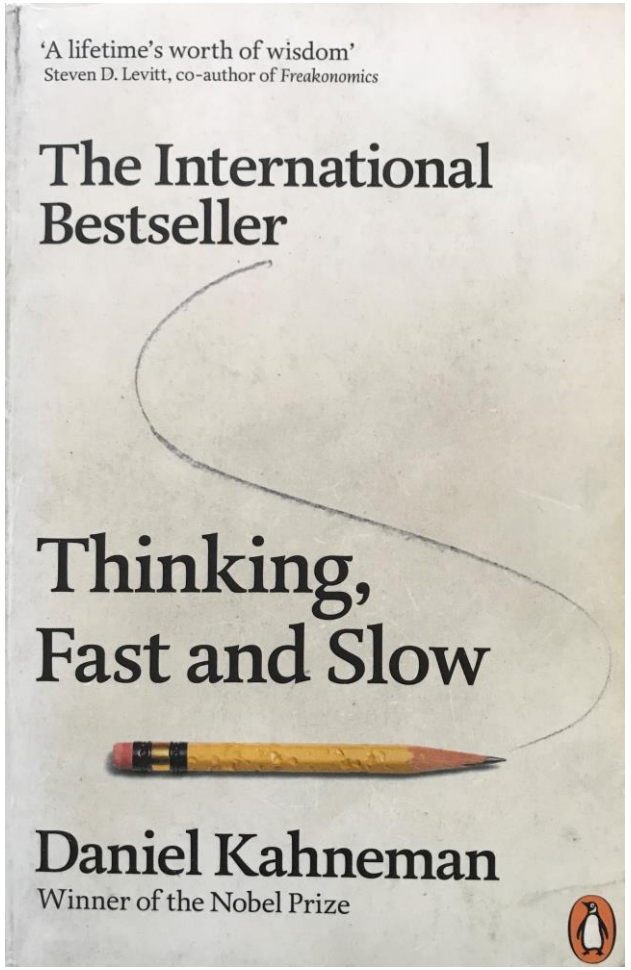
Can reality be hijacked?



Bertrand Russell 1872-1970



Of course not! Or could it?



This book says something important …

1. Fast thinking is our gut feeling, and our primary decision-making tool.

2. Slow thinking is heavy-duty, something we consult only when we have to.

… but it doesn't say:

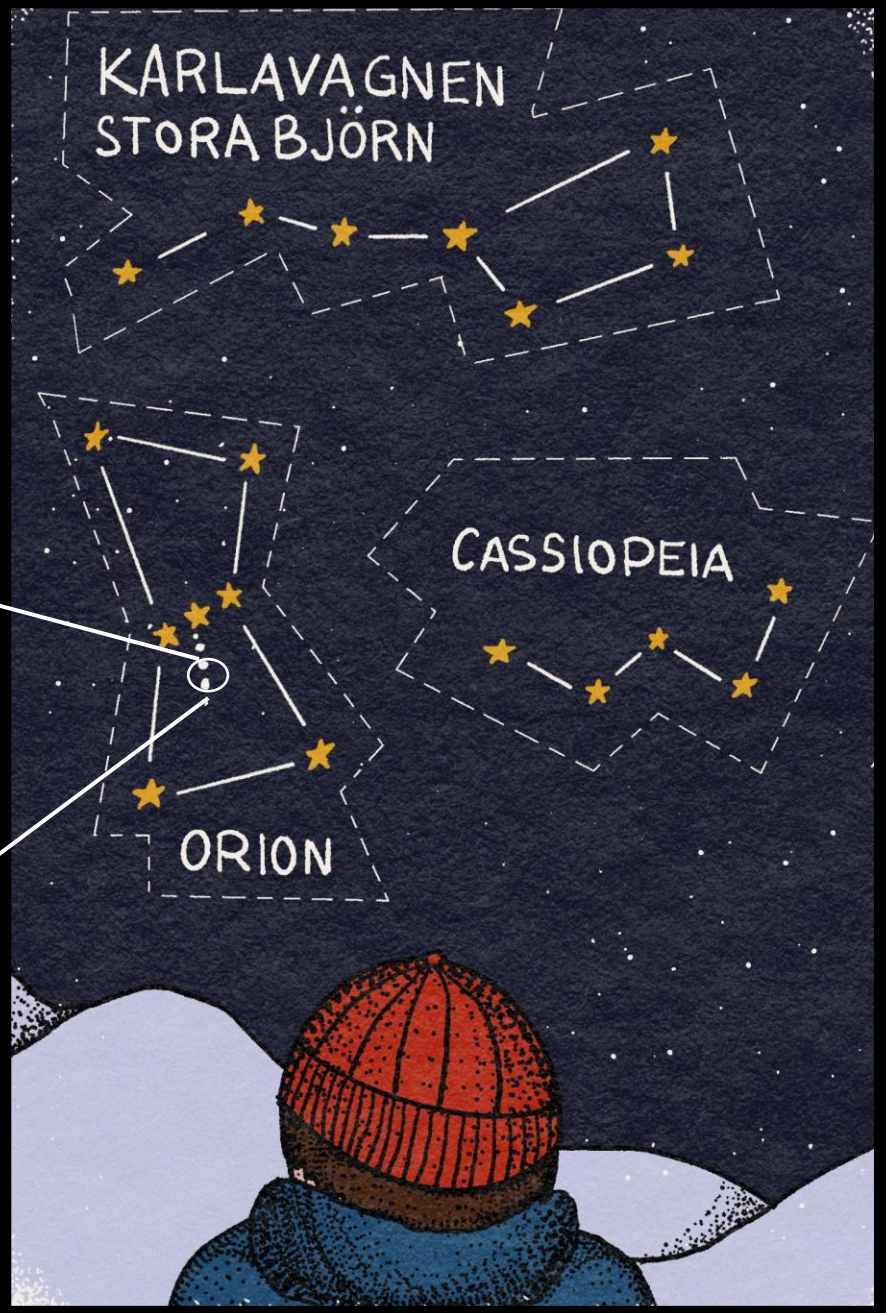
We are destined to be targets for manipulation.

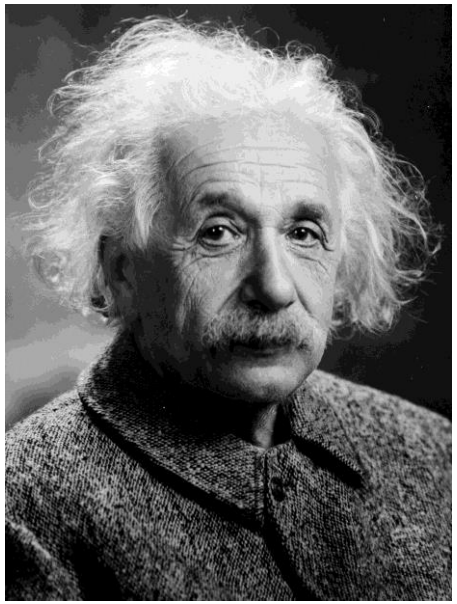
A warning sign is appropriate. People are trying to hijack our reality all the time.

The big picture invites big questions, like:

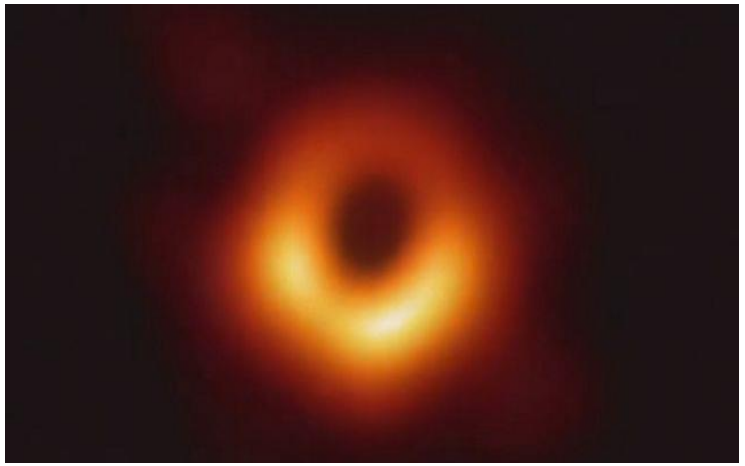
When did it all start?
And before that?
Where are we?
What's behind?
What's the meaning?

Hubble Space Telescope
NASA, ESA



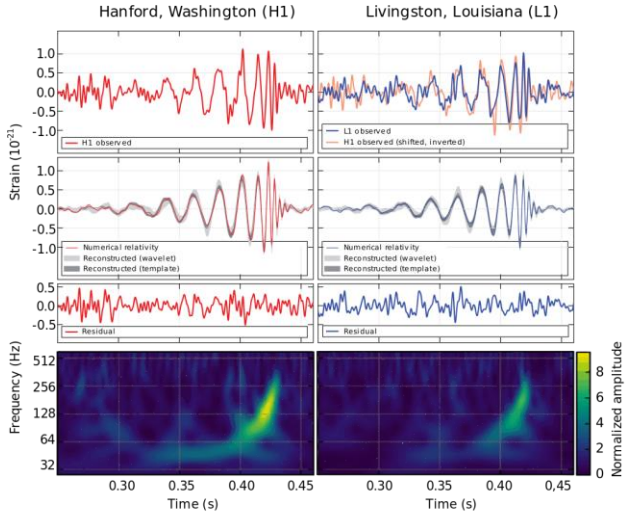


Albert Einstein's theory of general relativity was published in 1915. It took more than hundred years for two of its major predictions to be experimentally verified.



Event Horizon Telescope Collaboration

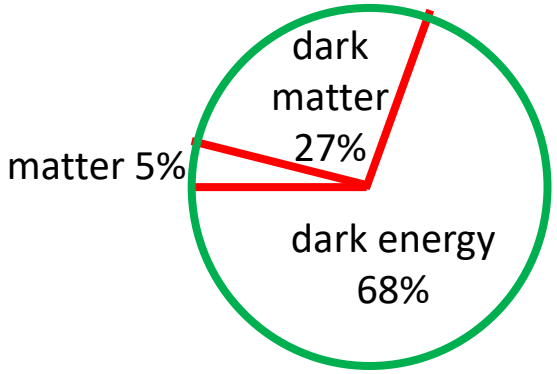
A **black hole** more than 50 million light years away pictured by a global array of synchronized radio telescopes.



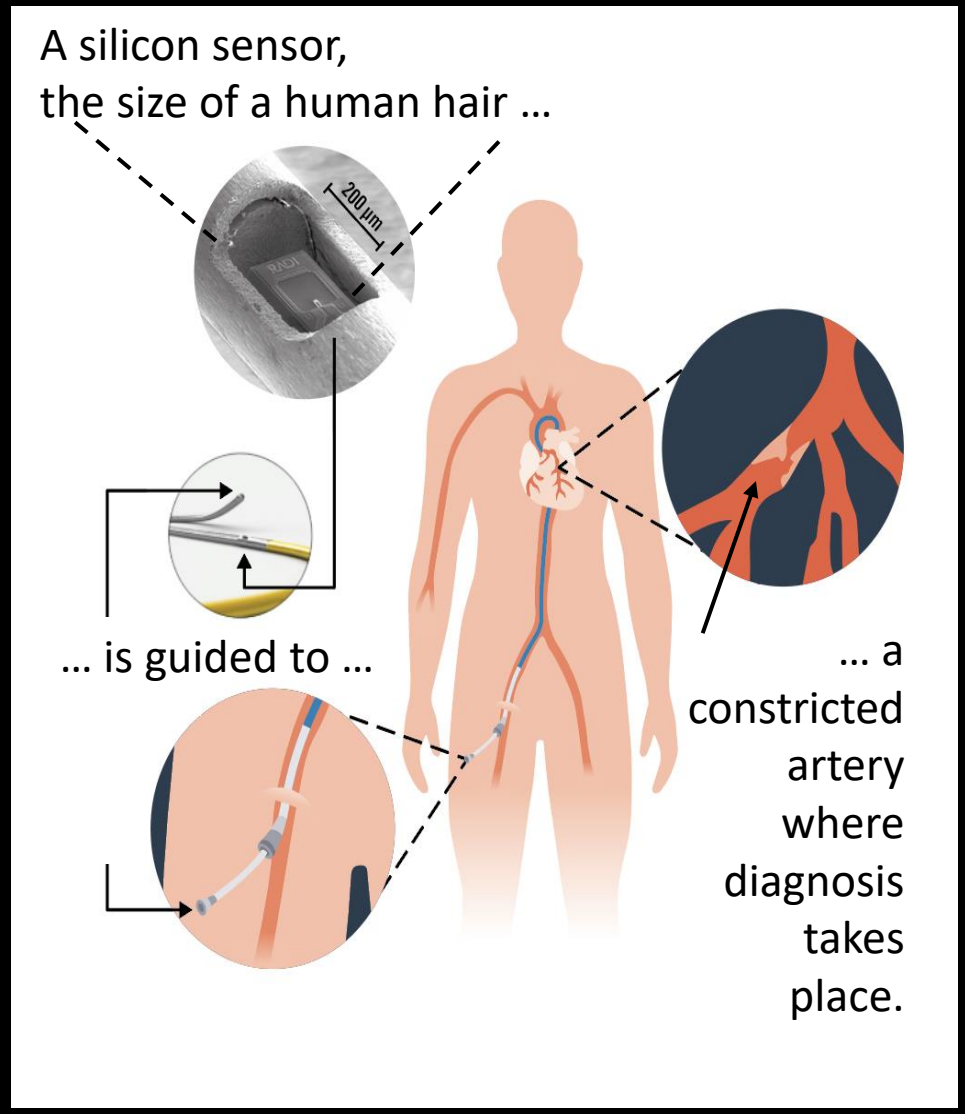
LIGO, Laser Interferometer Gravitational Wave Observatory

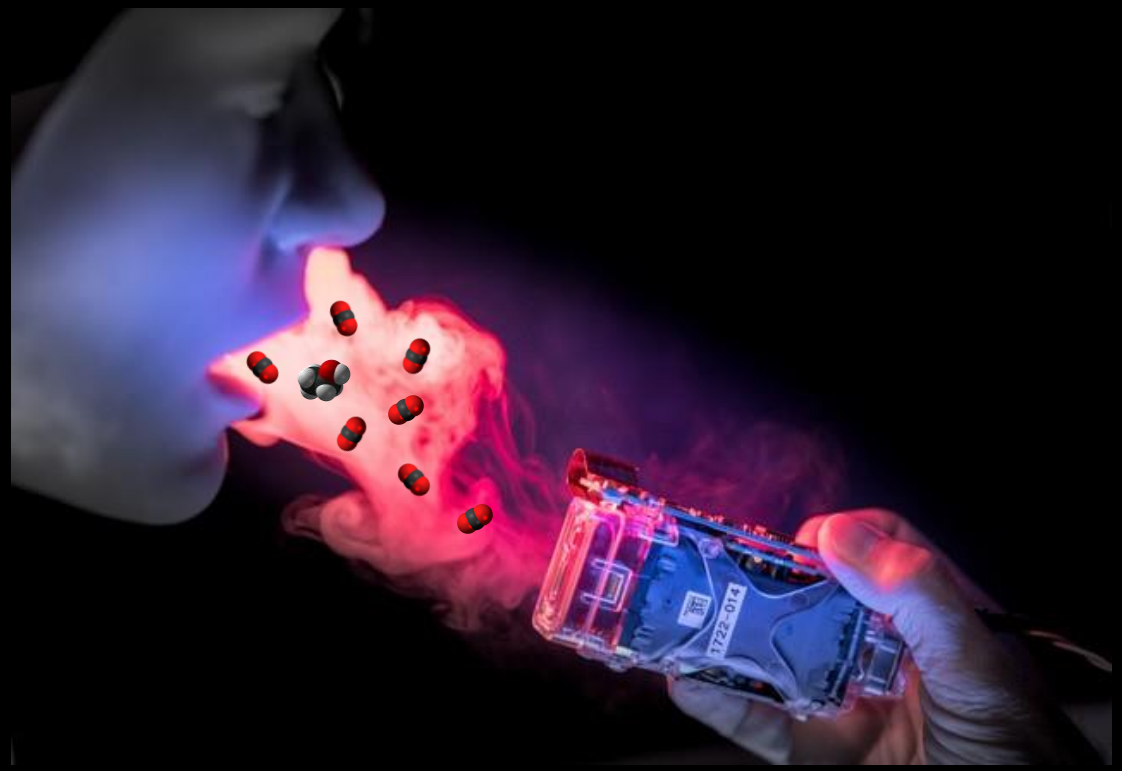
Gravitational waves from two colliding black holes observed as minimal vibrations by two 4 km interferometers operating simultaneously at different locations.

By the way:
What is this **dark matter and dark energy** supposed to make up 95% of the universe as we know it?
Do we know?



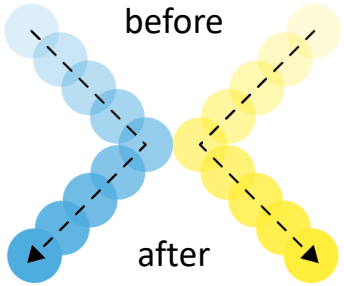
Small is beautiful and useful for saving lives





This sensor is capable of recognizing and counting exhaled molecules of CO_2 and alcohol. When there are more than eight hundred CO_2 molecules in one of alcohol, vehicle driving is allowed in Sweden.

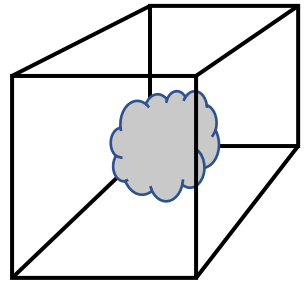
Are very small objects unpredictable?



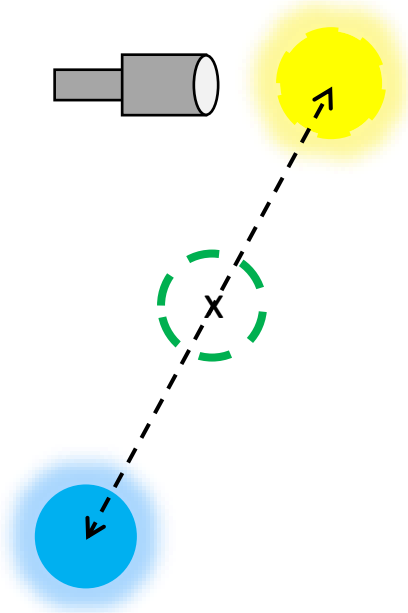
Small objects may in certain experiments behave like billiard balls, and like light beams in others.

Quantum mechanics is dealing with this apparent inconsistency, successfully in fields like laser engineering and nanoelectronics, less so in explaining its paradoxical roots.

Is **Schrödinger's cat** dead or alive?



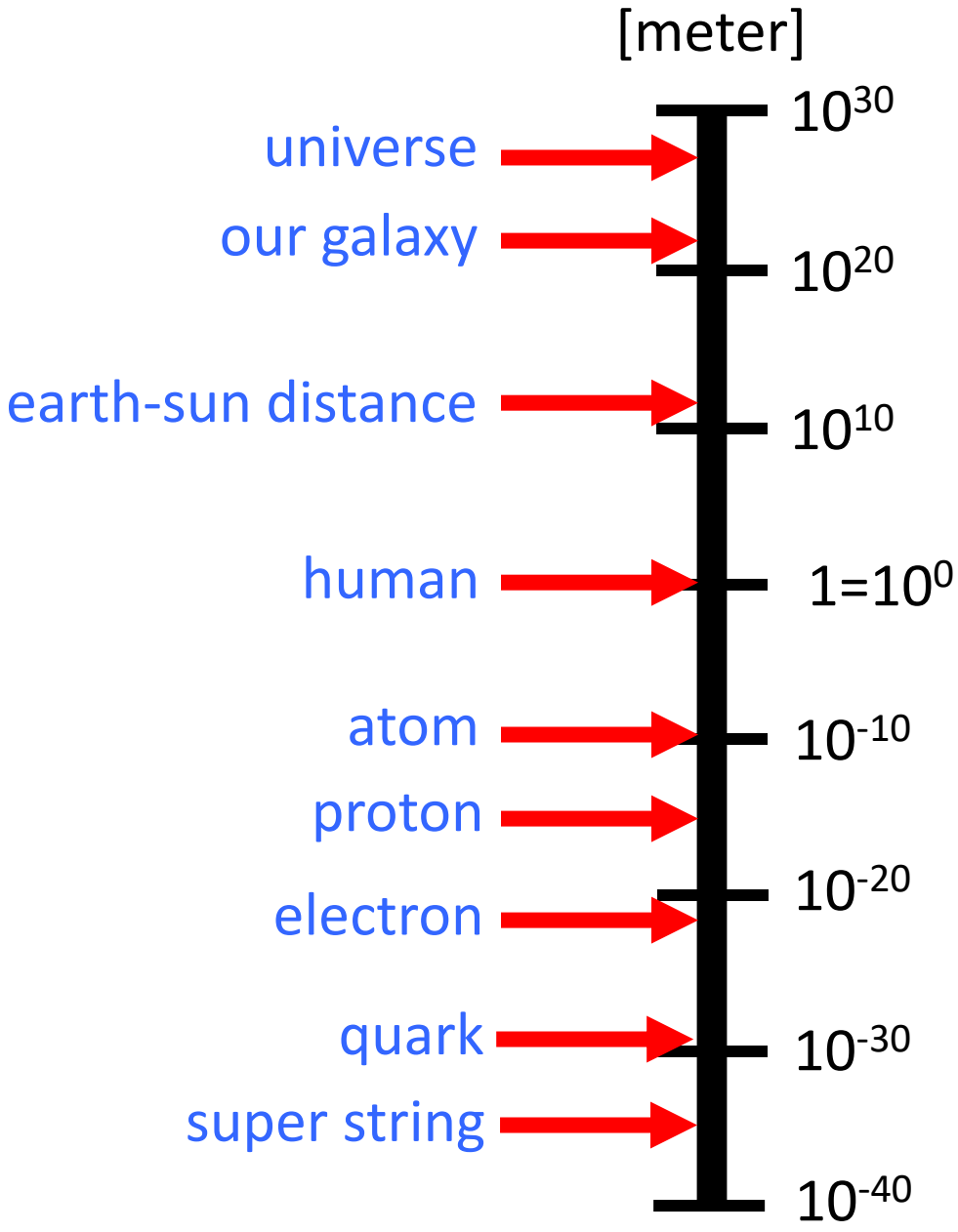
The classical thought experiment has been shaking up people's minds for almost a century.



The resolvement of the **Einstein-Podolski-Rosen** paradox involving entangled "twin particles". It resulted in quantum computing but remains disputable territory.

”There’s plenty of room at the bottom”

Richard Feynman 1918-1988



Are nuclear weapons an existential threat to humanity?

Early thermonuclear blast
Bikini Islands, 1954

Some historical landmarks

1905 Einstein Theory of special relativity, $E=mc^2$

1935 Leo Szilard
1938 Liese Meitner
Nuclear chain reaction

1945 Hiroshima, Nagasaki

1951 Thermonuclear bomb

1955 Russell-Einstein Manifesto

1955- Nuclear arms race

1970 United Nations' Treaty of Non-Proliferation of Nuclear Weapons

Where do we stand today?

Are prime numbers haphazard?

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	195	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
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221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
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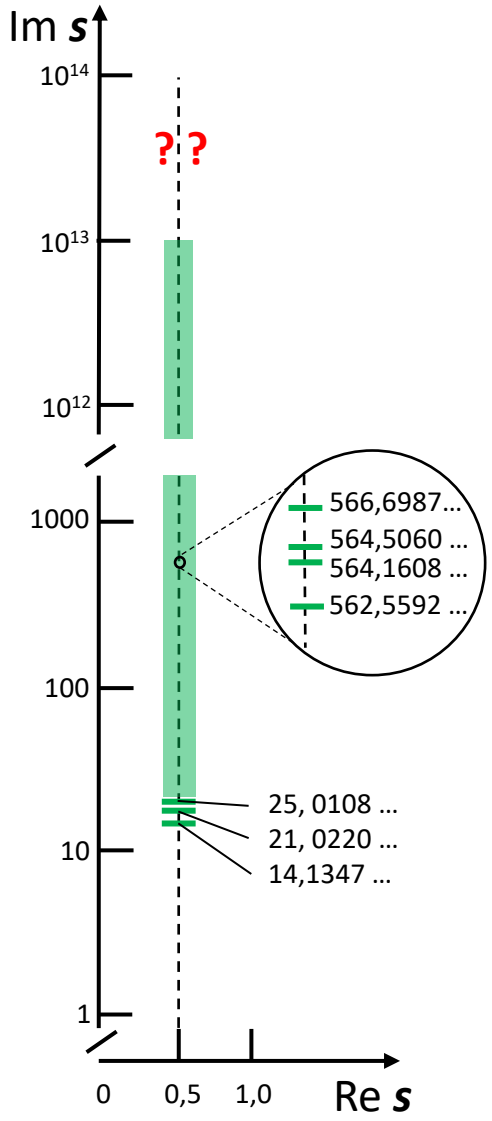
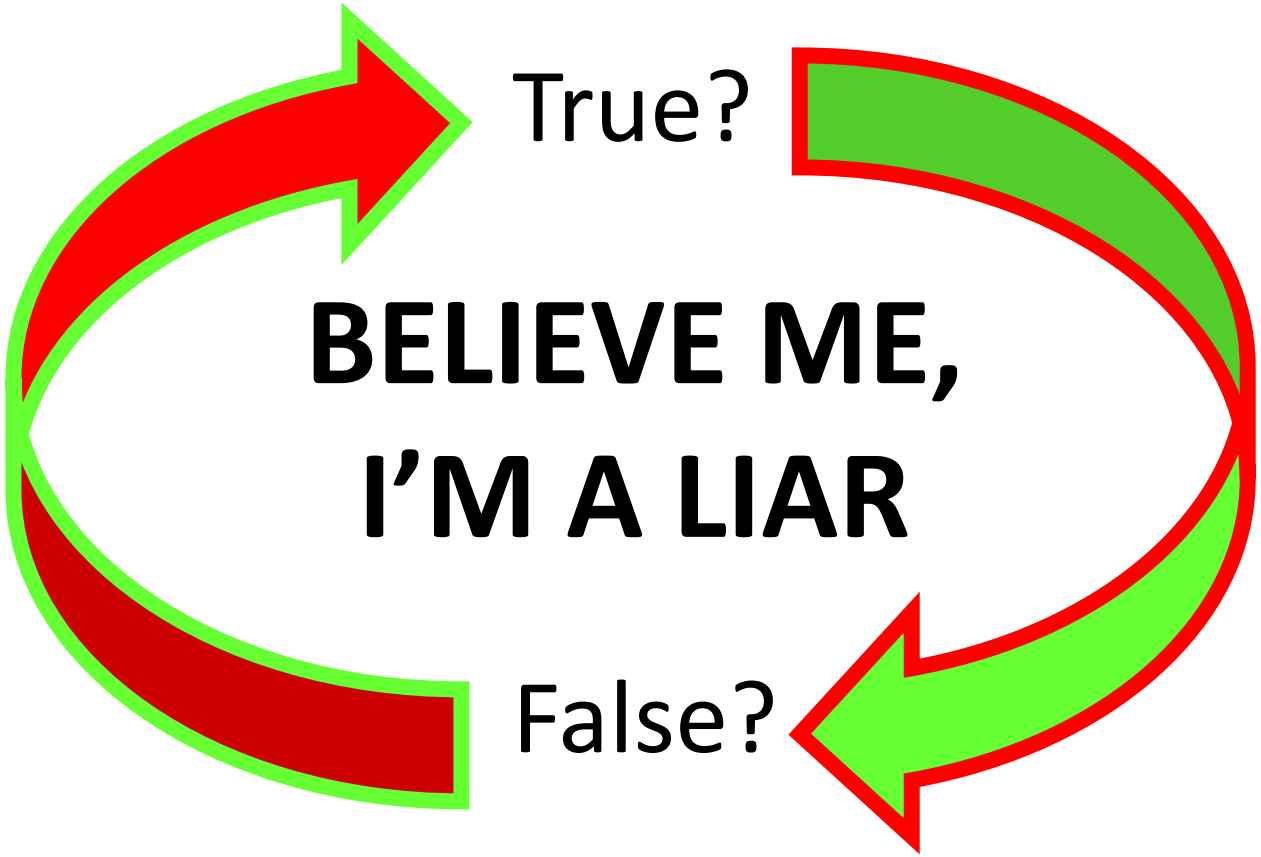
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400

The matrix above lists all integers from 1 to 400, with the prime numbers in color. Euclid (325-265 B. C.) was disturbed by their random appearance. Bernhard Riemann (1826-1866) hypothesized that his zeta ζ as a function of the complex variable ***s*** may explain the situation (see equation below).

$$\zeta(s) = \frac{1}{1^s} + \frac{1}{2^s} + \frac{1}{3^s} + \frac{1}{4^s} + \frac{1}{5^s} + \frac{1}{6^s} + \frac{1}{7^s} + \cdots = \frac{1}{1-2^{-s}} \times \frac{1}{1-3^{-s}} \times \frac{1}{1-p^{-s}} \times \ldots$$

The graph at right shows the zero's of the zeta function which according to Riemann's conjecture should all be localized excatly on the vertical line Re ***s***=1/2. The conjecture holds for all investigated zero's up to Im ***s*** below 10^{13}, which is the status at the present. No one knows, however, whether Riemann's conjecture is true for all values of ***s***. The conjecture may be false or inderminable. The same limbo holds for hundreds of depending mathematical theorems.

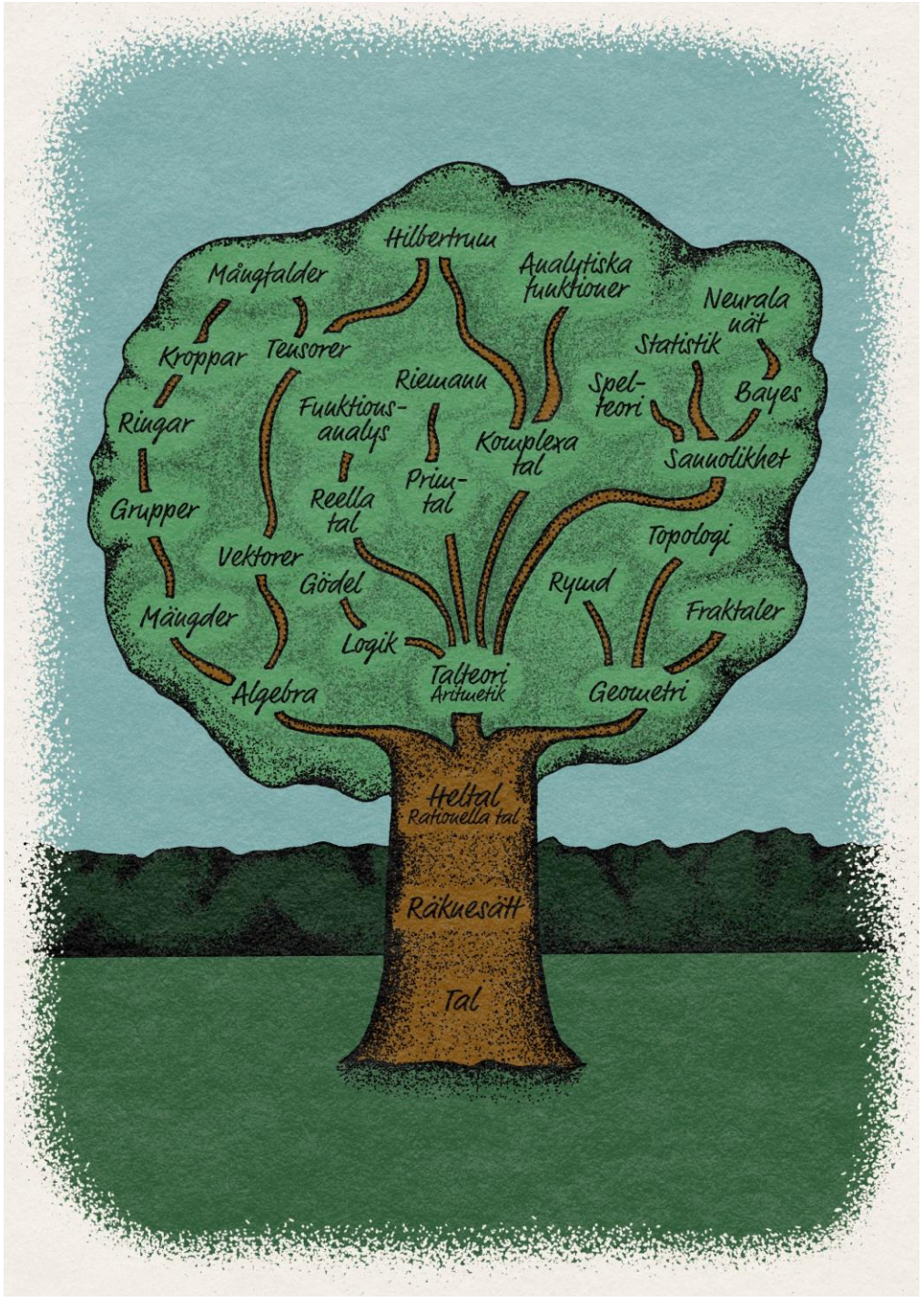




According to the myth, the liar paradox was introduced by the Cretan prophet **Epimenides** who claimed that all Cretans are liers. Should you believe him?

The mathematician and logician **Kurt Gödel** (1906-1978) brought basically the same paradoxical mind-trap to the highest possible philosophical level by proving that present logical systems cannot be both consistent and complete.

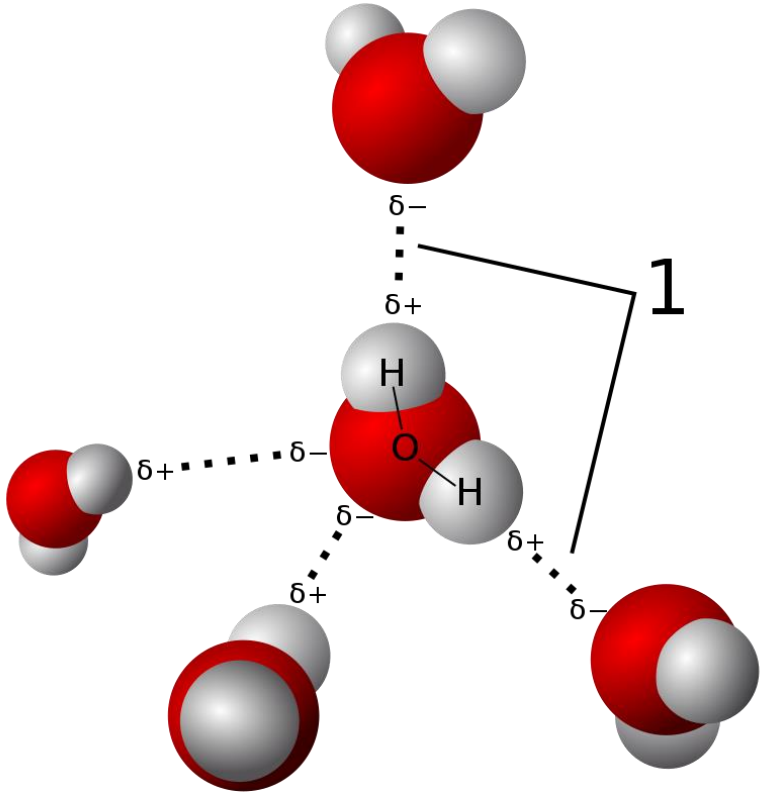
The tree of mathematics



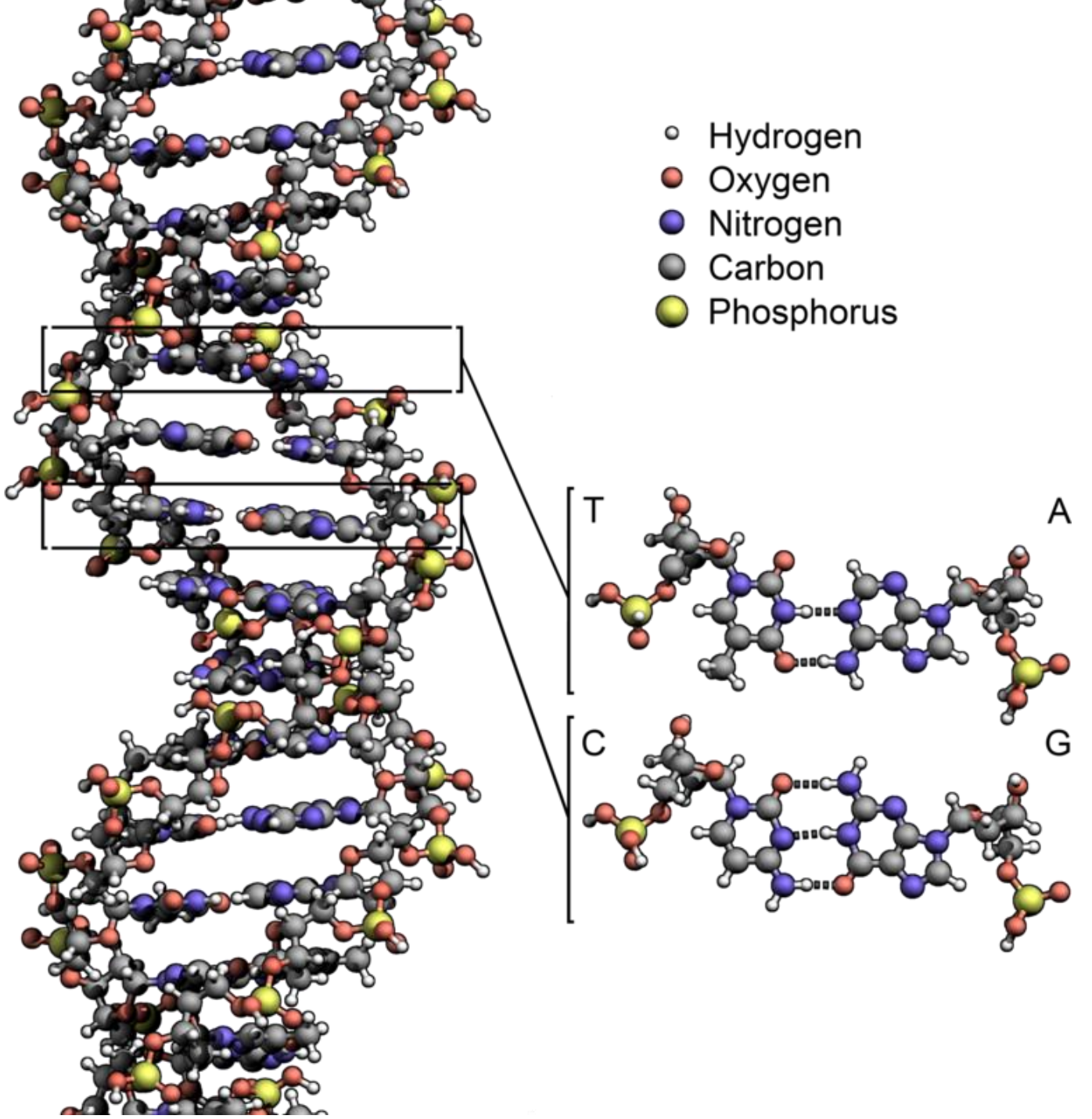
The tree of mathematics has been around for thousands of years and is still vital. From its stem of numbers and arithmetics it evolved into main branches of algebra and geometry. They multiplied and expanded. Some flourished whereas others were torn off. Unknown to most, the tree also has an intricate root system providing nourishment and other necessities for managing inconsistencies. The tree lives in a frail environment in which its existence is constantly challenged.

Above all – how heavily can we lean on it?

Comlexity of life on earth

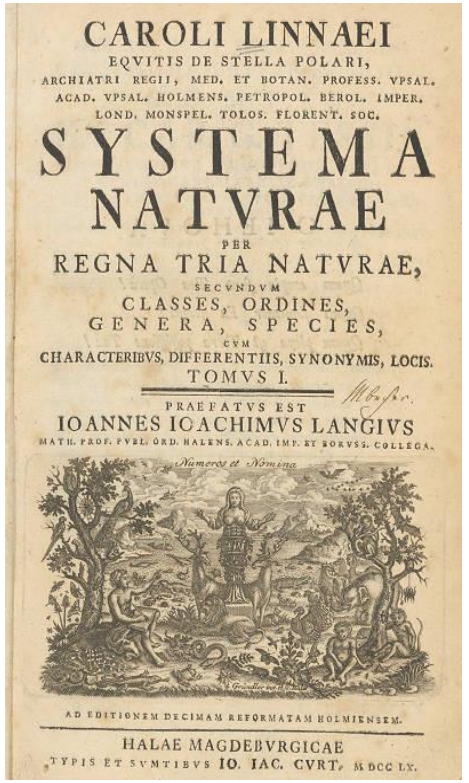


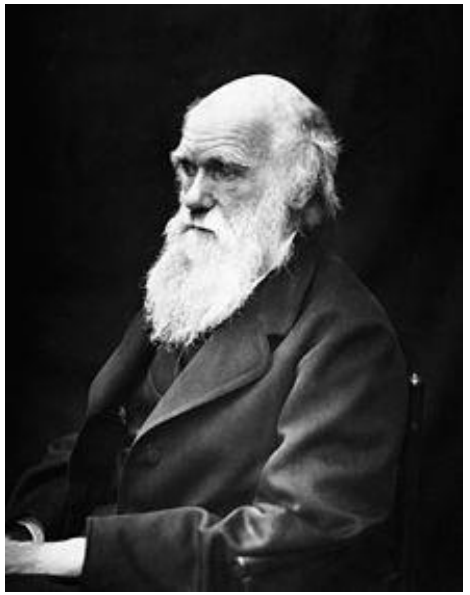
Molecules of water and DNA, two of life's building blocks

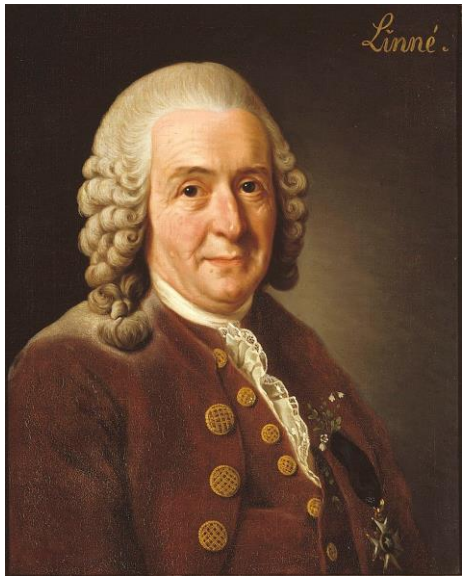


The relations and evolution of species

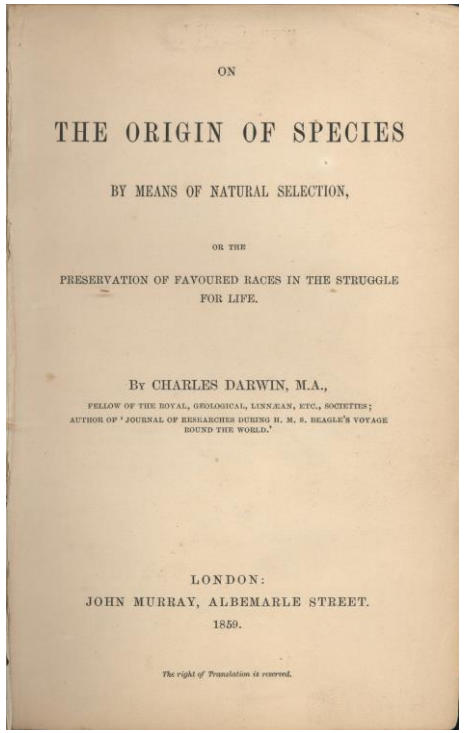
Few books have had such impact on our view on reality and ourselves as *Systema Naturae* by Carl von Linné and *On the Origin of Species* by Charles Darwin. In these books the relation and evolution of species were disclosed. The down-rating of human beings as one of many species in nature was suggested. Darwin correctly predicted the clash towards other opinions, and it is still remaining.


CAROLI LINNAEI
EQVITIS DE STELLA POLARI,
ARCHIATRI REGII, MED. ET BOTAN. PROFESS. VPSAL.
ACAD. VPSAL. HOLMENS. PETROPOL. BEROL. IMPER.
LOND. MONSPEL. TOLOS. FLORENT. SOC.
SYSTEMA
NATVRAE
PER
REGNA TRIA NATVRAE,
SECVNDVM
CLASSES, ORDINES,
GENERA, SPECIES,
CVM
CHARACTERIBVS, DIFFERENTIIS, SYNONYMIS, LOCIS.
TOMVS I.
PRAEFATVS EST
IOANNES IOACHIMVS LANGIVS
MATH. PROF. FVEL. ORD. HALENS. ACAD. IMP. ET BORVSS. COLLEGA.
Numerat et Nomina
AD EDITIONEM DECIMAM REFORMATAM HOLMIENSEM.
HALAE MAGDEBVRGICAE
TYPIS ET SVMTIBVS IO. IAC. CVRT. MDCC LX.


Charles Darwin 1809-1882



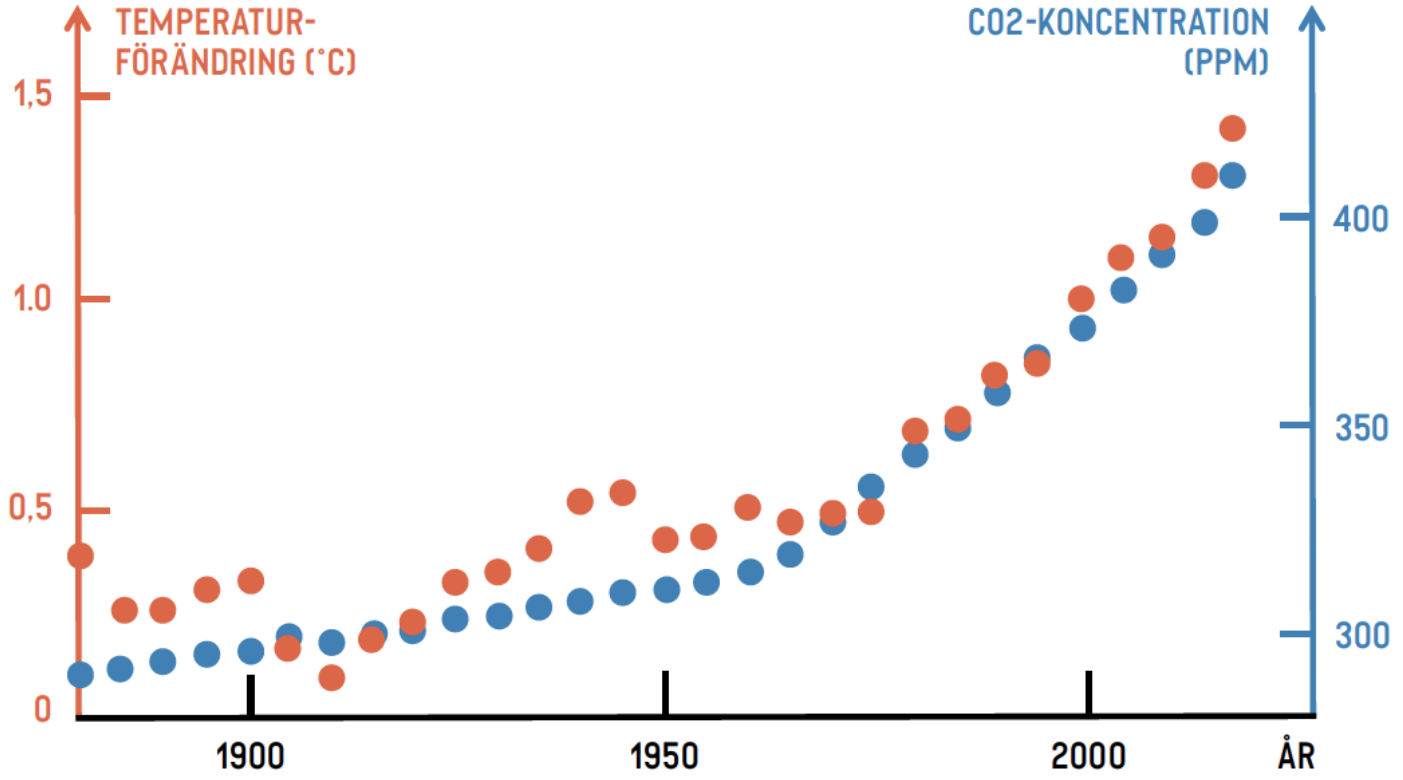
Carl von Linné 1707-1778


ON
THE ORIGIN OF SPECIES
BY MEANS OF NATURAL SELECTION,
OR THE
PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.
By CHARLES DARWIN, M.A.,
FELLOW OF THE ROYAL, GEOLOGICAL, LINNÆAN, ETC., SOCIETIES;
AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE ROUND THE WORLD.'
LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.
The right of Translation is reserved.

One spectacular emerging phenomenon …

Ball lightning is a rare phenomenon considered to be a bogey until adequately documented. But basic physical understanding is still lacking.

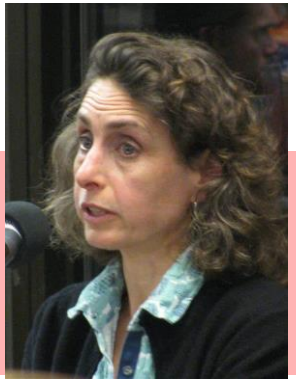
… followed by another:



Emergent phenomena can also be sneaking up on us, slowly. The covariation between carbon dioxide concentration in the atmosphere and the earth's surface temperature as shown in the graph strongly indicates the causal dependence of climate change from emission of green house gases driven by burning fossil fuels. Climate change has finally been acknowledged as an **existential threat to humanity** and the biosphere as we know it.

The sixth mass extinction – does it include the human species, and can it be stopped?

Elizabeth Kolbert, author of ***The Sixth Extinction – An Unnatural History*** (2014):



PROBLEM

"We are deciding, without quite meaning to, which evolutionary pathways which will reamin open and which will forever be closed. No other creature has ever managed this, and it will, unfortunately, be our most enduring legacy."

Edward O. Wilson, author of ***Half Earth – Our Planet's Fight for Life*** (2016):

PROBLEM

"The on-going mass extinction of species and with it the extinction of genes and ecosystems, ranks with pandemics, world war and climate change as among the deadliest threats that humanity has imposed on itself," and:

SOLUTION?

"The only solution to the sixth extinction is to increase the area of inviolable natural reserves to half the surface of the Earth or greater."

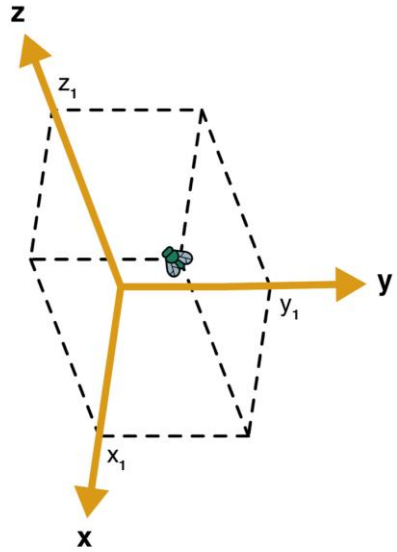
Realism vs deep thinking

Realism, the combination of observations and experiments with logical reasoning, as taught by Galileo Galilei, revolutionized modern thinking.

Galileo Galilei (1564-1642). instructing dignitaries how to use the telescope.

The projection of a fly on his bedroom ceiling inspired Renée Descartes to invent the coordinate system, thereby merging geometry with algebra. Without leaving his bed, or so it's said.

Renée Descartes (1596-1650)



"Cogito ergo sum",
"I think, therefore I am",
Descartes' first undeniable principle was used as a tool for developing an idealistic dualism in opposition to the realism of Galilei and others. The dispute between these schools is persistent.

The return of deep thinking

From 2016 and onwards, the world champion of the complex board game Go is no longer human.
Products based on artificial intelligence (AI) are unchallenged, since AlphaGo and its successor AlphaZero, by DeepMind, entered the stage.

Powerful algorithms for **face recognition** are in routine use for identification, surveillance, movement and behavior analysis.
The commercial success and economic impact of this and other similar AI tools is obvious.

YouTube

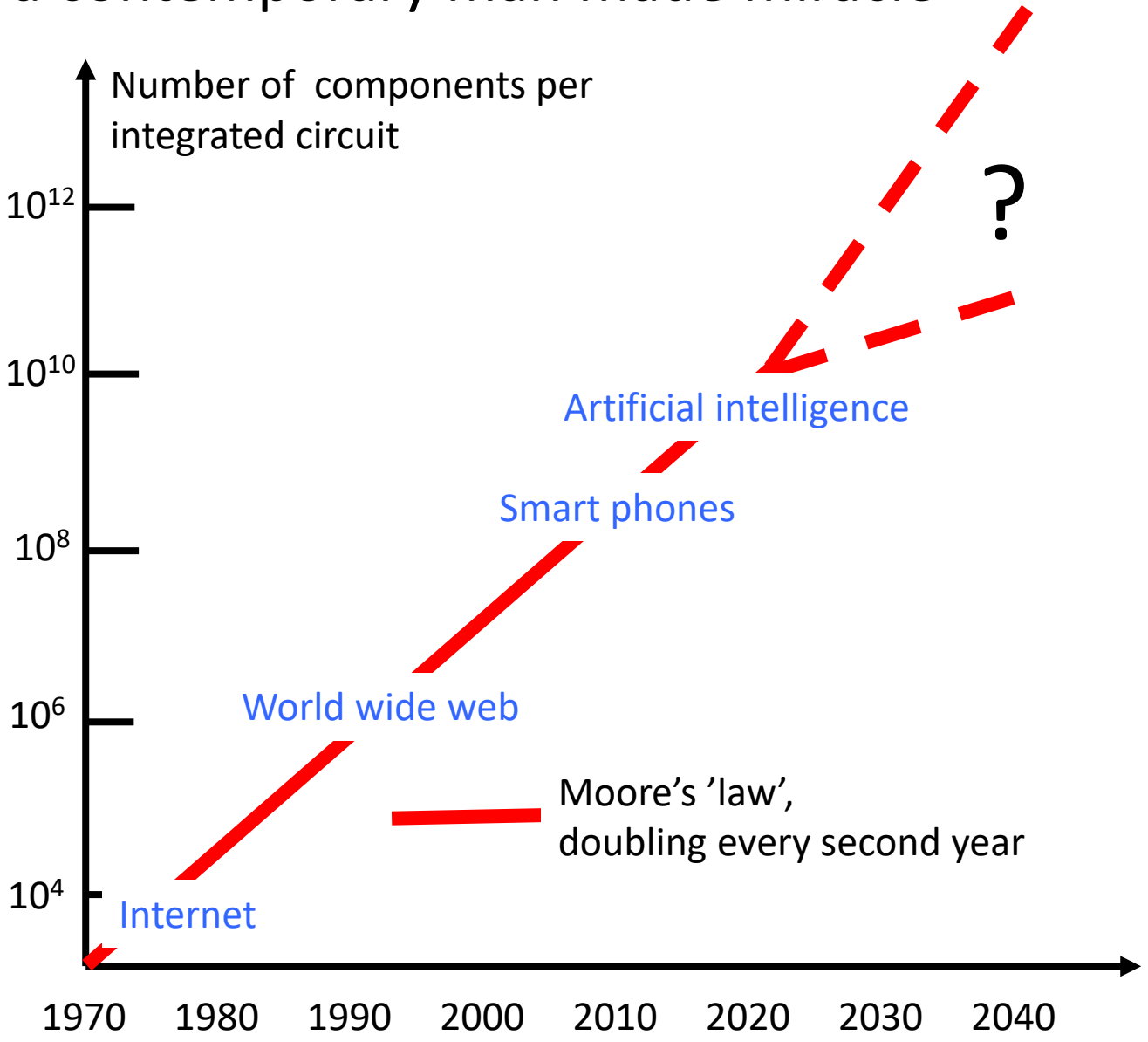
TikTok

Future of Life Institute

Future of Humanity Institute
UNIVERSITY OF OXFORD

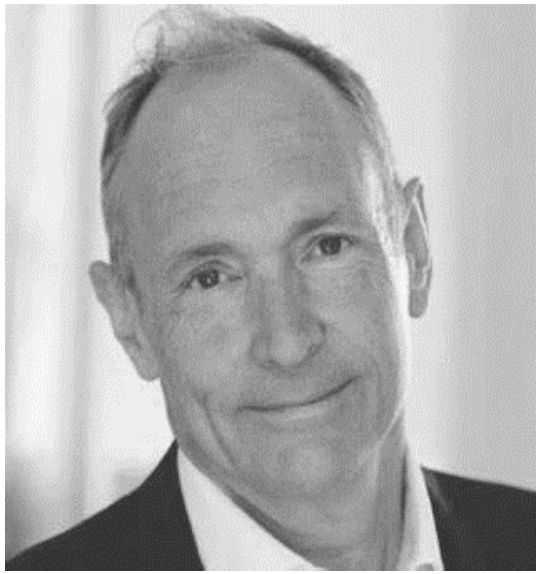
Can AI be guranteed to be benevolent?
Growing concern for malicious AI has positioned it on top of the highest existential threats to humanity.
Will we resist?

Behind the digital revolution
- a contemporary man made miracle

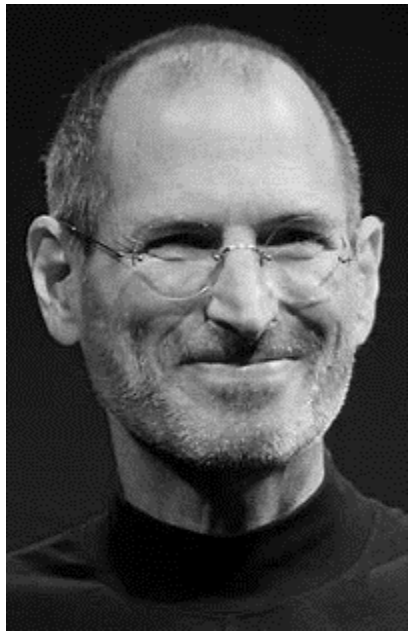


Paul Baran (1926-2011)

Donald Davies (1920-2000)

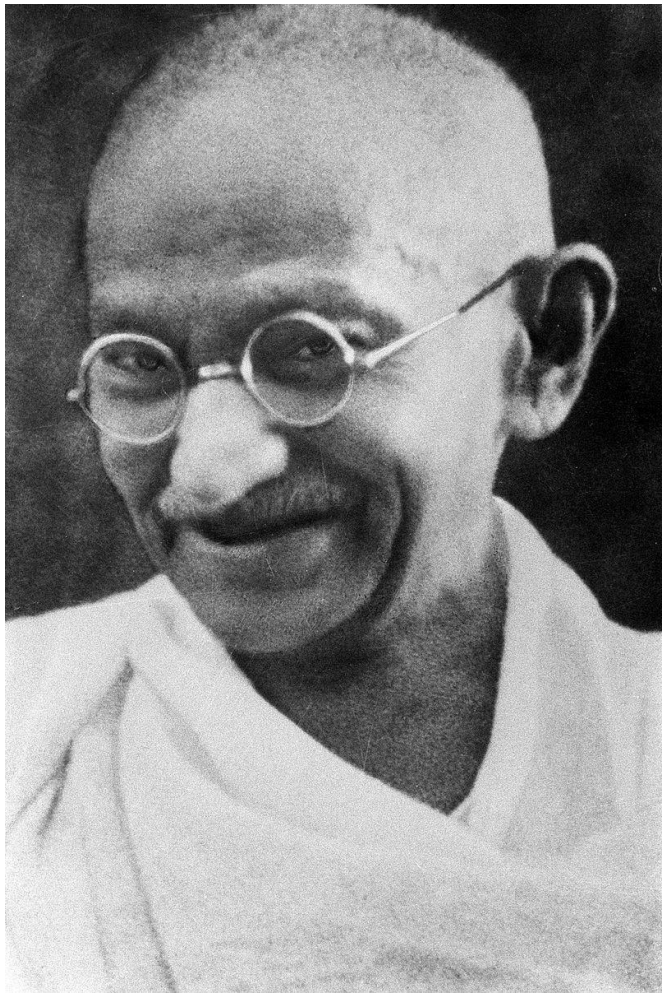


Tim Berners-Lee (1955-)

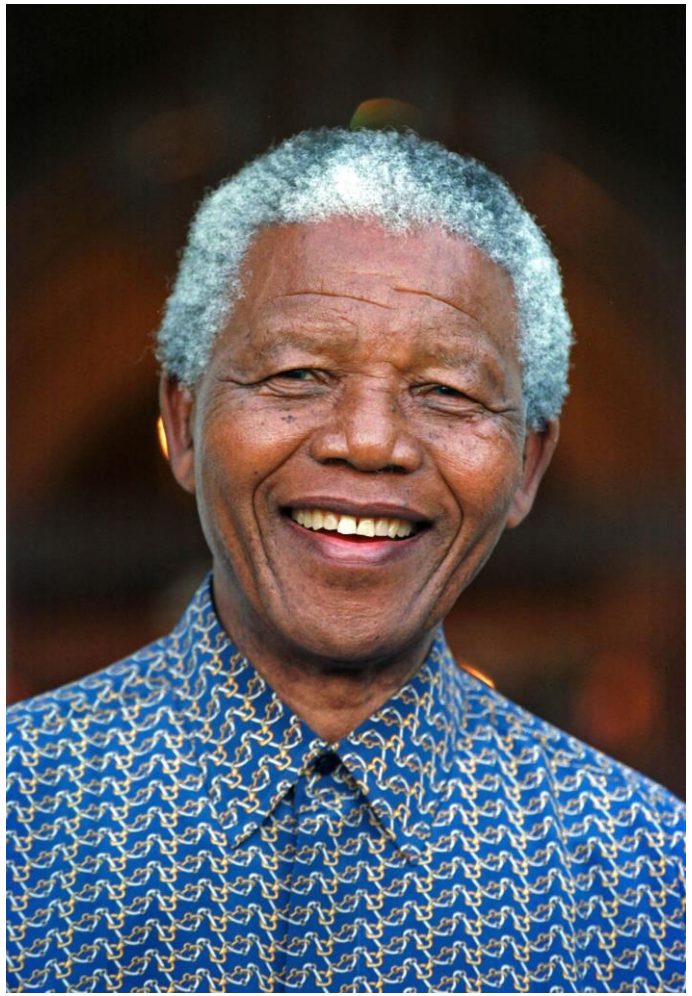


Steve Jobs (1955-2011)

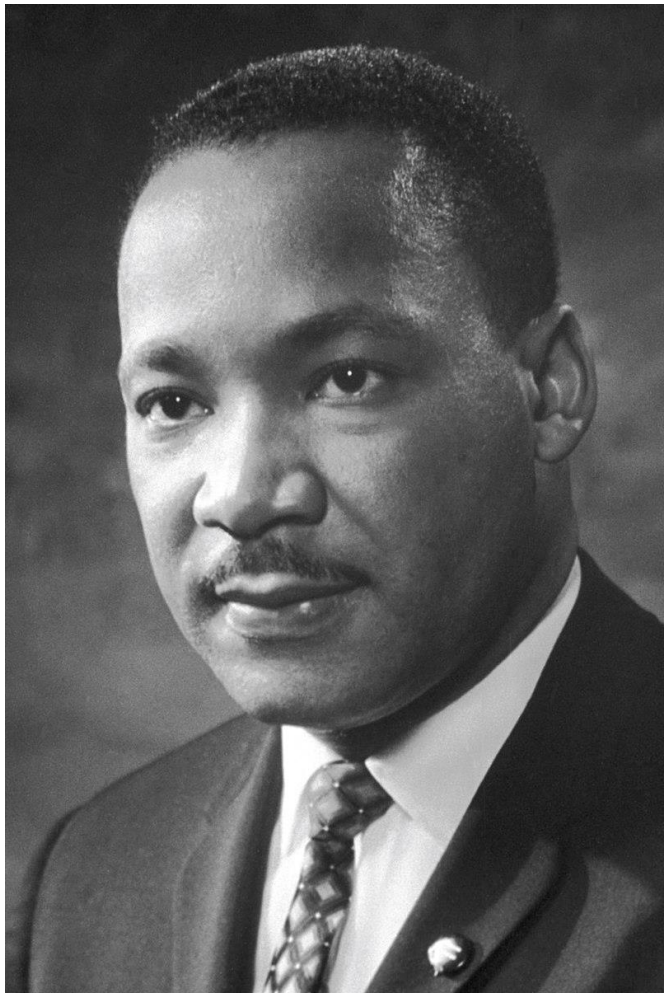
Heroes of the 20th century



Mahatma Gandhi 1869-1948



Nelson Mandela 1918-2013



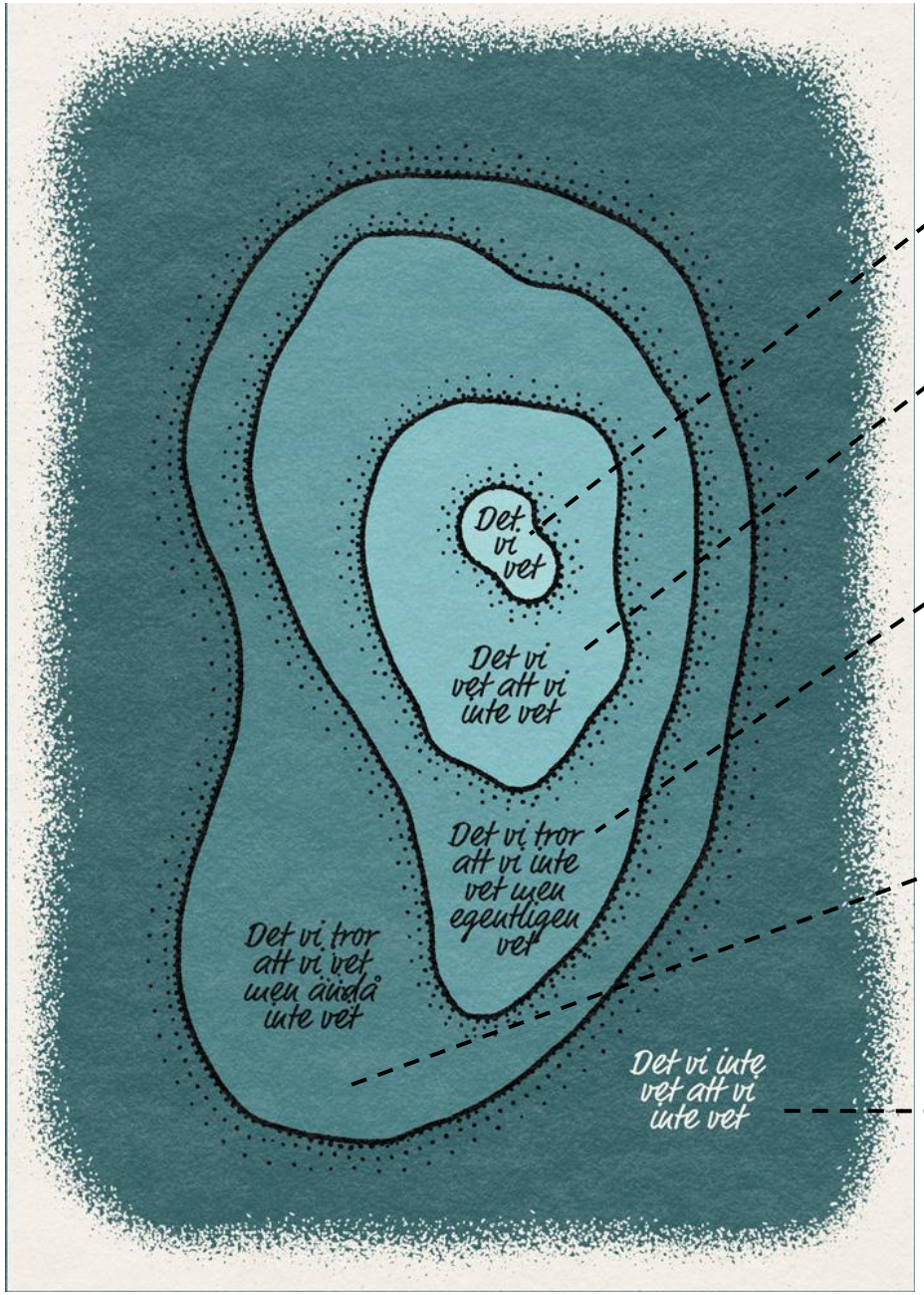
Martin Luther King 1929-1968

”I’m blinded
by the light of
God, Truth and Right
and I wander
in the night
without direction”

Paul Simon

Paul Simon and Art Garfunkel
Skogsvallen, Östervåla, Sweden, June 1966.

An island in the sea of the unknown



What we know

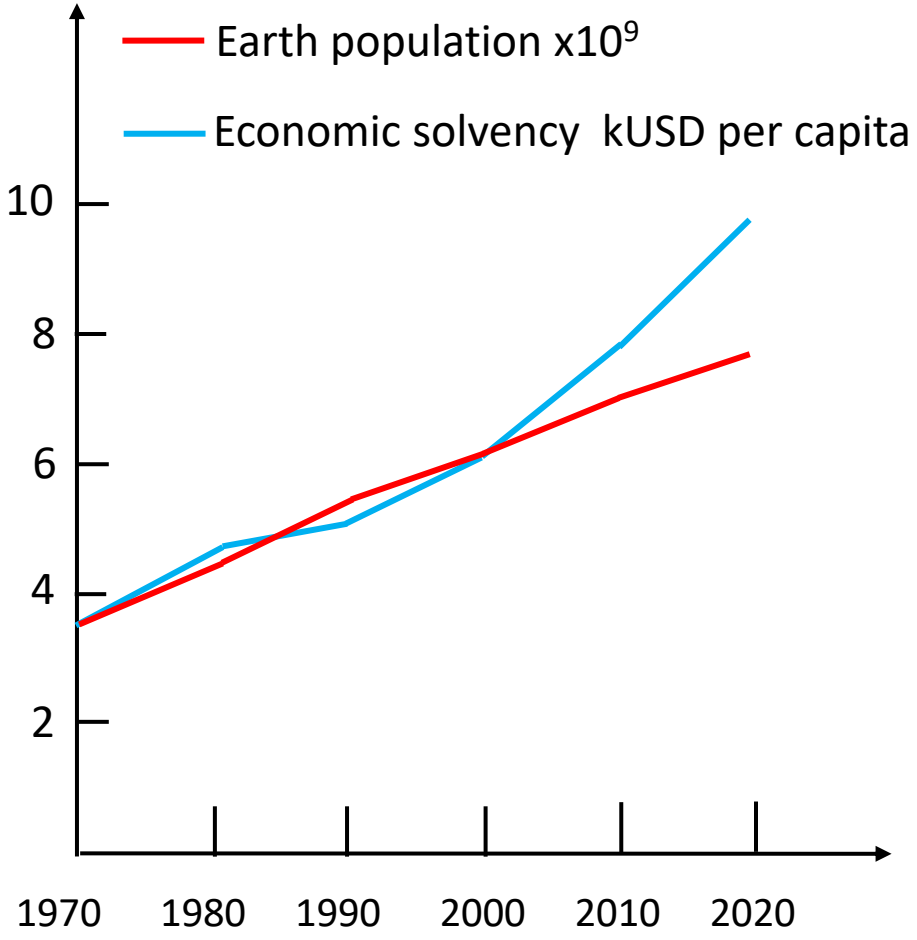
What we know that we don't know

What we think we don't know but in fact we do

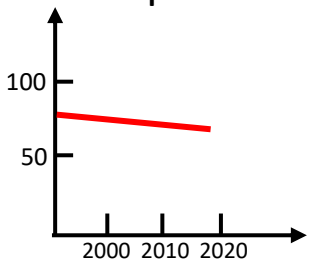
What we think we know but in fact we don't

What we don't know that we don't know

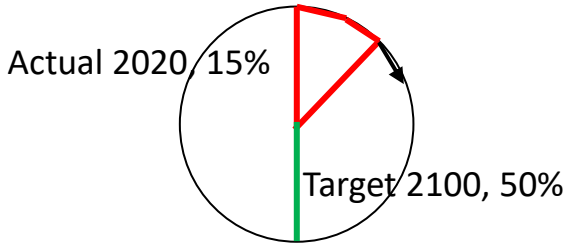
Global growth indicators



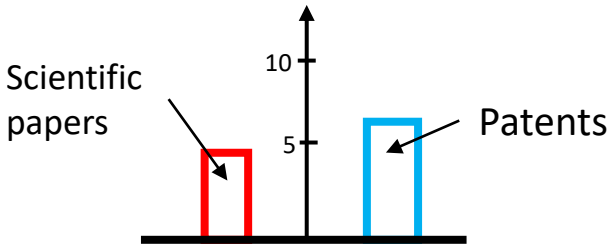
Illiterate persons x 10^6



Natural reserves, surface fraction



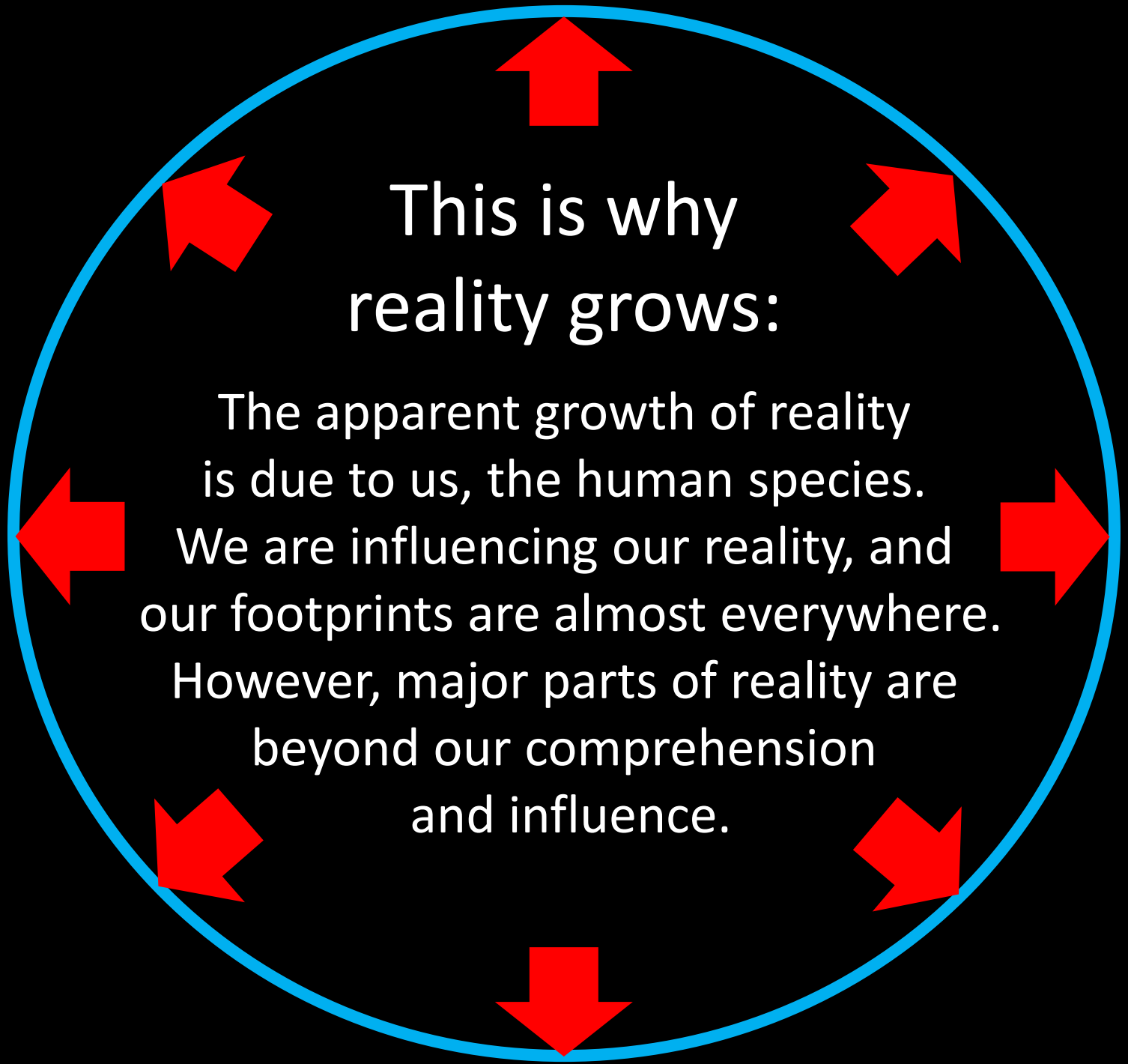
Annual growth %



Anthropogenic existential risks are growing by numbers and size

Short description	Risk this century
Nuclear war	1 in 1000
Climate change	1 in 1000
Other environmental damage	1 in 1000
Mass extinction	?
Engineered pandemics	1 in 30
Unaligned artificial intelligence	1 in 10
Unforeseen anthropogenic risk	1 in 10
Other anthropogenic risk	1 in 20
Total existential risk	1 in 6

This table is mostly reproduced from Toby Ord: *The Precipice – Existential Risk and the Future of Humanity* (2020), p. 167.


This is why
reality grows:
The apparent growth of reality
is due to us, the human species.
We are influencing our reality, and
our footprints are almost everywhere.
However, major parts of reality are
beyond our comprehension
and influence.

Humanity’s greatest challenge

1. Our knowledge of reality is fragmentary and incomplete.
2. The observed growth processes are basically out of control.
3. The management of anthropogenic existential risks cannot be less than the greatest challenge of humanity.
4. Time is running out.


The rising sun is a call for us
to get together, decide and act.
Thanks for your attention!