OUR LIFE ON EARTH

A human sojourn

DECEMBER 11, 2020

A narrative of conceptualization and trajectory …..

In humble remembrance of what I have read, learned, reflected, referred and experienced over the years.

An overview of life's vibrancy and mixed energies, while a different narrative is being weaved in real time….

One who pursues the internal search is known as a Tirtankara and one who pursues the search outside is known as a Chakravarthi…….

Mental health is an outcome of social stability, socio-political milieu, individual strife, awareness, social existence and appraisal of the holistic self.

References

Wikipedia

Google search spanning from scholarly articles to blogs

Individuals and organisations developing data visualisations

Home portals of important world organisations

Disclaimer

Periods are mostly approximated rather than true dates or exact periods for ease of reading. specifics of names and references not actively pursued. The purpose is to simplify overview and connections rather than facts, details and accuracy. It is acknowledged that facts/versions and level of details can be varied, which can likely influence a narrative and summary.

Contents

On Nature

Inferential Observations and translation

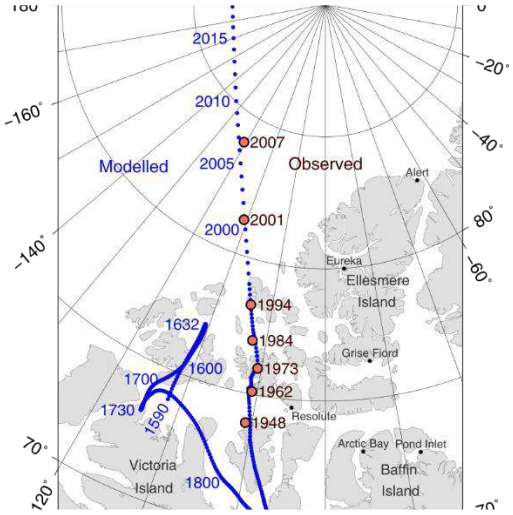
The events outside the planet are now available as photos and videos for viewing; example NASA website. Earth observatories, Satellites, space telescopes, Space observatories and International Space Station are some of the options in use.

There are different types of satellite imagery now in use which through computers converts the images to a final visual display. Visible light (VIS satellite for weather forecasting and analysis and can capture images only during day light hours) and Infrared (IRS satellite for temperature, water vapour and height measurements, captures images even at night) are the two main spectra used in earth observation. Satellites are managed by both public and private enterprises. Higher resolution, B&W and polychromatic imagery is used. AI has been recently used to enhance data analysis and applications such as in forestry, fishery, natural calamities etc.

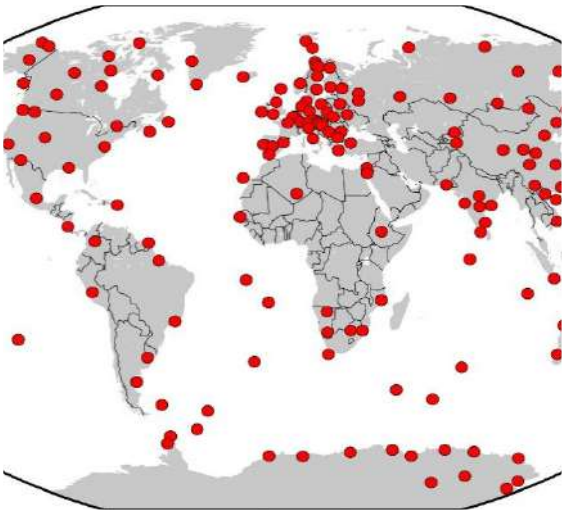
An observatory is a structure built on conducive places on earth to study phenomena on earth or in outer space.

Natural events on earth such as Volcano, Tsunami, Earthquakes, earth's magnetic field, gravitational field etc can be studied by special earth- based observatories designed to study these specific phenomena. The below example is of the observatories to study earth's magnetic field and how it was applied to study and postulate the migrating pattern of the earth's magnetic north pole.

north pole migration

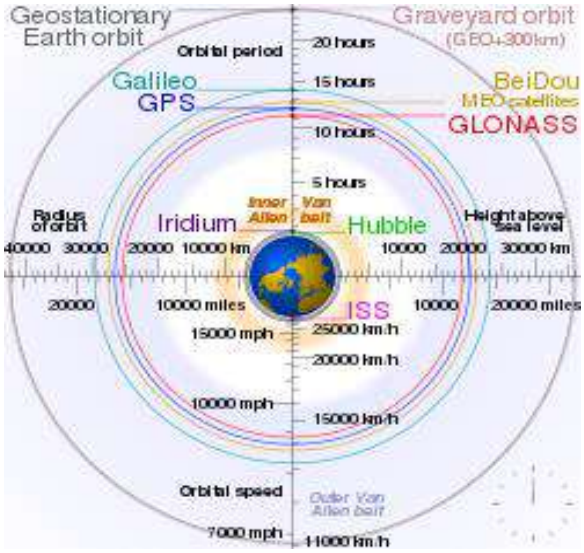


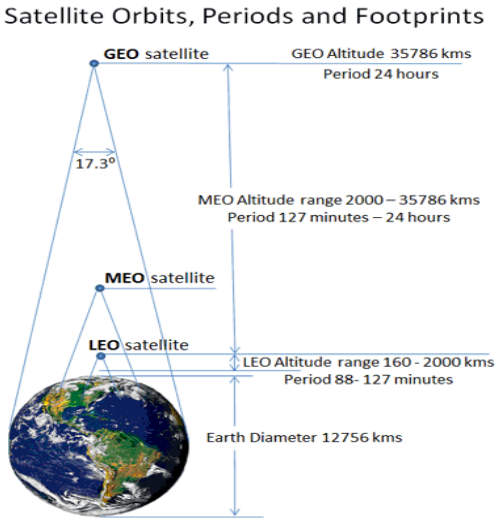
magnetic observatories location



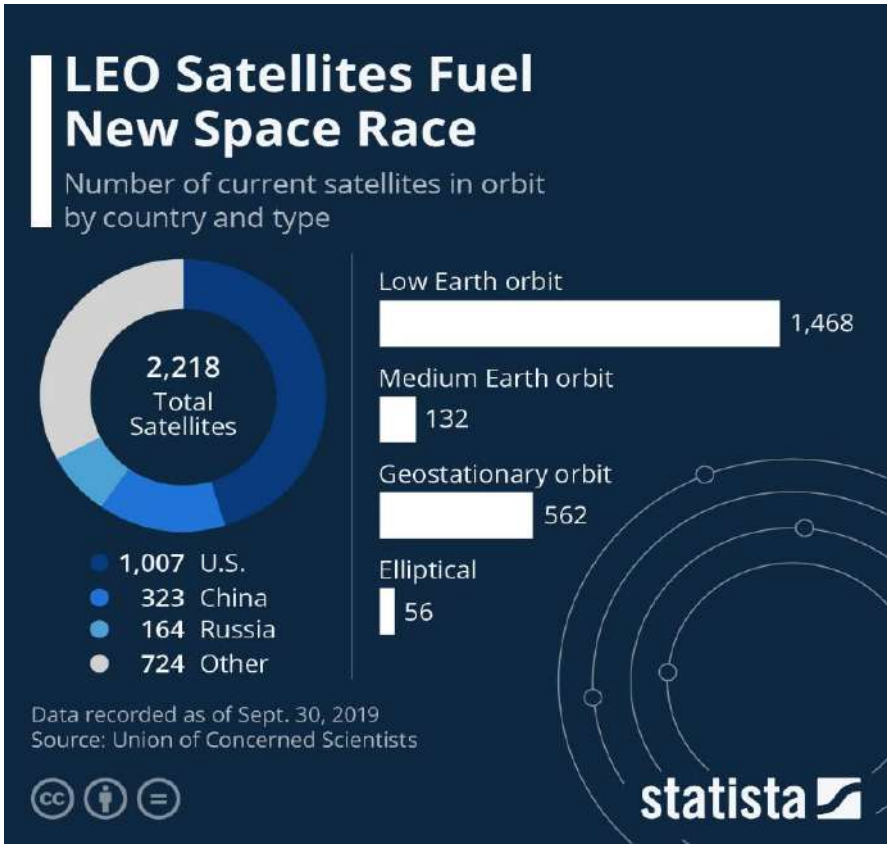
The spectrum used in earth-based observatories to study space is visible light and radio waves of the EMS. Radio observatories need minimum Electromagnetic Interference and placed in valleys. The highest earth observatory, Large Millimeter Array, a radio observatory, is in Atacama at an altitude of 5kms above sea level. On the contrary, optical observatories need least atmospheric disturbance and highest visibility. An example is Mauna Kea Observatory in Hawai islands. It has been researched that the eastern Antartica provides the best site for an observatory on earth. In collaboration of networked observatories across the globe, specific space observations can be undertaken by triangulation. Event Horizon Telescope is one such example.

Space based observatories overcome problems of resolution due to atmospheric disturbance and visibility but are expensive to make and maintain, needing space shuttle flights for maintenance. In the absence of the earth's atmosphere which filters a broad range of the EMS, these observatories can capture UV, Gamma, X and more infrared radiation spectrum. Hubble space telescope is one such observatory. To overcome maintenance costs, airborne observatories are used in the upper atmosphere; an example is SOFIA and hot air balloons.

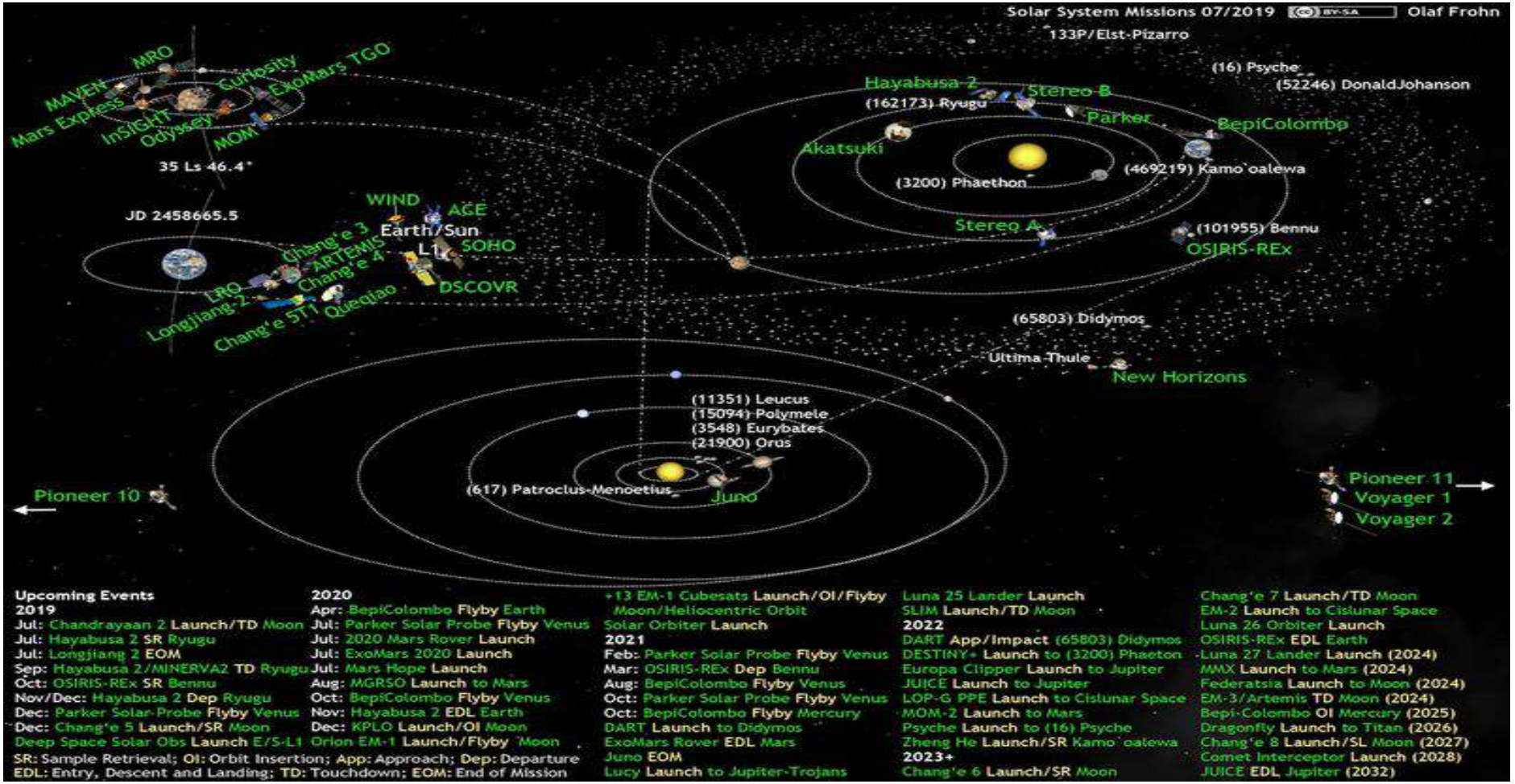




The picture above represents the distance from earth's surface of the various satellites and observatories. The earth's atmosphere extends up to 500kms from the surface. The Low Earth Orbit is the most used zone and is so high in satellite traffic that it has raised concerns of space debris.



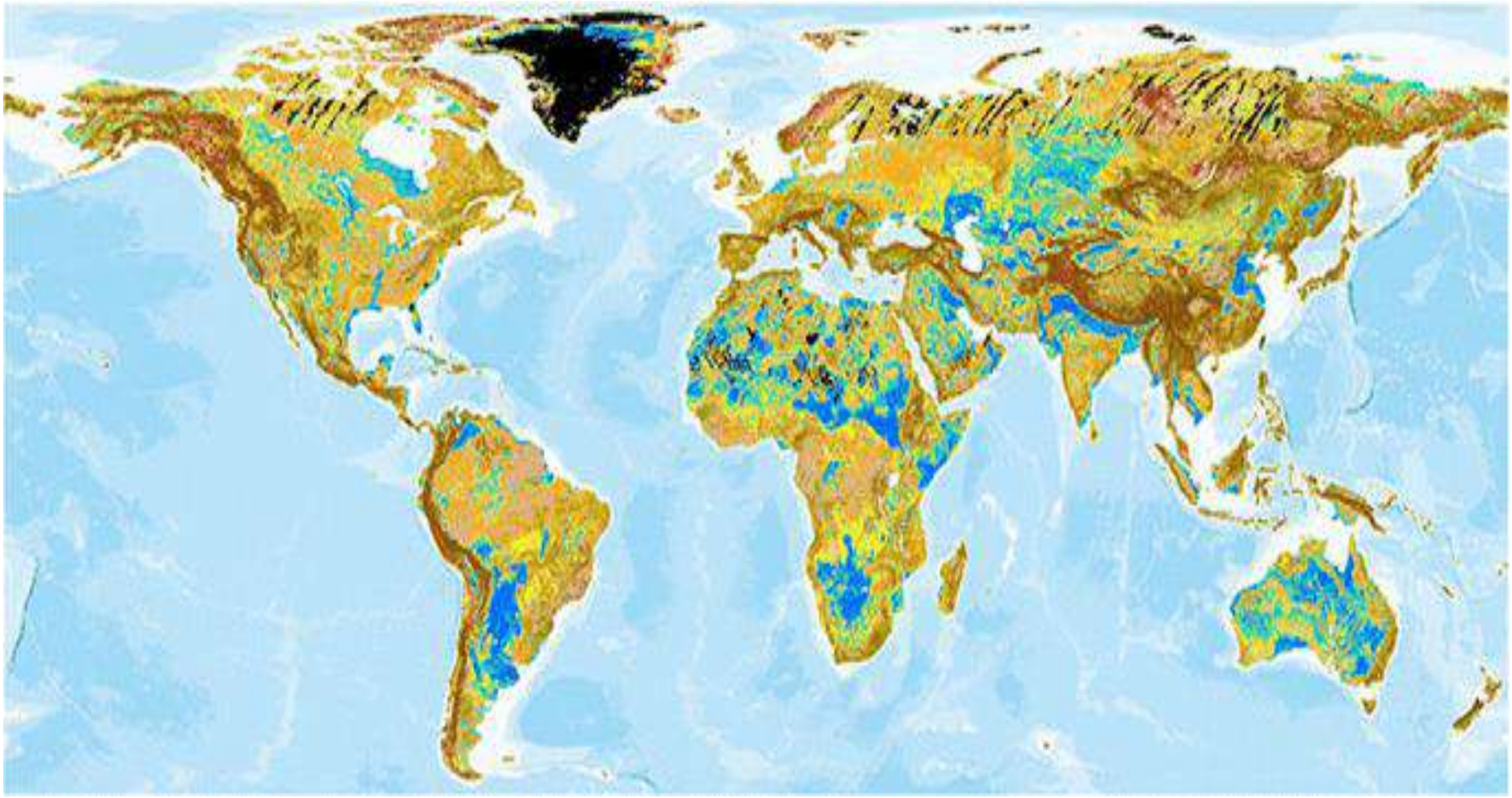
Deep space exploration is studying outer space with space probes outside the earth's orbit for interplanetary, solar, asteroid and outer space events. The farthest has already travelled into interstellar space.



By Olaf Frohn - http://www.planetary.org/multimedia/space-images/charts/whats-up-in-the-solar-system-frohn.html (image link), CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=80963751

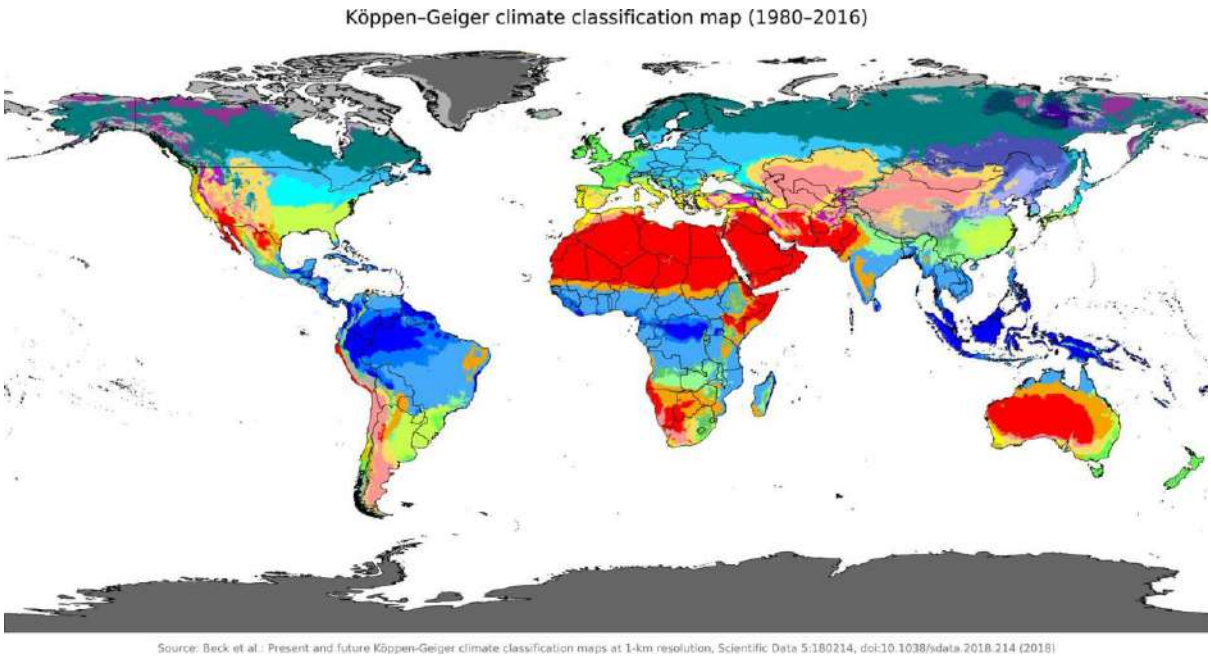
Nature as we know it

Digital elevation models DEM are now being used to describe in further detail geomorphology of land. Pictures from Progress in Earth and planetary Science Jan 2018 below demonstrate this.



Overview	Terrain group	Landform pattern	Typical landforms in Japan
Bedrock mountain	1a	Steep mountain (rough)	steep mountain of accretionary complex / un-decomposed plutonic rock
	1b	Steep mountain (smooth)	steep mountain of felsic / dissected mafic volcano, escarpment of caldera / fault-block mountain, inselberg
	2a	Moderate mountain (rough)	moderate mountain of felsic volcanic rock / accretionary complex
	2b	Moderate mountain (smooth)	moderate mountain of old sedimentary rock / dissected mafic volcano
Hills	3a	Hills (rough in small and large scale)	hills and mountain footslope of weathered rock
	3b	Hills (smooth in small scale, rough in large scale)	hills of pyroclastic flow deposits / Tertiary sedimentary rock, talus
Large highland slope	4	Upper large slope	un-dissected mafic volcano
	5	Middle large slope	volcanic footslope of debris, dissected escarpment of sediments
Plateau, terrace, large lowland slope	6	Dissected terrace, moderate plateau	hilly terrace, metropolitan areas and coastal industrial areas
	7	Slope in and around terrace or plateau	terrace edge or valley bottom plain in and around terrace
	8	Terrace, smooth plateau	terrace, sand bar, metropolitan areas and coastal industrial areas
	9	Alluvial fan, pediment, bajada, pediplain	alluvial fan, dissected alluvial fan
Plain	10	Alluvian plain, pediplain	alluvial plain in upstream
	11	Alluvial or coastal plain, pediplain	alluvial plain, coastal lowland
	12	Alluvial or coastal plain (gentlest), lake plain, playa	delta, marsh, coastal lowland

This is a move for further detail from the latitude classification of polar, temperate and tropical to both North and South of the equator.



The Koppen-Geiger method of climate classification uses temperature and precipitation to identify key zones and their transitions by colour coding.

Legally Protected wilderness existed by 1775 in Trinidad and Tobago and Mongolia but the first public National park in the world was Yellowstone National Park in USA in 1872. John Muir (a Scottish

immigrant to America) is known as the father of national parks. Abraham Lincoln gathered constitutional willingness and approval of legal standing to these conservation zones identified within USA. There are about 60 National Parks in USA now with 270 million visitors annually. In the world, there are about 4000 National Parks.

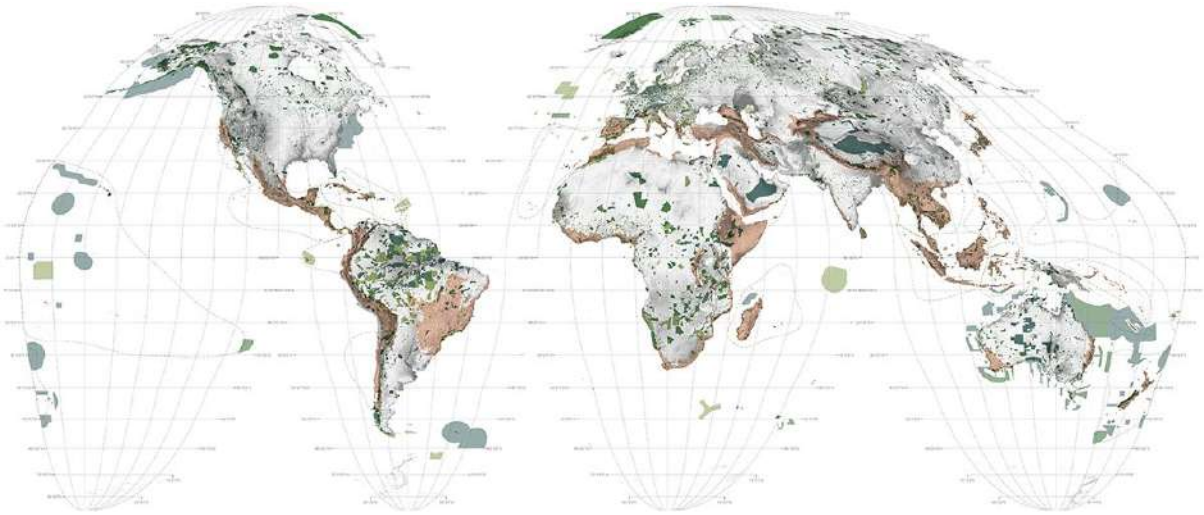
Glacier National park

yosemite national park

yellowstone national park

Antelope canyon

Munro bagging is a sport in Scotland for climbing all the mountain peaks >3000ft in height called Munros. Sir Munro surveyed and catalogued them in 1891. There are 282 Munros in Scotland and to date, about 6800 people have completed the munro bagging title – called munroists.



The International Union for the Conservation of Nature (IUCN) oversees the World's protected areas, of which, there are 209,000 now. The 2014 United Nations Environment Program's Protected Area Report states that 15.4% of the world's terrestrial and inland waters, and 3.4% of the world's oceans are currently protected.

There are several hiking friendly trails in the world specifically curated with assistance, maintenance, sign boarding and lodging.

American walking trails

tour du mont blanc

kungsleden trail Sweden with northern lights

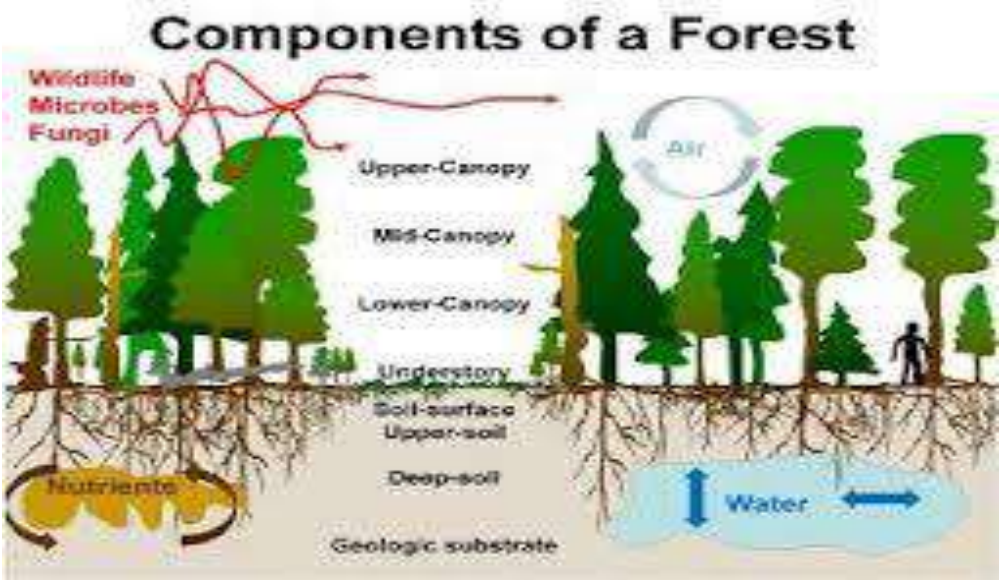
Biwindi impenetrable forest Uganda

Bolivia, Ecuador, Costa Rica, Patagonia (Argentina and Chile), Venezuela, Iceland, Norway, Switzerland, Scotland, Kashmir and Ladakh (India), Uganda – would exhibit all geographical variations and altitudes of natures wonders.

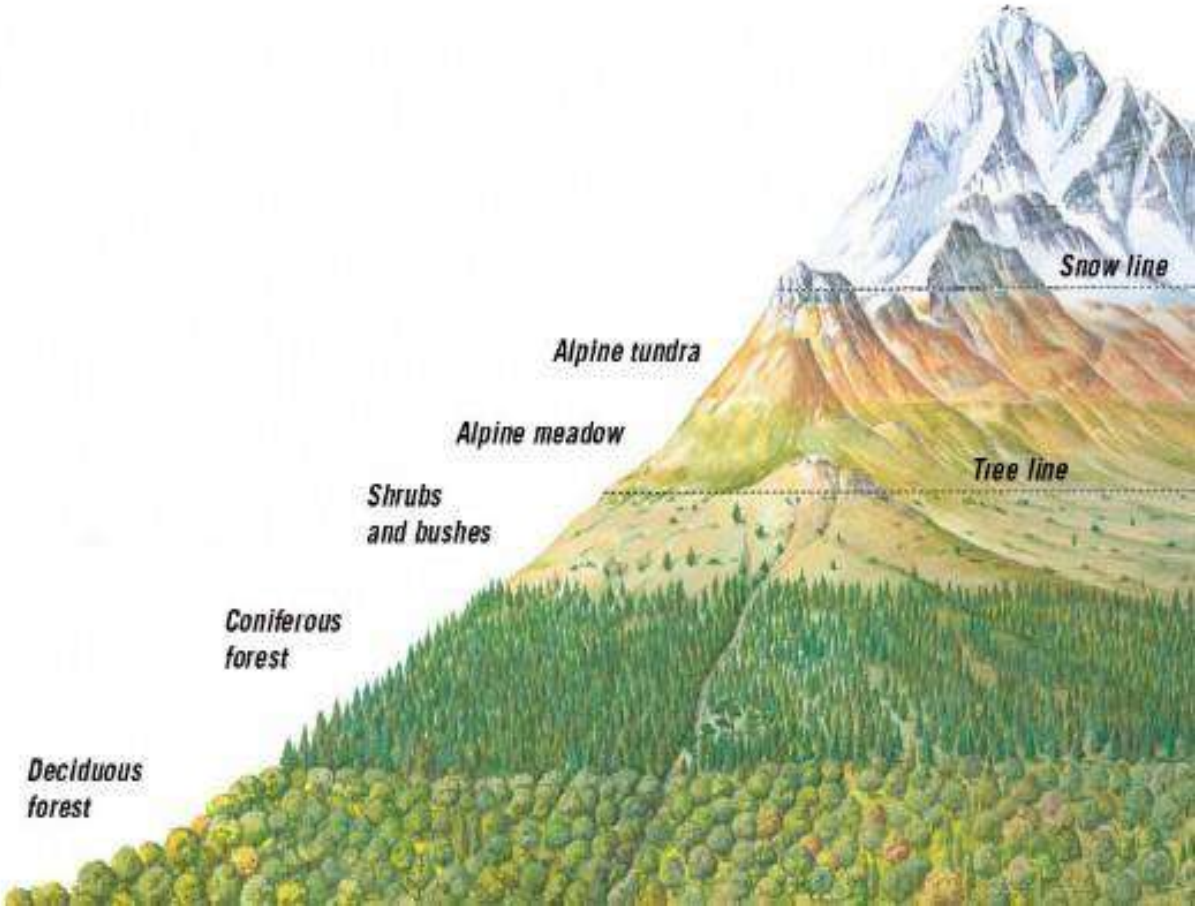
BBC Bristol with Sir David Attenborough and National Geographic have produced some of the best high-resolution complex production team work on digital documentary series regarding wildlife and natural wonders. Google earth has some satellite images of natural wonders. Virtual tourism is being offered by some destinations to attract tourists (ex: Faroe islands). WWF and National geographic provide ecotourism locations around the world.

Knowing the specific types of ecosystems in a natural habitat helps to plan exploration for flora and fauna spotting in addition to natural beauty.

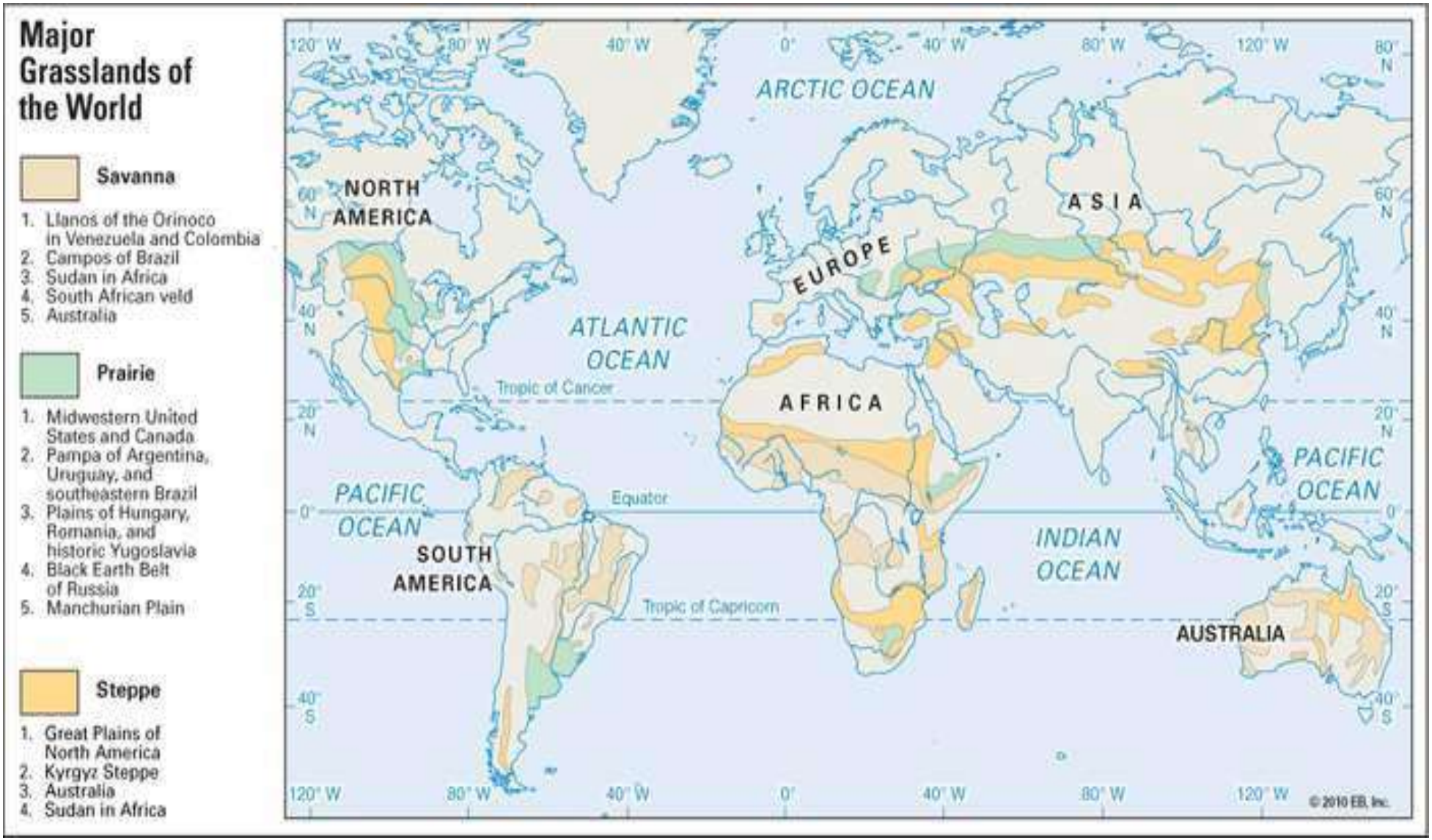
Ecosystem	**Types**	**Subtypes**	
Terrestrial	Mountain	• Folded • Block • Dome • Volcanic • plateau	Figure below
	Forest	Tropical rain, deciduous and scrub Temperate rain and deciduous Evergreen coniferous Mangrove forests	Figure below
	Desert	Sandy, stony, rock, plateau, mountain, cold	
	Grassland	See image	
	Tundra	Artic, antartic and alpine	
Aquatic	Marine	Estuaries, salt marshes, rocky shores, sandy shores, coral reef, mangrove swamp, barrier islands, ocean floor, broad ocean, inter-tidal zones, lagoons, kelp forest, polar seas	See image
	Freshwater	Standing - lake, pond Transitional – estuaries, wetlands (bogs, tens, swamps & marshes) Moving – river, stream	See image



Components of Forest ecosystem



Components of Mountain Ecosystem


Major Grasslands of the World
Savanna
1. Llanos of the Orinoco in Venezuela and Colombia
2. Campos of Brazil
3. Sudan in Africa
4. South African veld
5. Australia
Prairie
1. Midwestern United States and Canada
2. Pampa of Argentina, Uruguay, and southeastern Brazil
3. Plains of Hungary, Romania, and historic Yugoslavia
4. Black Earth Belt of Russia
5. Manchurian Plain
Steppe
1. Great Plains of North America
2. Kyrgyz Steppe
3. Australia
4. Sudan in Africa
ARCTIC OCEAN
NORTH AMERICA
EUROPE
ASIA
ATLANTIC OCEAN
AFRICA
PACIFIC OCEAN
SOUTH AMERICA
INDIAN OCEAN
AUSTRALIA
Tropic of Cancer
Equator
Tropic of Capricorn
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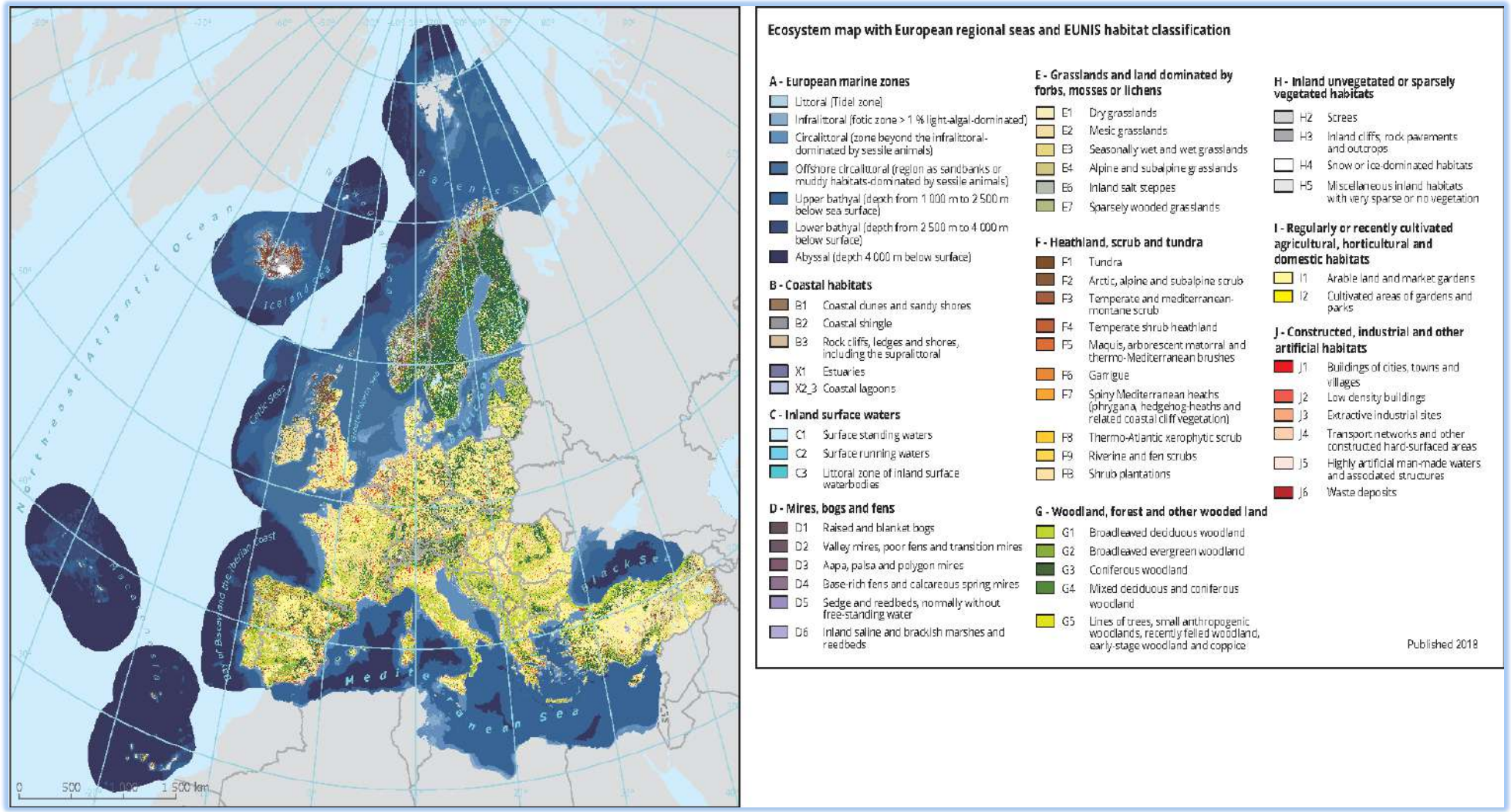
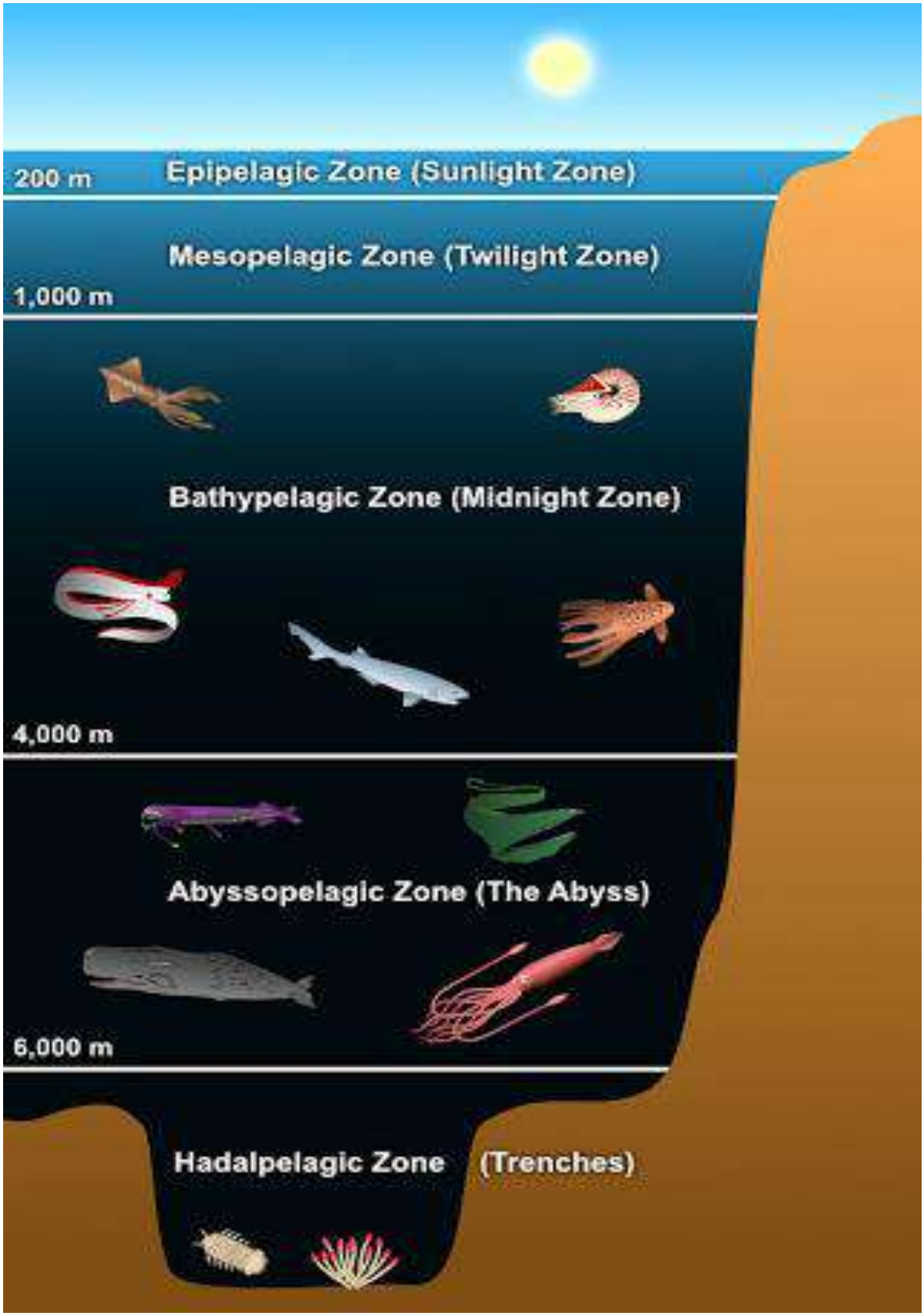


European Environment Agency

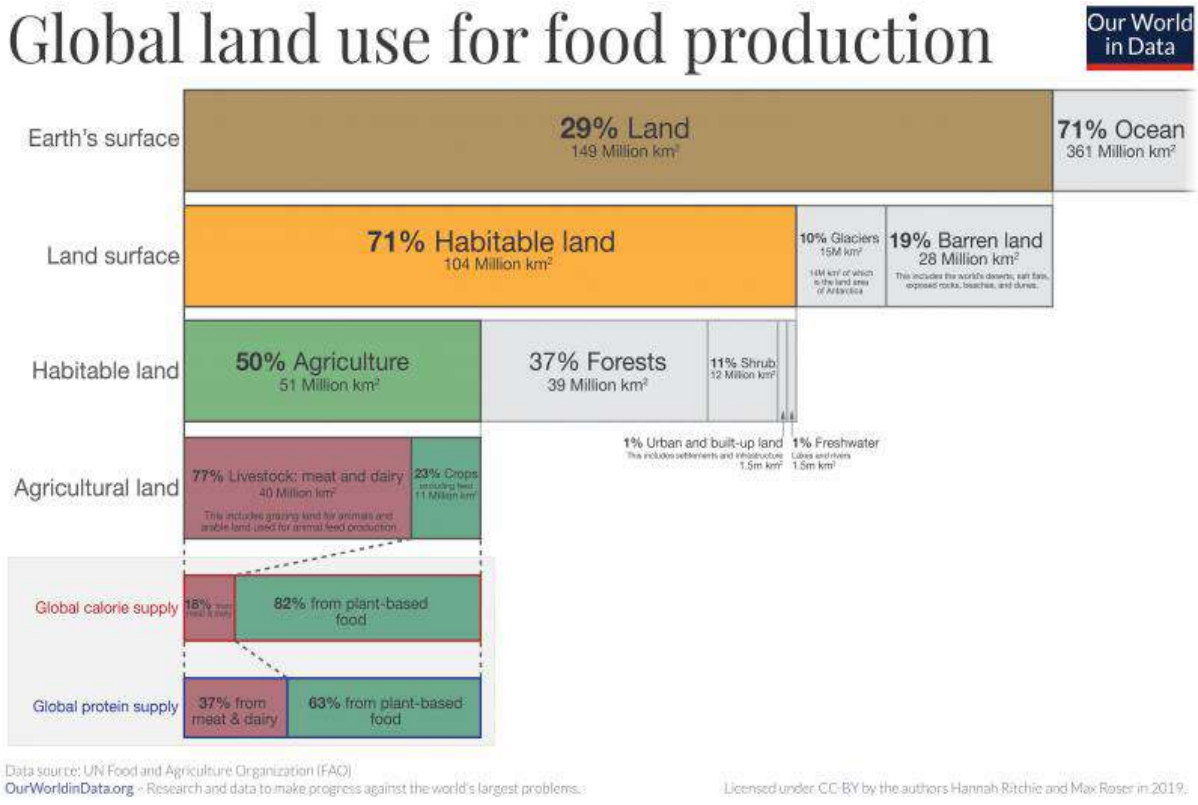
https://www.eea.europa.eu/themes/biodiversity/mapping-europes-ecosystems


200 m
Epipelagic Zone (Sunlight Zone)
Mesopelagic Zone (Twilight Zone)
1,000 m
Bathypelagic Zone (Midnight Zone)
4,000 m
Abyssopelagic Zone (The Abyss)
6,000 m
Hadalpelagic Zone (Trenches)

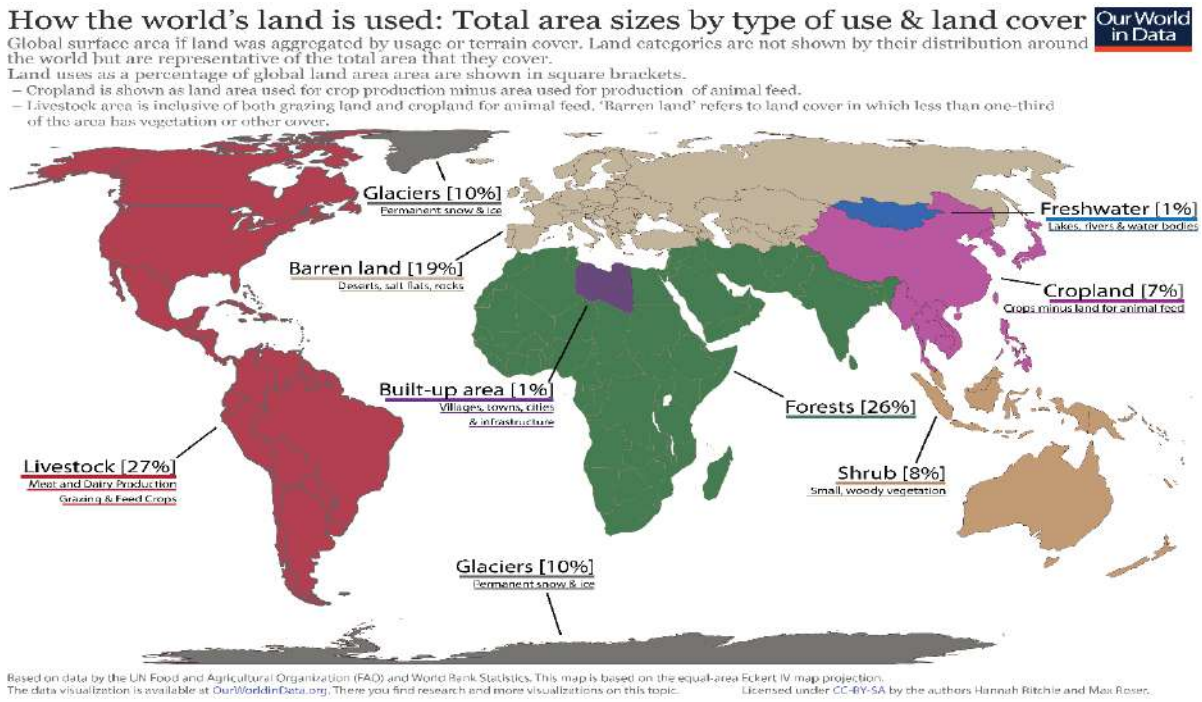
On population

Human population was estimated at 200million in 1 AD, 300million in 1000 AD, has grown from 1.6 billion in 1900 to 7.7 billion in 2020. Most estimates of human population by the turn of this century is at about 12 billion. This growth is linked to World War I, a story about how the Haber-Bosch process for synthesising ammonia and nitrates (for explosives) developed in Germany in 1910 was later used for manufacturing fertilisers. The global use of fertilisers is now about 250 million tonnes annually, thus restricting land mass needed for agriculture to 1/4 of land needed without fertilisers. The other explanation is around reducing mortality (average global life expectancy was 30 years in 1800 and the UN now estimates it as 72 years), improving social standards, and improved public health measures.

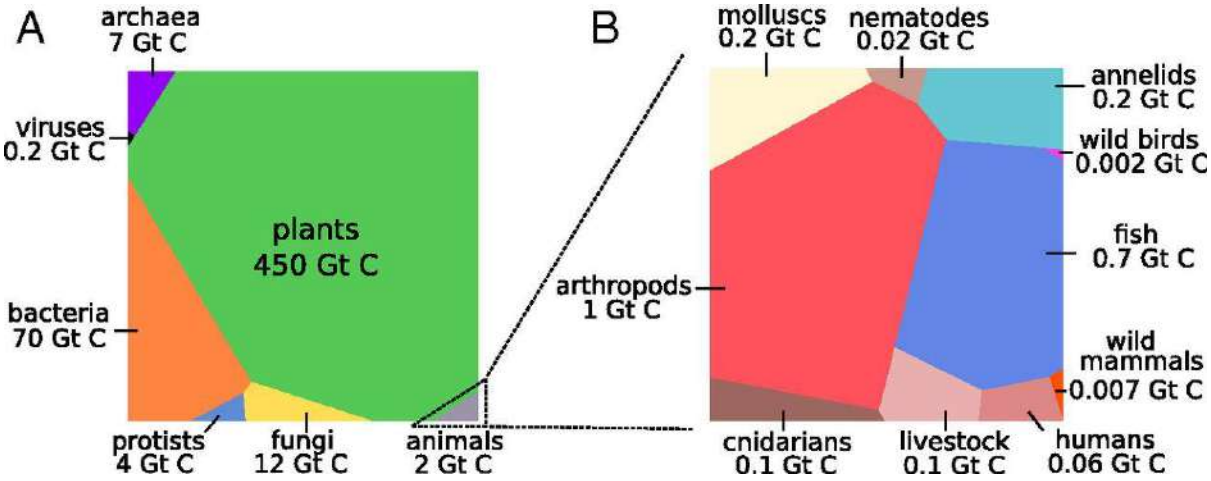
On a parallel note, the earth's surface is 30% land and the rest water. A pictorial representation from our world in data.org shows that built up land on earth is only 1% but makes up 50% for livestock (77%) & agriculture (23%) of the overall habitable land area. Over the last 4 centuries, agriculture & livestock land use has increased 5 folds.



The use of habitable land has increased from 10% to 50% in the last 4 centuries (livestock > agriculture).



A recent census by Marine Life Scientists published by PLoS biology estimate 9 million species as currently present on earth with 90% needing discovered, identified and catalogued. 70% of species are terrestrial. The IUCN Red list monitors less than 1% of these species. In a recent PNAS publication of 2018, the global biomass of all life forms on earth was estimated at 550G tons and the picture below from this study shows the distribution of biomass.



Livestock biomass is ten times the biomass of Wild mammals and wild birds. The global tree count is about 3 trillion trees as published by the Journal Nature in 2015 with a human to tree ratio of 1:400.

In summary, livestock & agricultural land use has increased over the centuries; livestock lands = 4 x crop lands, at the expense of the forests and shrublands. This would have further been the case if not for the invention of fertilisers, plant hybridisation, genetic modification, pesticides and plant disease control; however, on the contrary, population spurt is also highly influenced by use of fertilisers. Humans form the highest biomass for large mammals; impressively still, they can be compacted to living within 1% of habitable land mass. Therefore, the land use is more for purposes of subsistence rather than actual habitation (35 times more for subsistence than habitation).

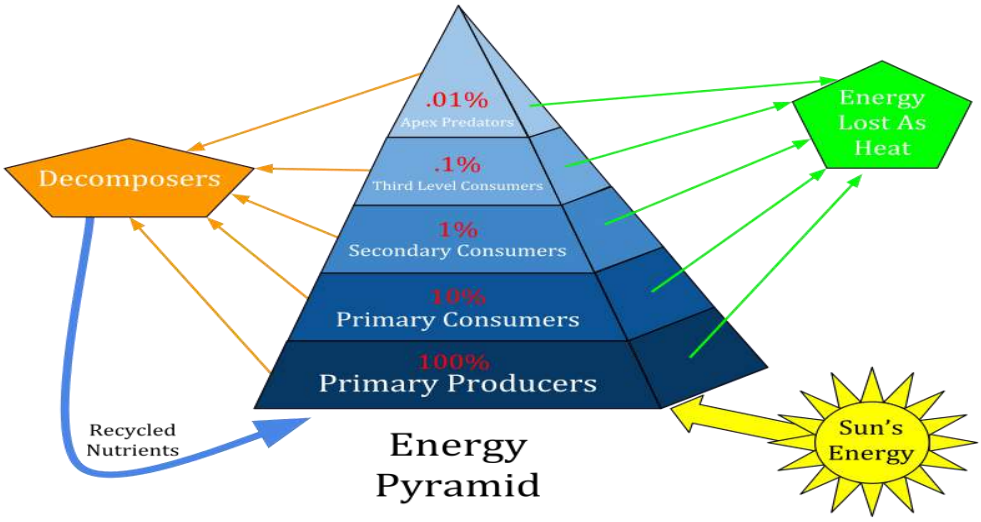
On food

Cooking food is a million-year-old human heritage. It is believed that humans used to gather wild grains for consumption for over 100,000 years now. Man's hunter gatherer status changed to an agricultural and livestock one in the late stone age, about 10,000BC. It is believed to have started in different regions of eastern Mediterranean, Americas and east asia. There were barely a few different plant and livestock options. Of the 400,000 plant species on earth, humans now consume about 200 of these plant species [new scientist, July 2015]. These become our basic food ingredients. Among livestock, FAO has 20 categories used for food, leather, clothing, perfumes, honey etc. In both plant and animals for human use, domestication has progressed over the years to selected breeding choices, genetic engineering and disease prevention and treatment. It is reported in a blogspot that there could be as many as 200,000 ingredients for cooking in the world.

Cuisines are categorised in many ways – one such is by region, by history, by ethnic and religious, by cuisine styles. This comes to several hundreds' if not thousands in cuisine numbers. Then the question of number of recipes in the world is not answerable where we would have to factor in aroma, texture, colour, heating method used, cooking time and so many other variables that go into a single recipe. It could be said that the potential combinations could lead to an infinite number of recipes.

The revenue from the global food market is estimated at 7.5 trillion dollars in 2020 (8.6% of global GDP). The Restaurant industry is estimated at 2% Global GDP. A family's monthly food expenditure may be from 10%-30% of their monthly earnings.

A human consumes about 35 tons of food in a lifetime or the entire world population consumes 4 billion tonnes of food a year. The total live biomass on the planet is 500 billion tonnes of carbon and is replenished @ 100 billion tonnes per year. Humans consume 4% of the yearly renewable biomass, we being only 0.01% of the earth's biomass i.e 400times our own biomass. An estimated 5% of the world population is vegetarian. Vegetarian diet has more fibre and magnesium content, nonvegetarian has more fatty acids and protein. The mean BMI is 5 point higher on a nonvegetarian diet. Both fulfil daily caloric requirements.



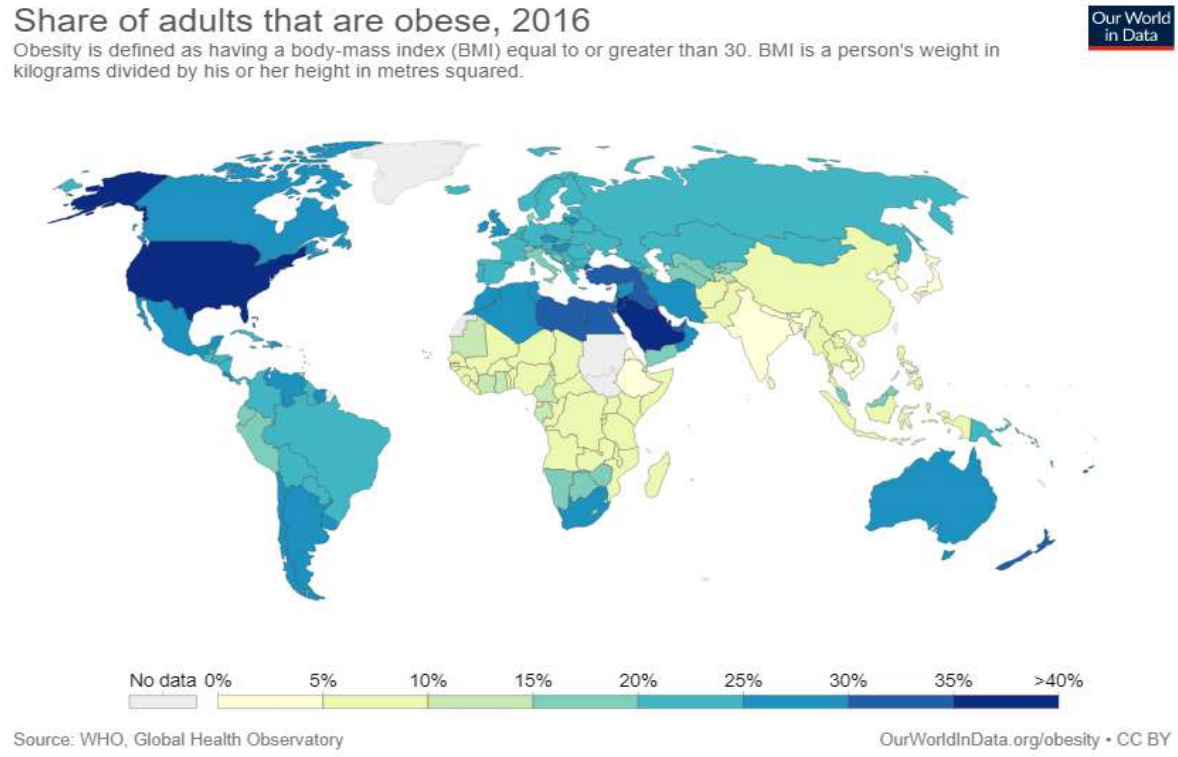
In the USA, Department of agriculture in 2008 worked out 4 categories of food plans in a study: thrifty, low, medium and high. The lowest cost thrifty food plan was estimated at about $600 per month per person. A balanced nutritious diet with variability and taste would likely cost $1000 per month per adult in USA. If purchasing power parity conversion factor is used, this would be about Rs 5000 per month per person in India.

On Health and illness

Individual Health dimensions include physical, physiological, mental, psychological, spiritual, sexual and social. An individual exists within a society and in this world. Hence welfare, political and environmental health also have long term contributions on an individual's health. There is no perfect health and death is the other end of the spectrum.

Heredity, maternal and paternal health and welfare and social supports provide the starting elements of one's health. Good enough familial bonding, normal development, good nutrition and exercise provide the growing factors. Good enough education, progress in life pursuits, resilience to reasonable life struggles, survival aptitude, wisdom, good breathing, diet and exercise, awareness and regulation of one's mind, abstinence from life excesses (injuries from sports and adventure, accidents, addictions etc) are some ingredients in maintaining reasonable health. This is neither comprehensive nor all-inclusive in defining the elixir of life nor a Utopic recipe for perfect health. Even the best athletes of their time have later life illnesses. People with enough financial purchasing power sometimes still entirely cannot treat their illness. Despite all factors being conducive does not exclude one from ill health but reduces the statical probability of ill health and prolongs longevity and sail many more hardships relatively better.

Allopathy is an aetiological statistical science and many illnesses are multifactorial in aetiology. Most conditions have some genetic aetiology too which is currently untreatable although advances in gene therapy are underway. The treatment interventions are also hence an attempt to target multiple causation factors. Many illness conditions are poorly responsive to treatment as the efficacy is still in development. Chronic illness conditions vastly outnumber acute remitting conditions and, in such circumstances, other patient factors such as affordability, compliance and other lifestyle factors of the individual and their social environment play a bigger role. Most chronic conditions related treatments are adjusted to improving quality of patient life and providing personalised patient and family centred care. As the chronicity of one condition increases, it leads to the development of other medical conditions. This phenomenon is now being studied under specialised branch of network physiology. Obesity is a complicating factor for all conditions; both a cause and effect. Central obesity increases diabetic and cardiovascular risks.



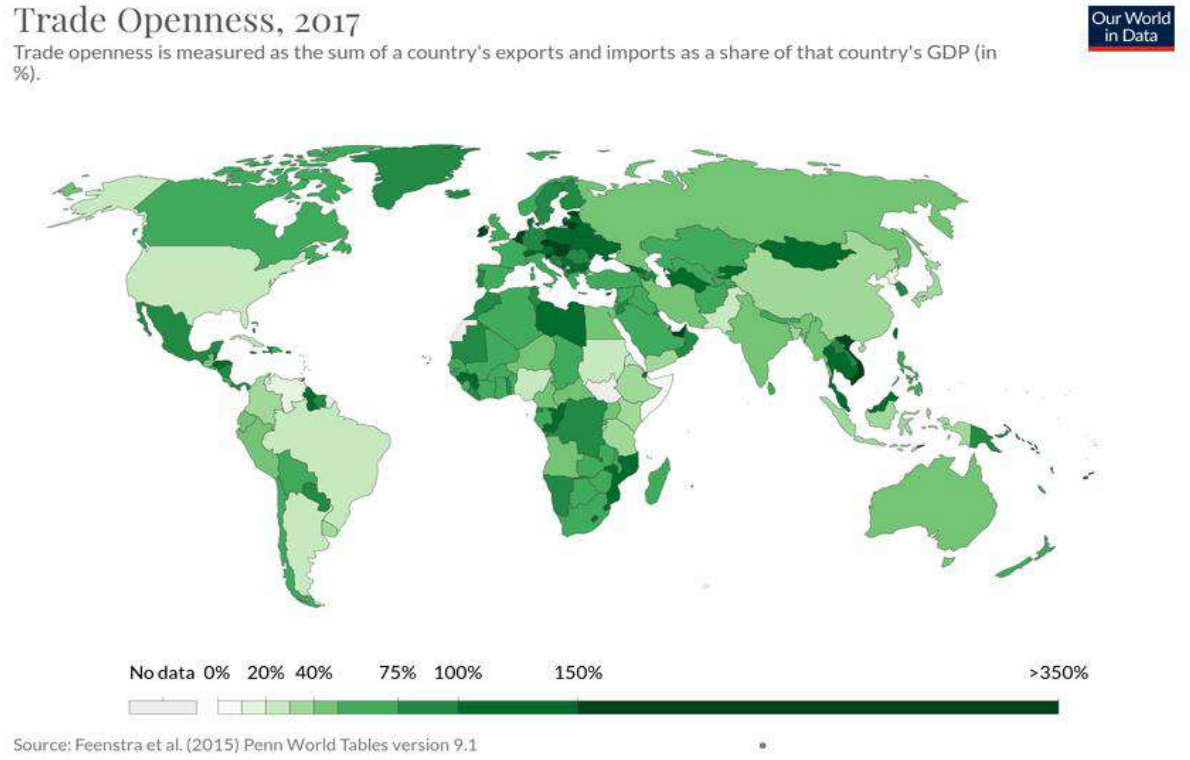
Healthcare delivery models are also very diverse across the world catering to demographic, environment, financial feasibility and provision, patient and clinician expectations, workforce availability and welfare availability of a country. There are also infrastructure and management approaches that vary widely across healthcare facilities although less so with current industry approaches to productivity, safety, quality and feasibility (automation, surveillance, feedback, continuing professional development, emphasis on efficacy, value, financial models, social engineering, psyops and teamwork)

The International Classification of Diseases, edition 11, version May 2019 provides an inclusive classification of all medical conditions. There are 55,000 unique codes in this classification although some are not disease related. A lancet study in 2015 estimated that only 5% of the world's population had no illness that year and 1/3 of the population has more than 5 ailments. On average, an individual provides ~ 10% of their lifetime as a care giver to an elderly.

Just as multiple layers of treatment, second opinions, further treatment, medicinal types, caregivers and life adjustments can be provided in ill health; same can be the case for achieving good health but in the opposite direction. There are health spas, biometric assessment centres for body physiology, various health improvement styles, diets and exercise/sports/adventure training to achieve better health. Reasonable optimum health hence is a disease-free state that is of good functional reserve to allow an individual to pursue reasonable life goals.

On Culture

It is a wide mix of social behaviours and norms of a society. Every relative culture has peaks and troughs and sudden disruptions as is shown in history. Colonial times and the Industrial revolution were the most-dense episodes of sudden global cultural shifts. The new wave is of globalisation since the 1980's which brings about change internally in a society and draws individuals out to external societies.



Further research is in progress. Cultural evolution is another field in development applying evolutionary principles to the study of culture. The culture of a society is the inclusive life of its people at a certain period in time. There are unfortunately no detailed established metrics to view this vibrancy apart from its socio-economic development.

The personality of an individual is significantly affected by their culture and the degree of its adoption in their lifestyle. Significant changing trends in the culture of a society has a heavy impact on the individual's adaptation to the society; especially in the global era of increased access to movement and potential migrations.

Culture is studied in anthropology and a ten-scale model of culture is construed.

1 = None
2 = Mnemonic or nonwritten records
3 = True writing

Scale 2: Fixity of residence
1 = Nomadic
2 = Seminomadic
3 = Sedentary

Scale 3: Agriculture
1 = None
2 = 10% or more, but secondary
3 = Primary

Scale 4: Urbanization (largest settlement)
1 = Fewer than 100 persons
2 = 100–399 persons
3 = 400+ persons

Scale 5: Technological specialization
1 = None
2 = Pottery
3 = Metalwork (alloys, forging, casting)

Scale 6: Land transport
1 = Human only
2 = Pack or draft animals
3 = Vehicles

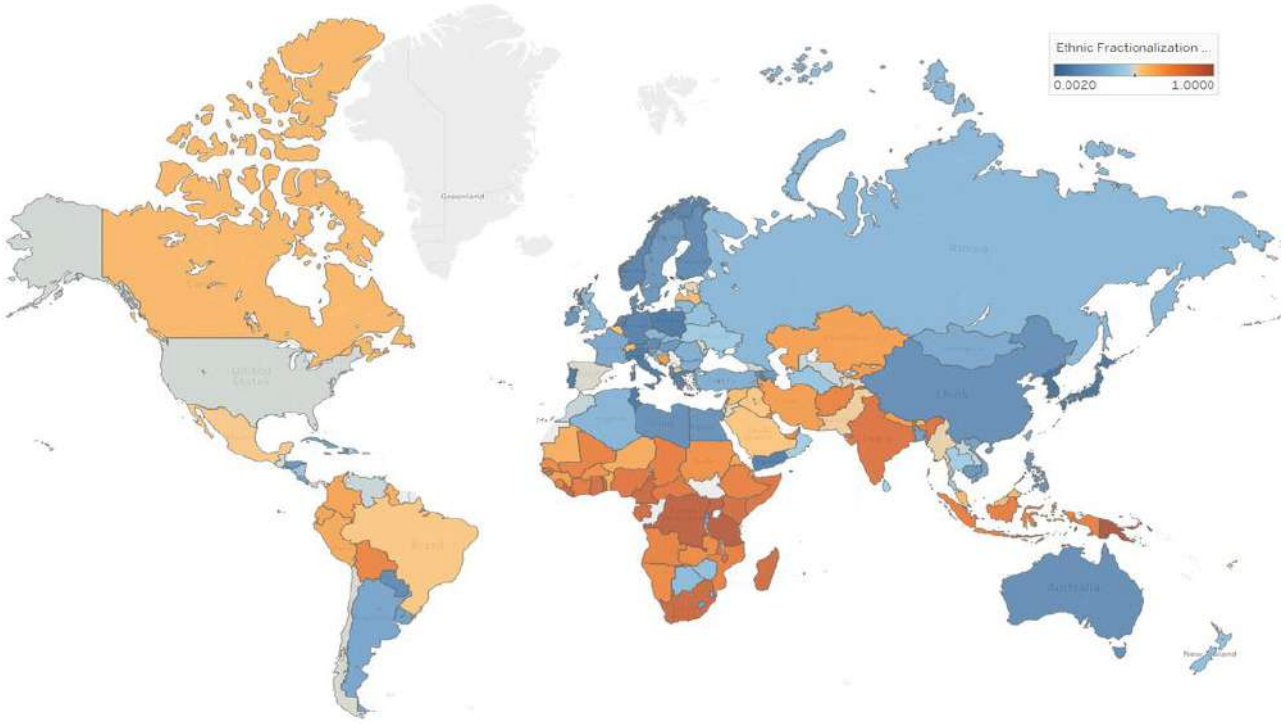
Scale 7: Money
1 = None
2 = Domestically usable articles
3 = Currency

Scale 8: Density of population
1 = Less than 1 person/square mile
2 = 1–25 persons/square mile
3 = 26+ persons/square mile

Scale 9: Political integration
1 = Autonomous local communities
2 = 1 or 2 level above community
3 = 3 or more levels above community

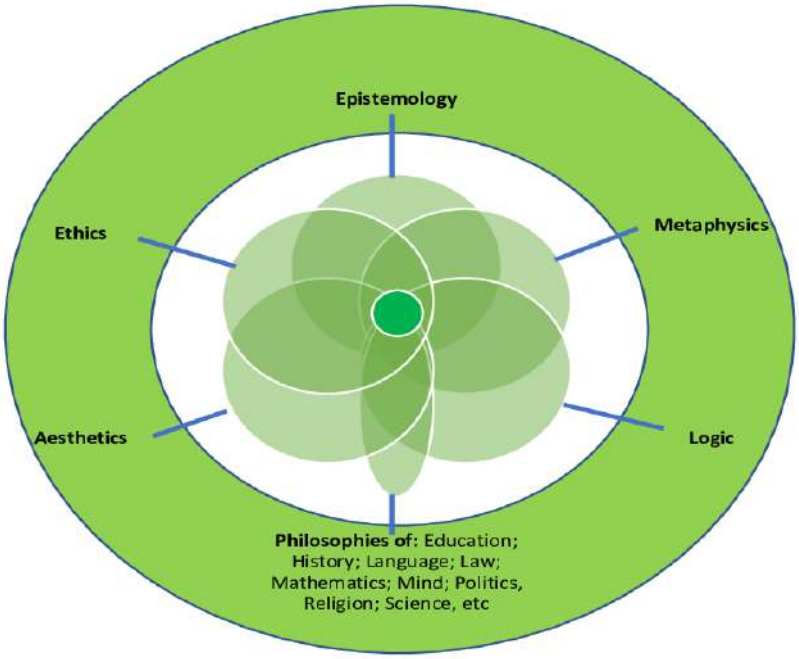
Scale 10: Social stratification
1 = Egalitarian
2 = 2 social classes
3 = 3 or more social classes or castes

Fearon's analysis uses levels of ethnic, cultural, linguistic and religious fractionalization to describe ethnic and cultural diversity. The trend here appears to be that economic development is not conducive for cultural diversity (exceptions noted)



On Philosophy

It is the human interest on nature of knowledge, reality and existence. These early ponderings eventually gave off shoots to several independent subjects. The exchange of ideas between individuals and civilisations over time has now led to several interconnected disciplines.



Prof Favley (Research Gate)

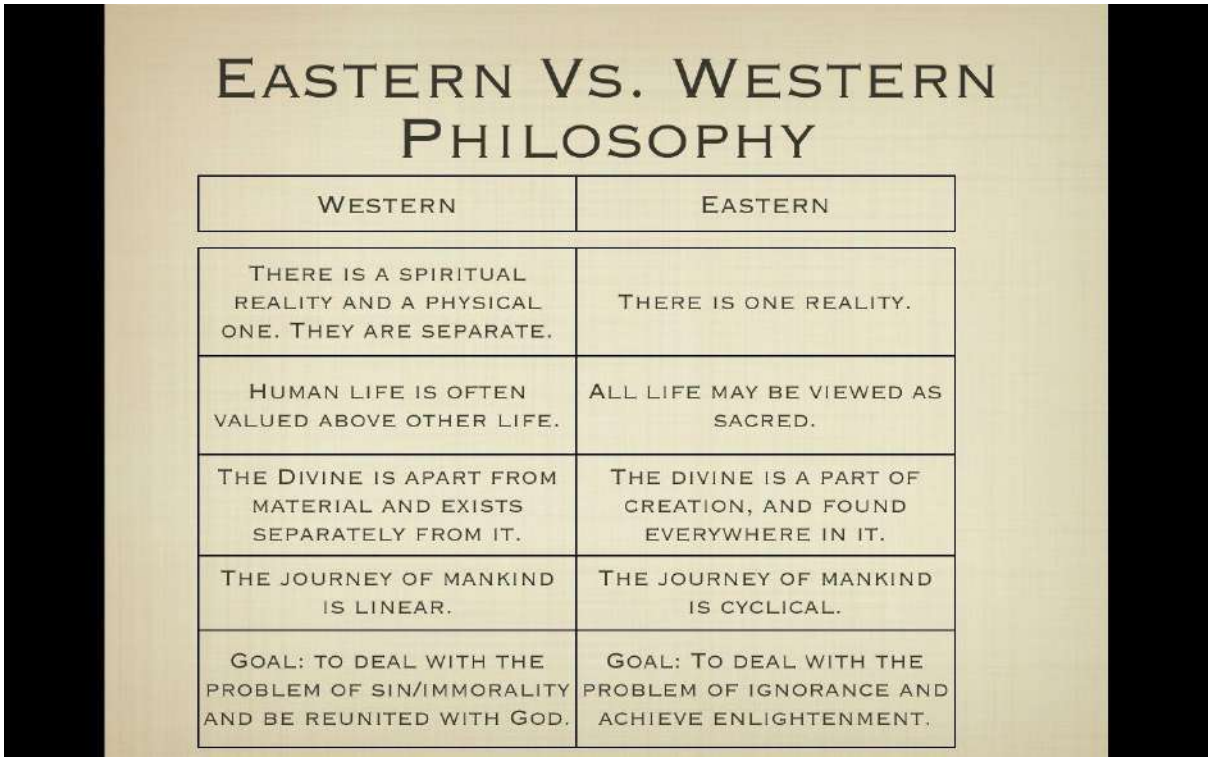
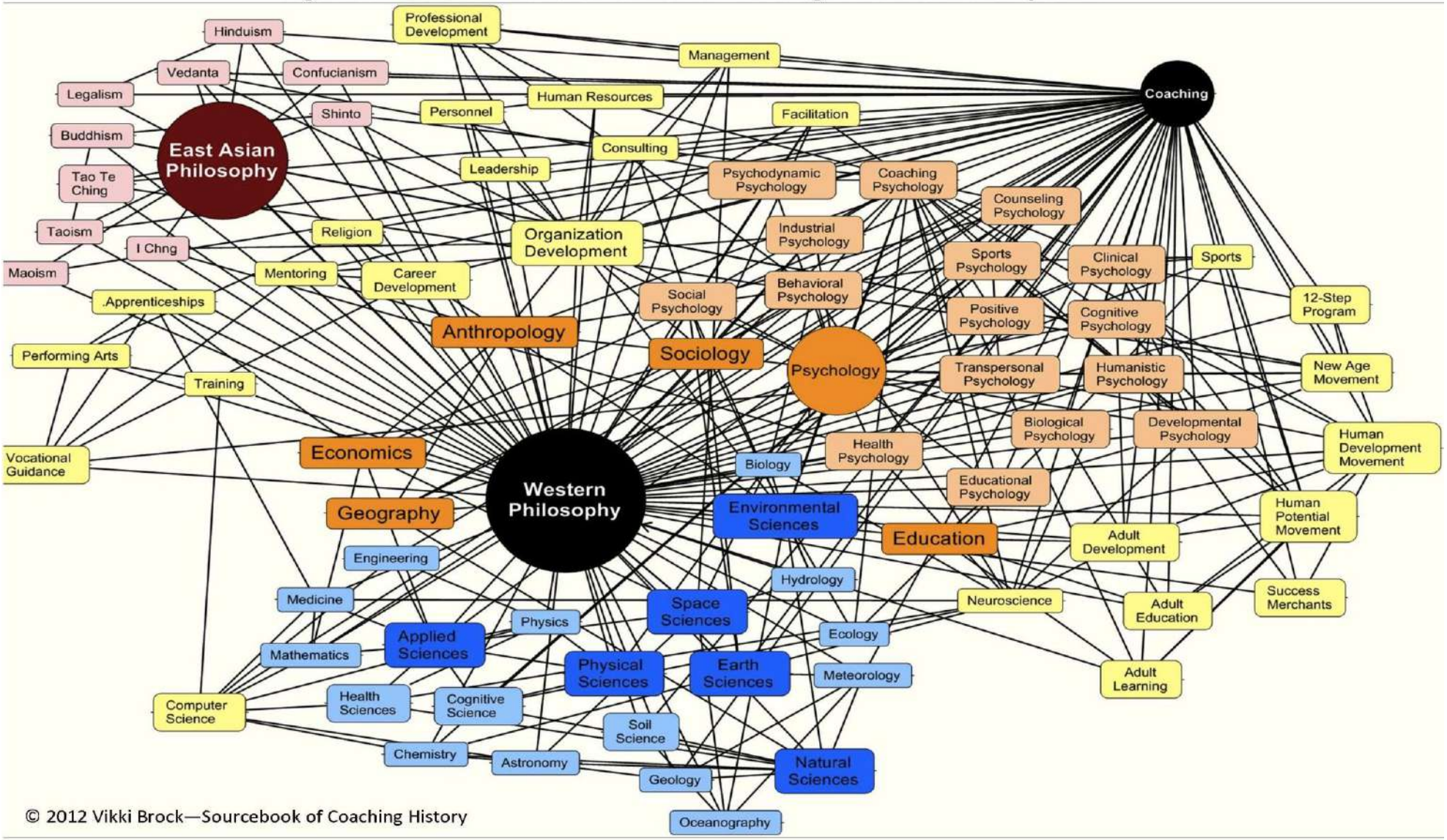
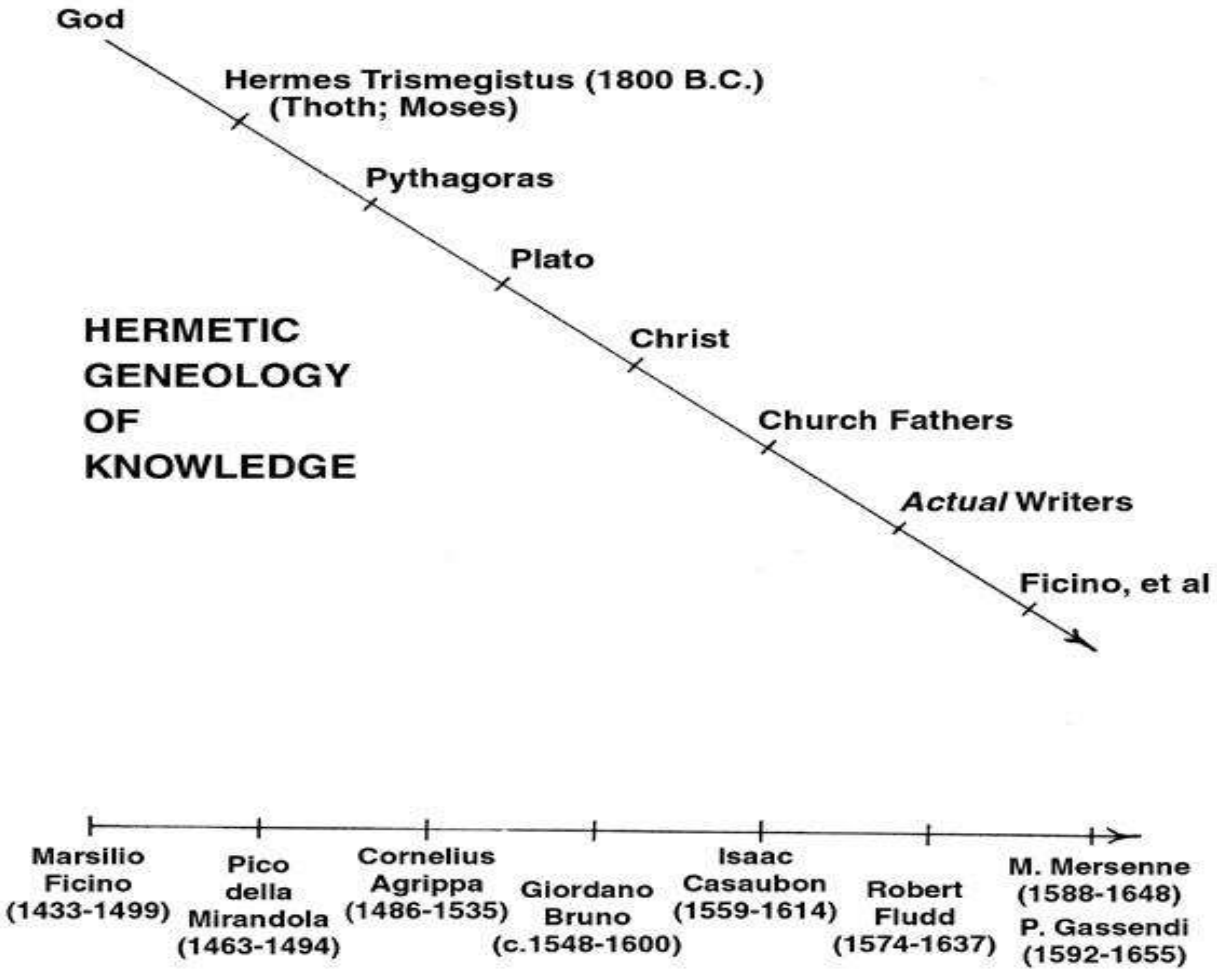


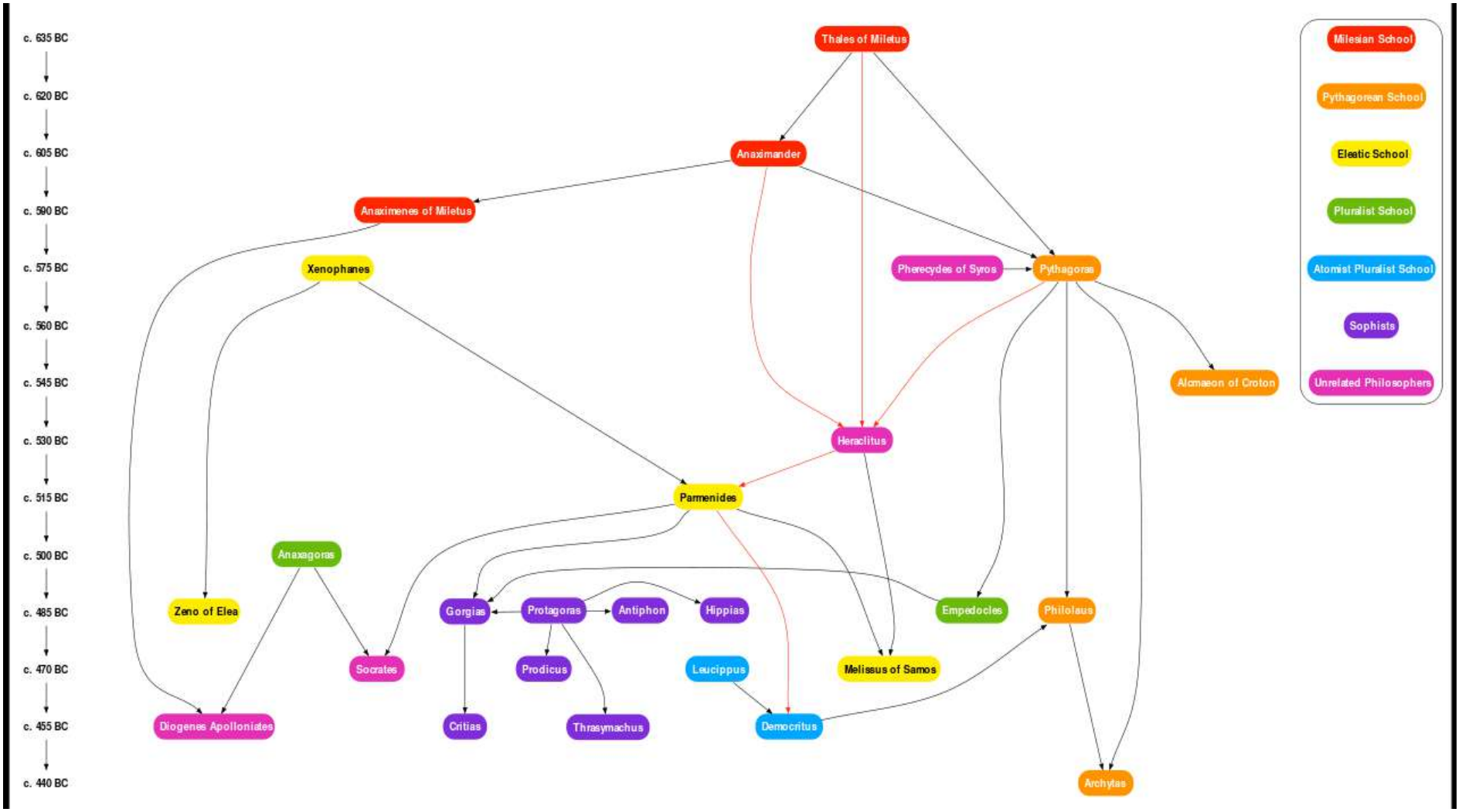
Figure 4 Interconnections between coaching and its root disciplines



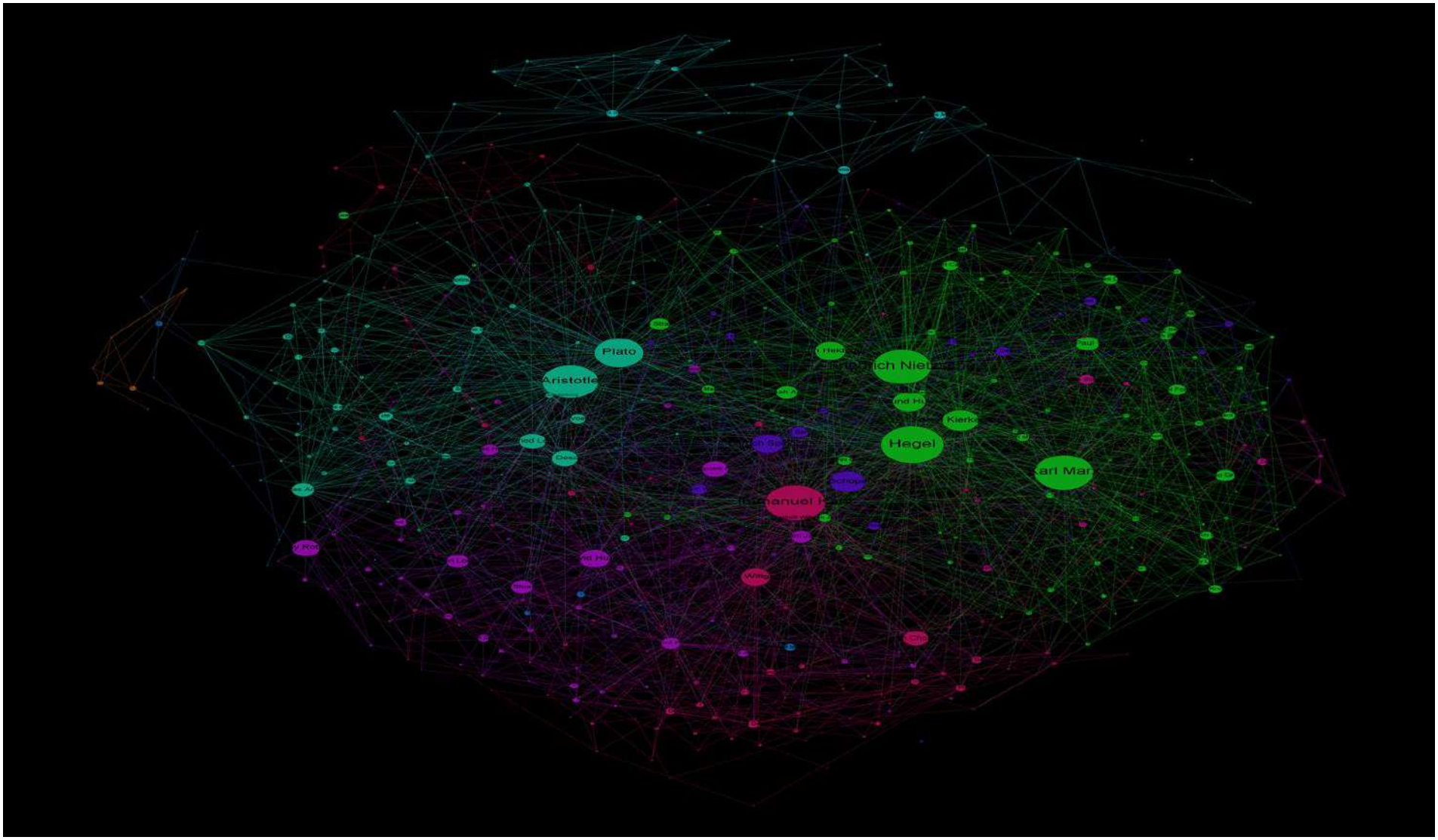


A timeline of western philosophy with basic elements:

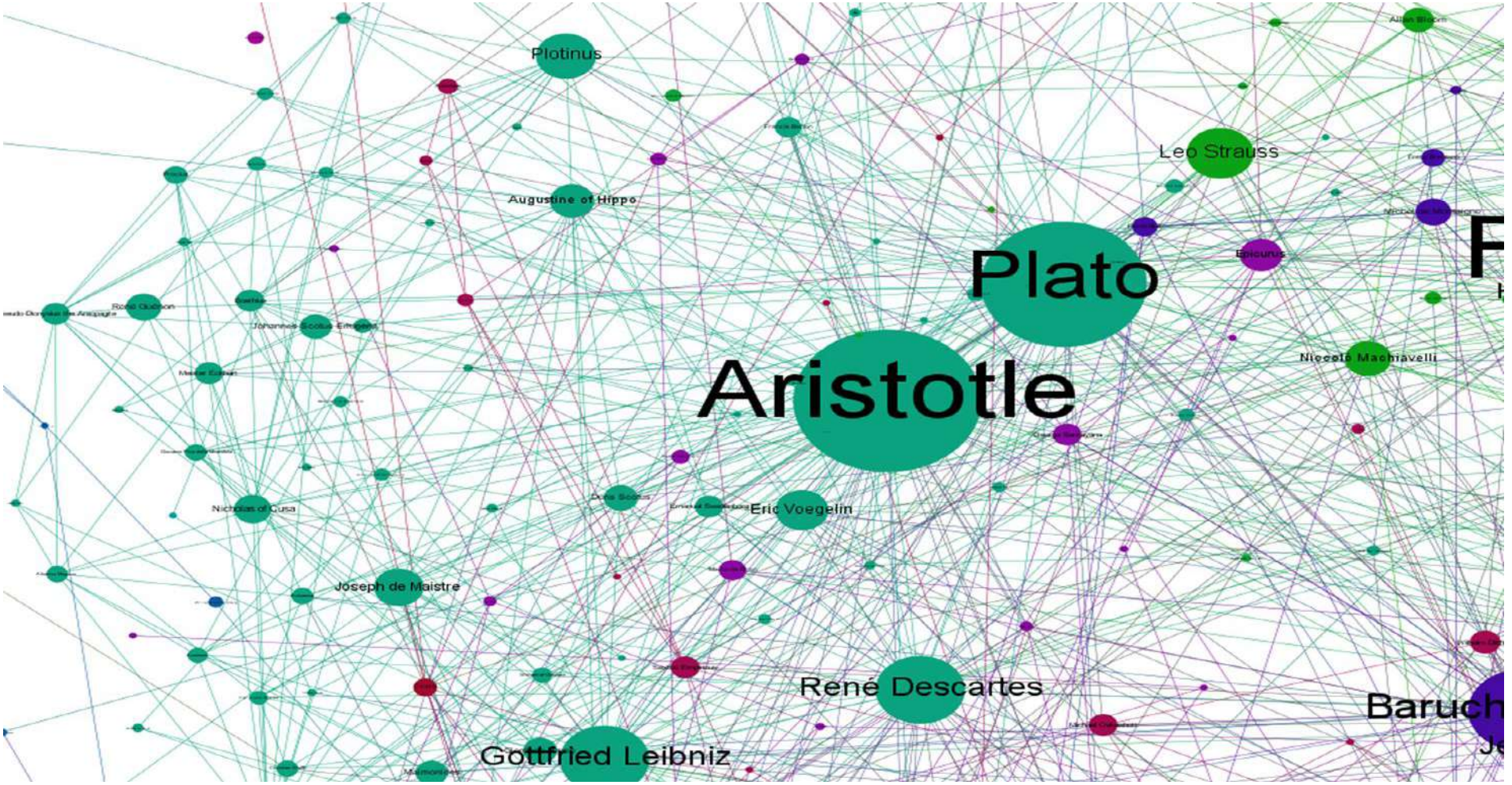
https://visual.ly/community/Infographics/education/history-philosophy



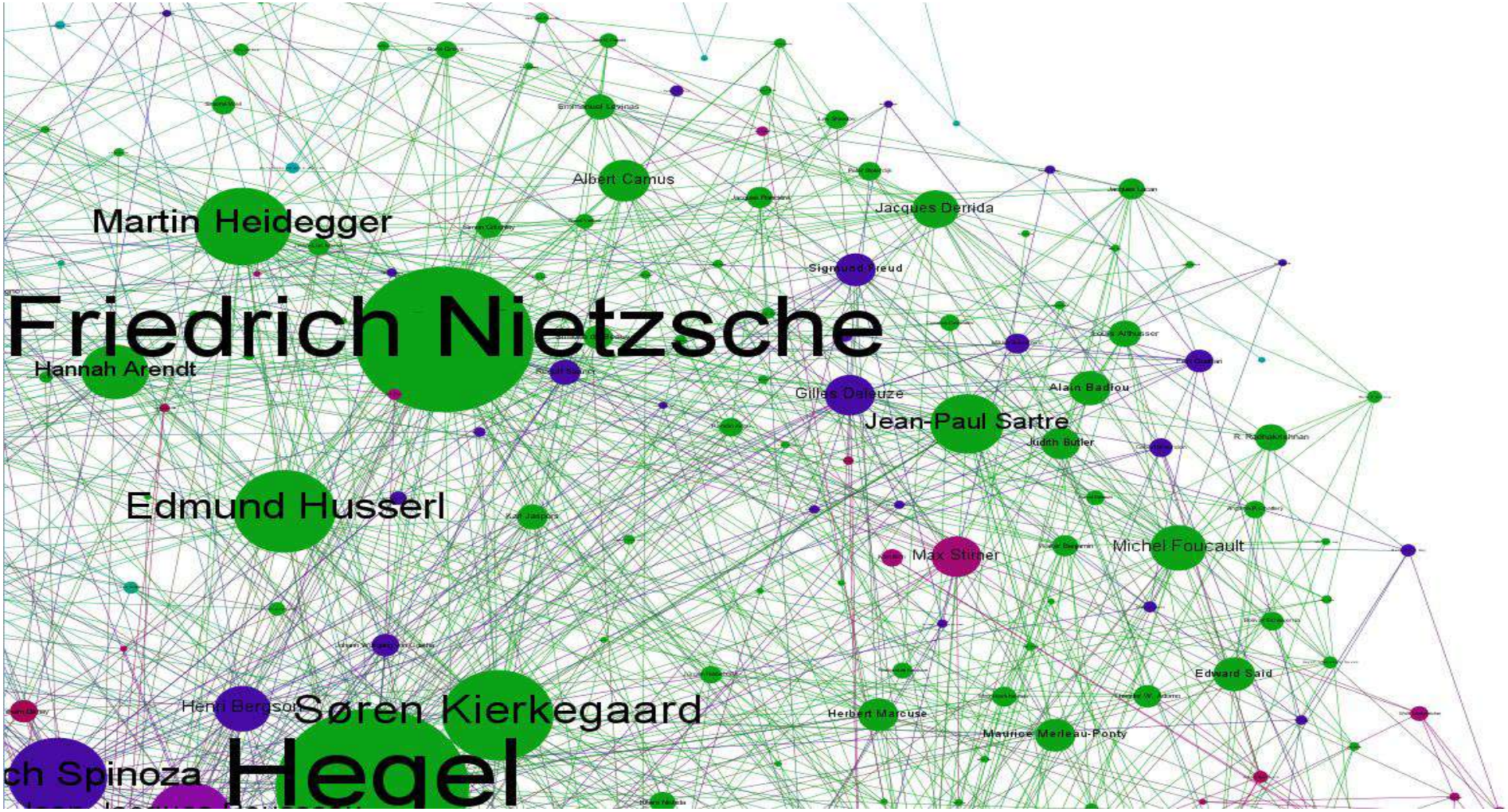
Hellenistic Philosophers



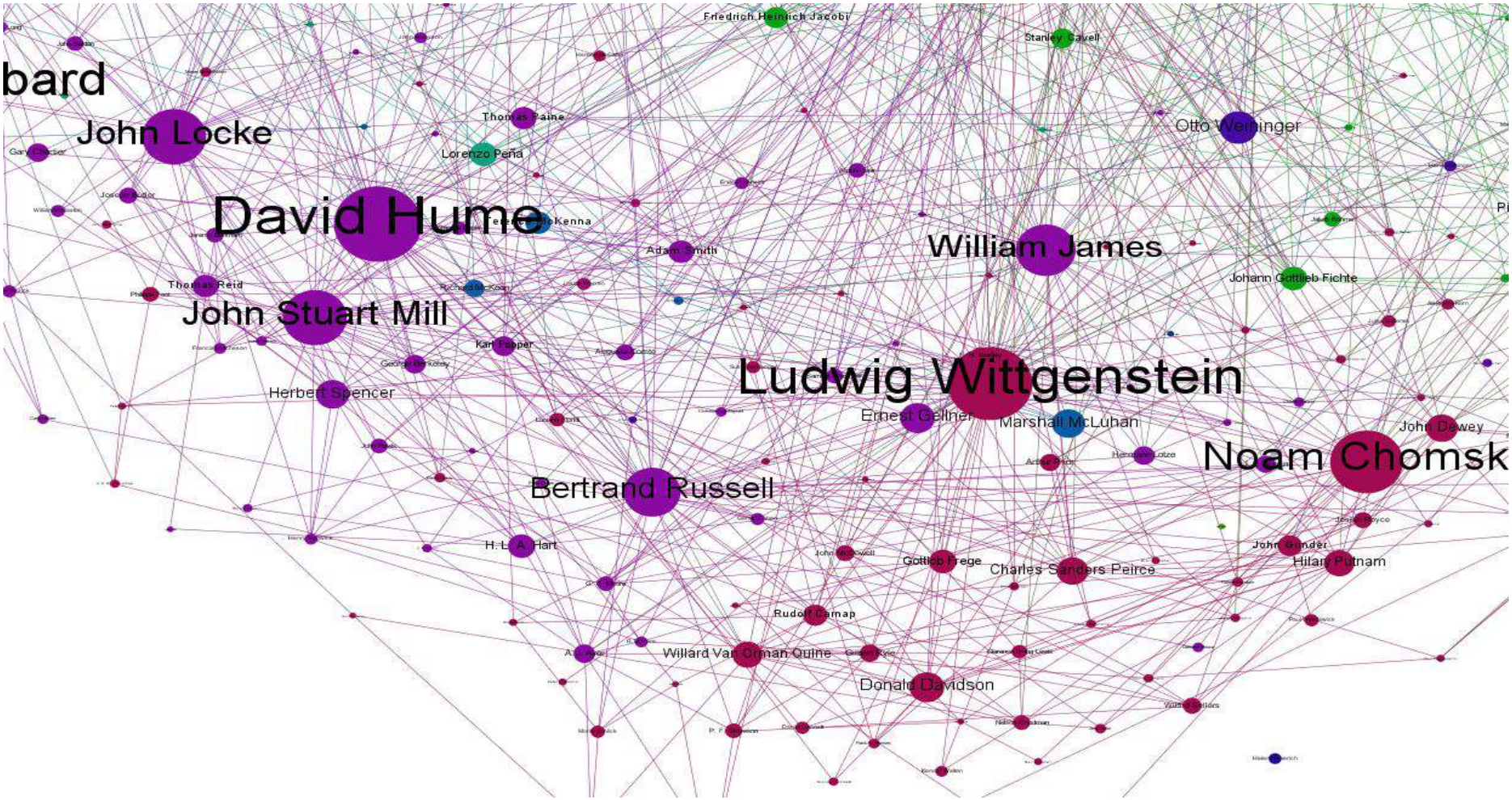
Western Philosophy interconnections



Ancient and Medieval Philosophy



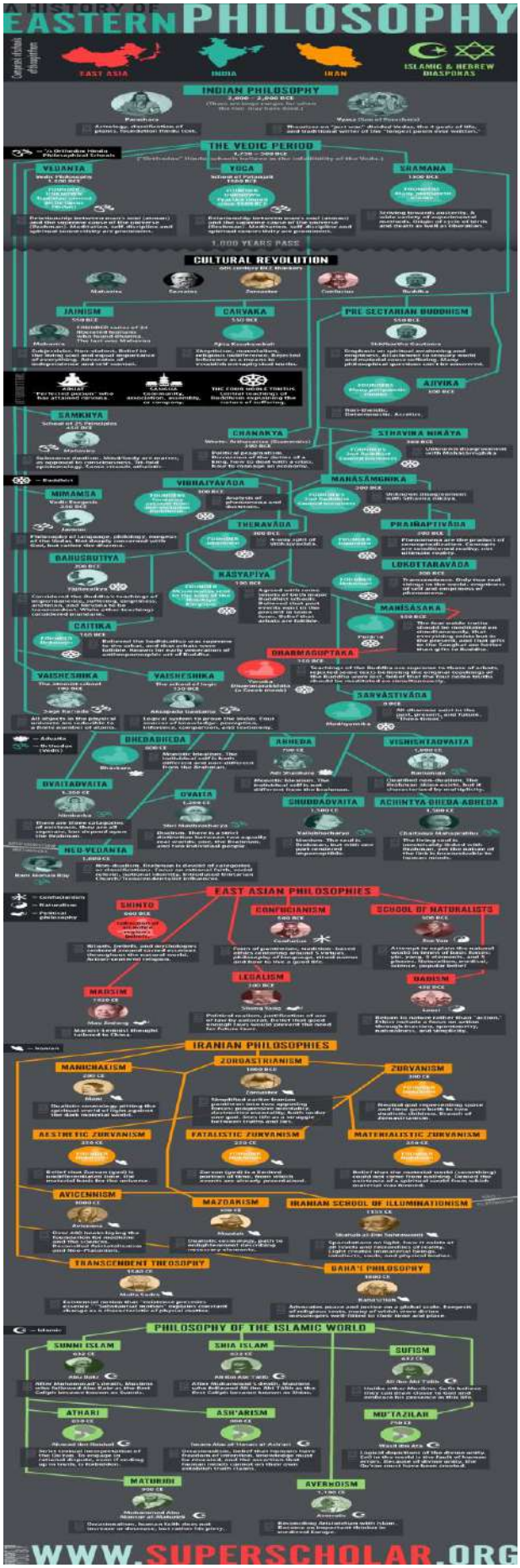
Continental Tradition

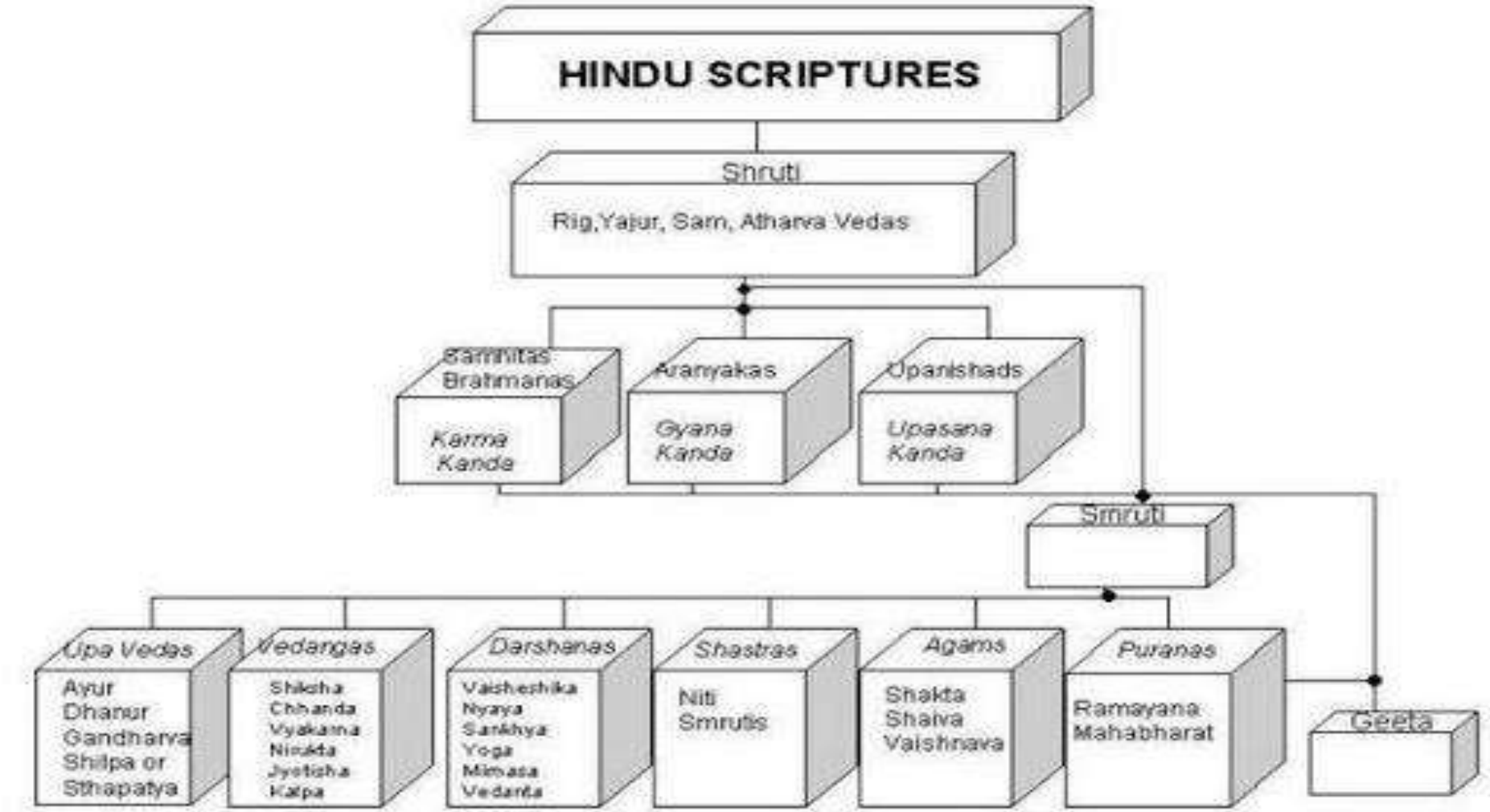


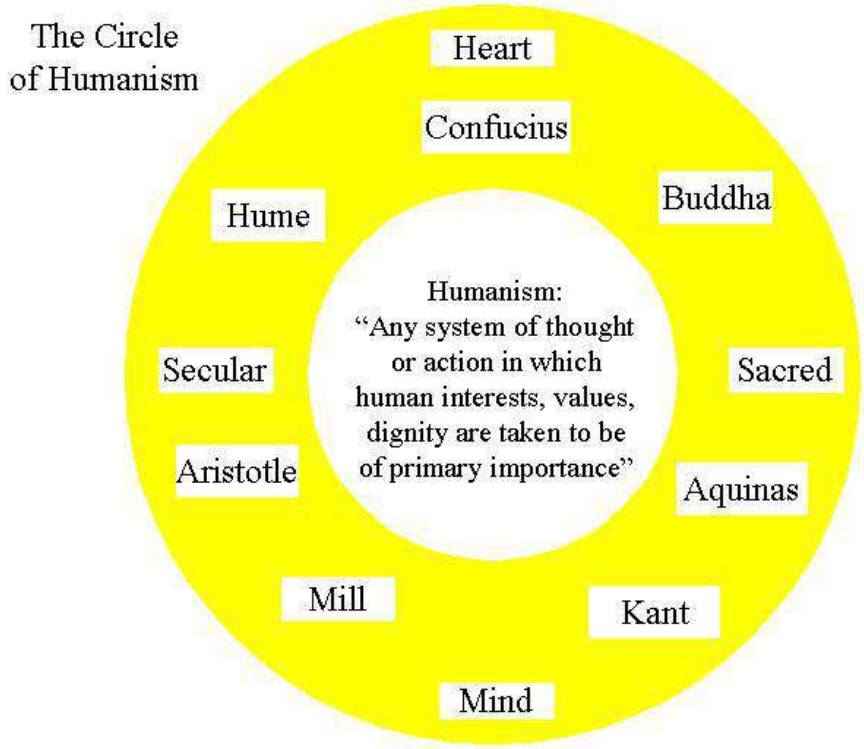
British empiricism, American Pragmatism and Analytical tradition

Eastern Philosophy

Timeline of eastern philosophy with basic elements: https://visual.ly/community/infographic/history/history-eastern-philosophy


A HISTORY OF
EASTERN PHILOSOPHY
EAST ASIA
INDIA
IRAN
ISLAMIC & HEBREW DIASPORAS
INDIAN PHILOSOPHY
THE VEDIC PERIOD
VEDANTA
YOGA
ŚRAMANA
CULTURAL REVOLUTION
JAINISM
CARVAKA
PRE SECTARIAN BUDDHISM
AJIVIKA
SAMKHYA
CHANAKYA
SUTRAVADA NIKAYA
MAHASAMGHIKA
VIBHAJYAVADA
MIMAMSA
THERAVĀDA
PRAJÑAPTIVĀDA
BAHUSRUTIYA
LOKOTTARAVADA
KASYAPIYA
MAHISASAKA
CAITIKA
DHARMAGUPTAKA
VAISHESHIKA
SARVĀSTIVĀDA
BHEDABHEDA
ABHEDA
VISHISHTADVAITA
DVAITADVAITA
DVAITA
SHUDDADVAITA
ACHINTYA BHEDA ABHEDA
NEO-VEDANTA
EAST ASIAN PHILOSOPHIES
SHINTO
CONFUCIANISM
SCHOOL OF NATURALISTS
LEGALISM
MOHISM
DAOISM
IRANIAN PHILOSOPHIES
MANICHAEISM
ZOROASTRIANISM
ZURVANISM
AESTHETIC ZURVANISM
FATALISTIC ZURVANISM
MATERIALISTIC ZURVANISM
AVICENNISM
MAZDAKISM
IRANIAN SCHOOL OF ILLUMINATIONISM
TRANSCENDENT THEOSOPHY
BAHA'I PHILOSOPHY
PHILOSOPHY OF THE ISLAMIC WORLD
SUNNI ISLAM
SHIA ISLAM
SUFISM
ATHARI
ASH'ARISM
MU'TAZILAH
MATURIDI
AVERROISM
WWW.SUPERSCHOLAR.ORG

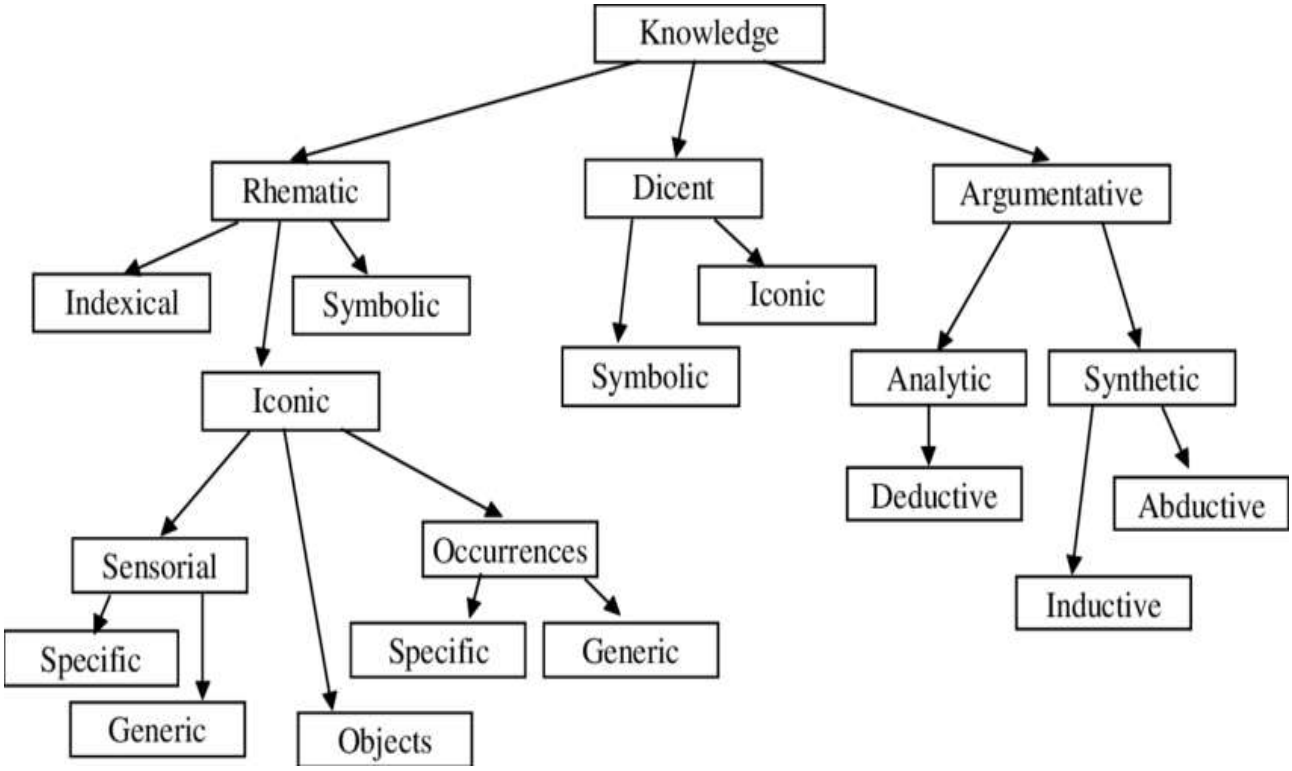

HINDU SCRIPTURES
Shruti
Rig,Yajur, Sam, Atharva Vedas
Samhitas
Brahmanas
Karma
Kanda
Aranyakas
Gyana
Kanda
Upanishads
Upasana
Kanda
Smruti
Upa Vedas
Ayur
Dhanur
Gandharva
Shilpa or
Sthapatya
Vedangas
Shiksha
Chhanda
Vyakarna
Nirukta
Jyotisha
Kalpa
Darshanas
Vaisheshika
Nyaya
Sankhya
Yoga
Mimasa
Vedanta
Shastras
Niti
Smrutis
Agams
Shakta
Shaiva
Vaishnava
Puranas
Ramayana
Mahabharat
Geeta



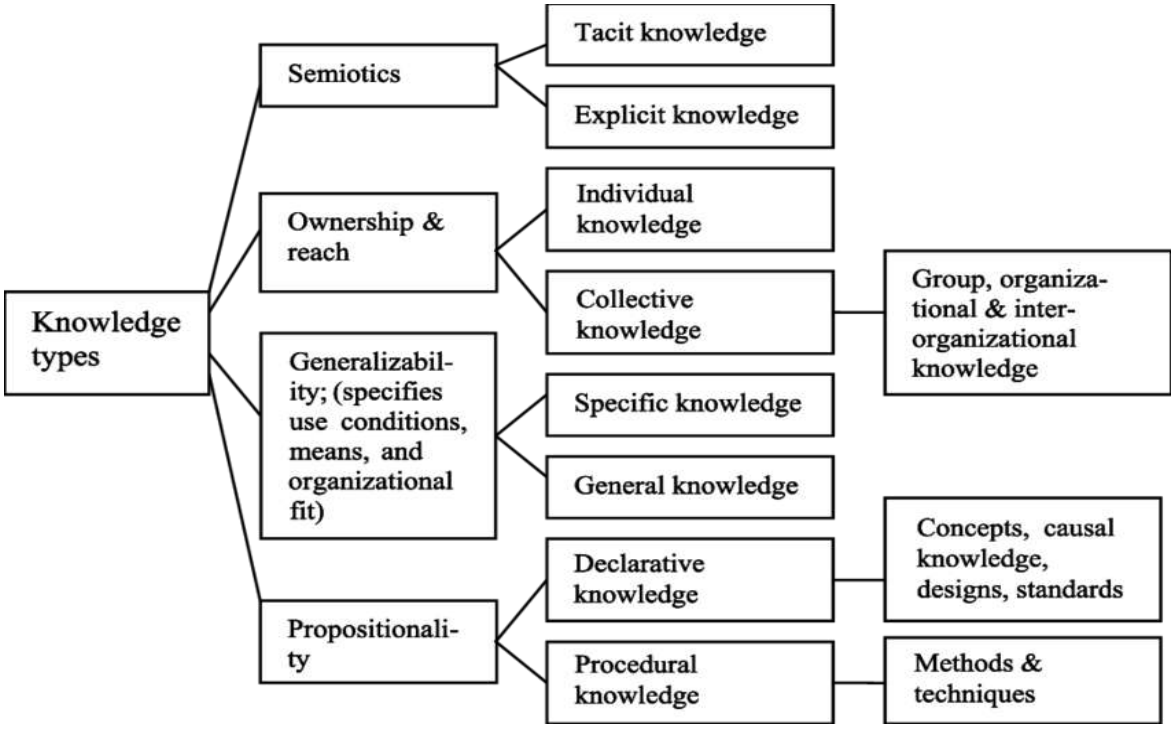
An example of how similar and continuous certain themes are having originated at different times and places

On Knowledge

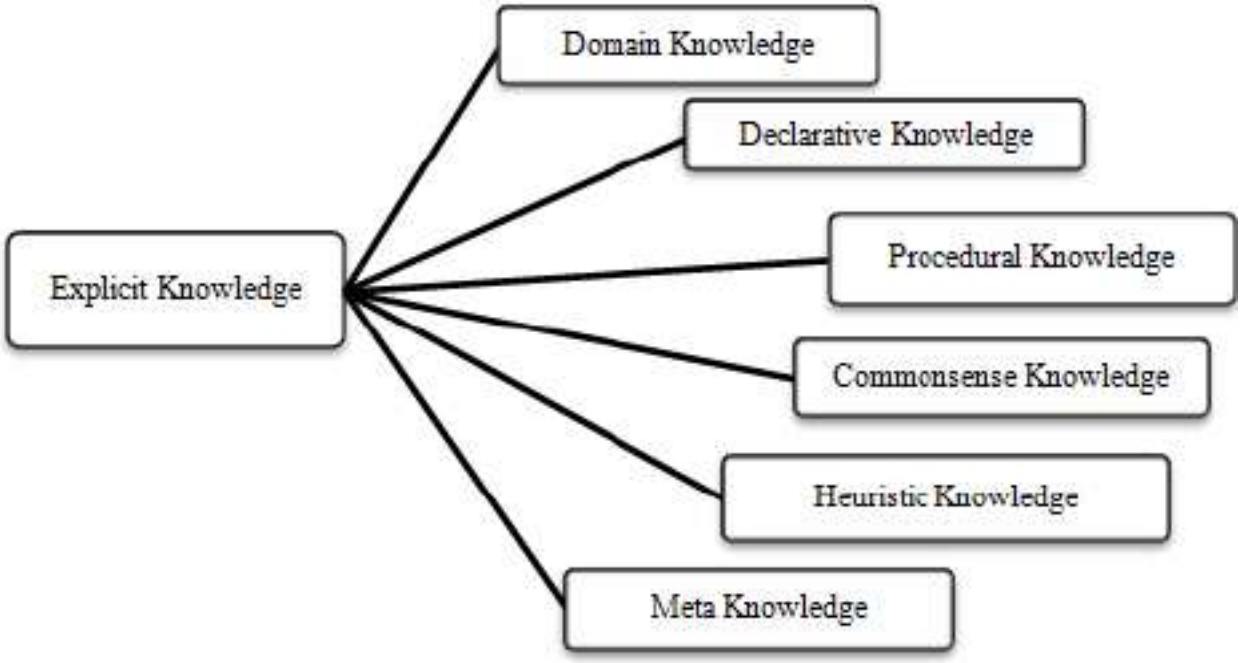
There are many attempts to organise the body of knowledge available in human history from time to time and is extensive in content.



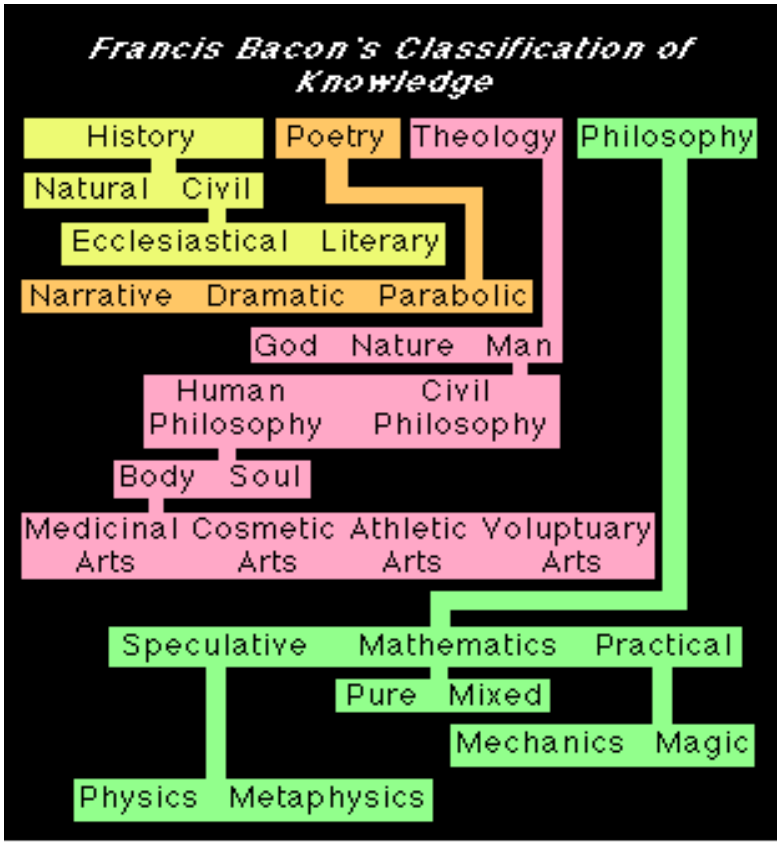
Classification of Elementary Knowledge (Research Gate)

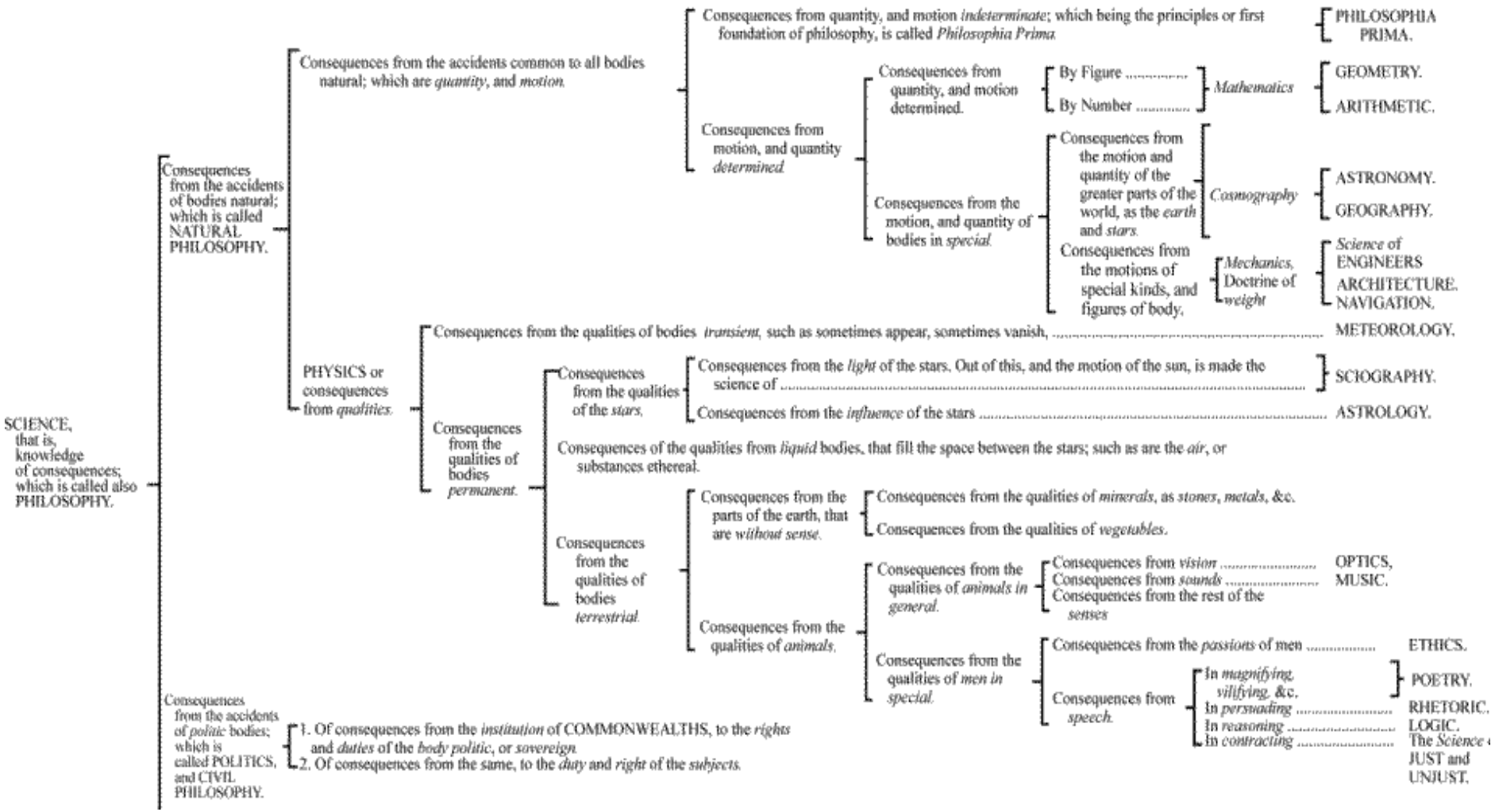


Fons Wijnhoven (Research Gate)

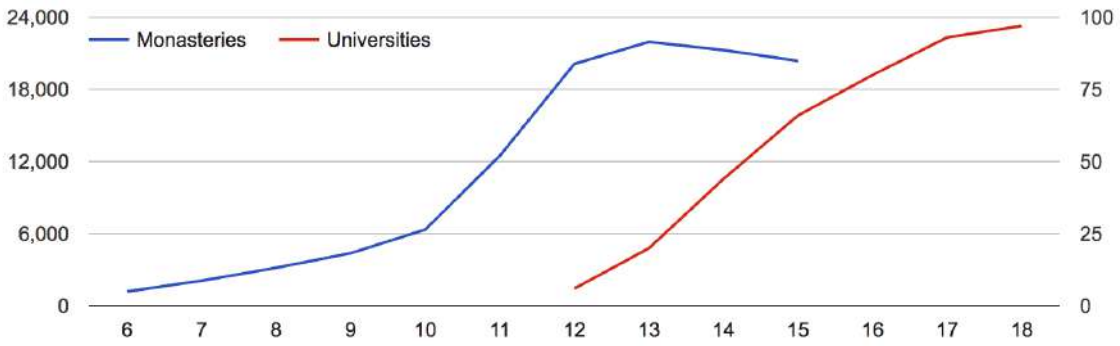


Classification of Explicit Knowledge

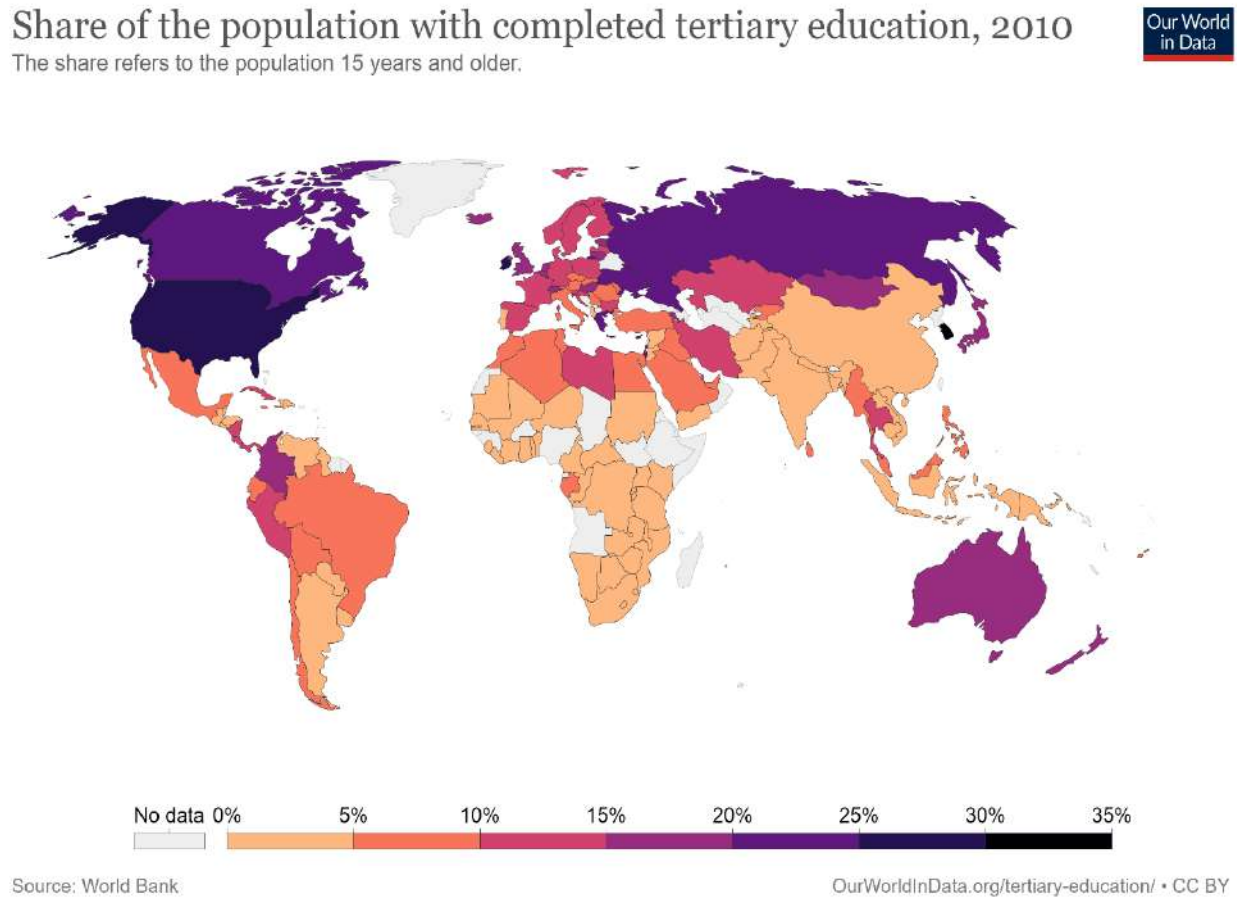


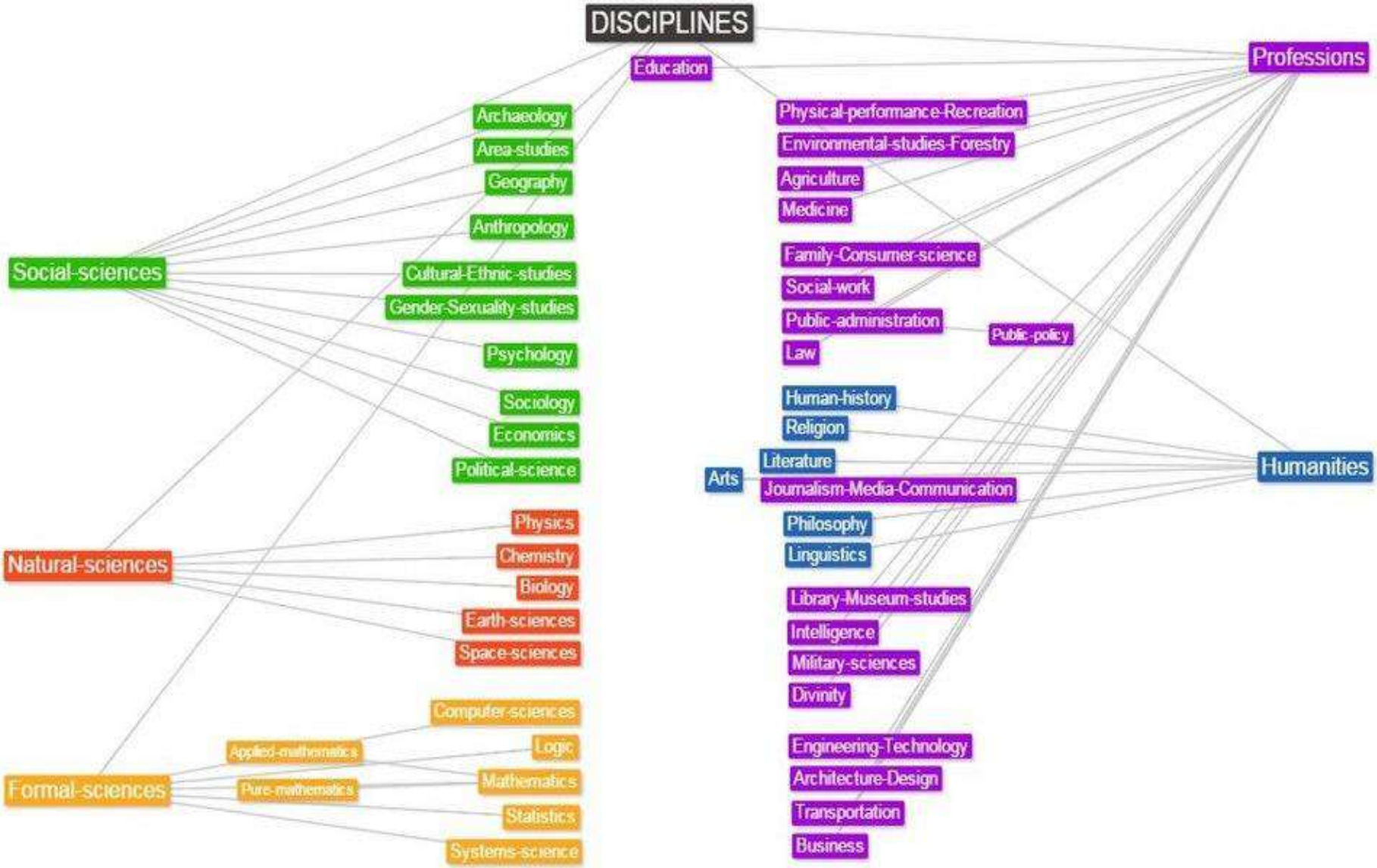

SCIENCE, that is, knowledge of consequences; which is called also PHILOSOPHY.
Consequences from the accidents of bodies natural; which is called NATURAL PHILOSOPHY.
Consequences from the accidents common to all bodies natural; which are *quantity*, and *motion*.
Consequences from quantity, and motion *indeterminate*; which being the principles or first foundation of philosophy, is called *Philosophia Prima*.
PHILOSOPHIA PRIMA.
Consequences from motion, and quantity *determined*.
Consequences from quantity, and motion determined.
By Figure
By Number
Mathematics
GEOMETRY.
ARITHMETIC.
Consequences from the motion, and quantity of bodies in *special*.
Consequences from the motion and quantity of the greater parts of the world, as the *earth* and *stars*.
Cosmography
ASTRONOMY.
GEOGRAPHY.
Consequences from the motions of special kinds, and figures of body.
Mechanics, Doctrine of *weight*
Science of
ENGINEERS
ARCHITECTURE.
NAVIGATION.
PHYSICS or consequences from *qualities*.
Consequences from the qualities of bodies *transient*, such as sometimes appear, sometimes vanish,
METEOROLOGY.
Consequences from the qualities of bodies *permanent*.
Consequences from the qualities of the *stars*.
Consequences from the *light* of the stars. Out of this, and the motion of the sun, is made the science of
SCIOGRAPHY.
Consequences from the *influence* of the stars
ASTROLOGY.
Consequences of the qualities from *liquid* bodies, that fill the space between the stars; such as are the *air*, or substances ethereal.
Consequences from the qualities of bodies *terrestrial*.
Consequences from the parts of the earth, that are *without sense*.
Consequences from the qualities of *minerals*, as *stones*, *metals*, &c.
Consequences from the qualities of *vegetables*.
Consequences from the qualities of *animals*.
Consequences from the qualities of *animals in general*.
Consequences from *vision*
Consequences from *sounds*
Consequences from the rest of the *senses*
OPTICS,
MUSIC.
Consequences from the qualities of *men in special*.
Consequences from the *passions* of men
ETHICS.
Consequences from *speech*.
In *magnifying, vilifying*, &c.
POETRY.
In *persuading*
RHETORIC.
In *reasoning*
LOGIC.
In *contracting*
The *Science* of JUST and UNJUST.
Consequences from the accidents of *politic* bodies; which is called POLITICS, and CIVIL PHILOSOPHY.
1. Of consequences from the *institution* of COMMONWEALTHS, to the *rights* and *duties* of the *body politic*, or *sovereign*.
2. Of consequences from the same, to the *duty* and *right* of the *subjects*.

There are about 1800 academic majors globally. These further branch into minors with an indexing system of major Alphabet/s and 3 or 4 digits for identifying and standardising courses. The ISBN book numbering system was created in 1967 and now has a 13-digit numbering system for each book. Google estimate of number of books in the world is about 130 million. The ISSN number identifies newspapers and periodicals.



600AD-1800AD in Europe: Universities replacing Monasteries

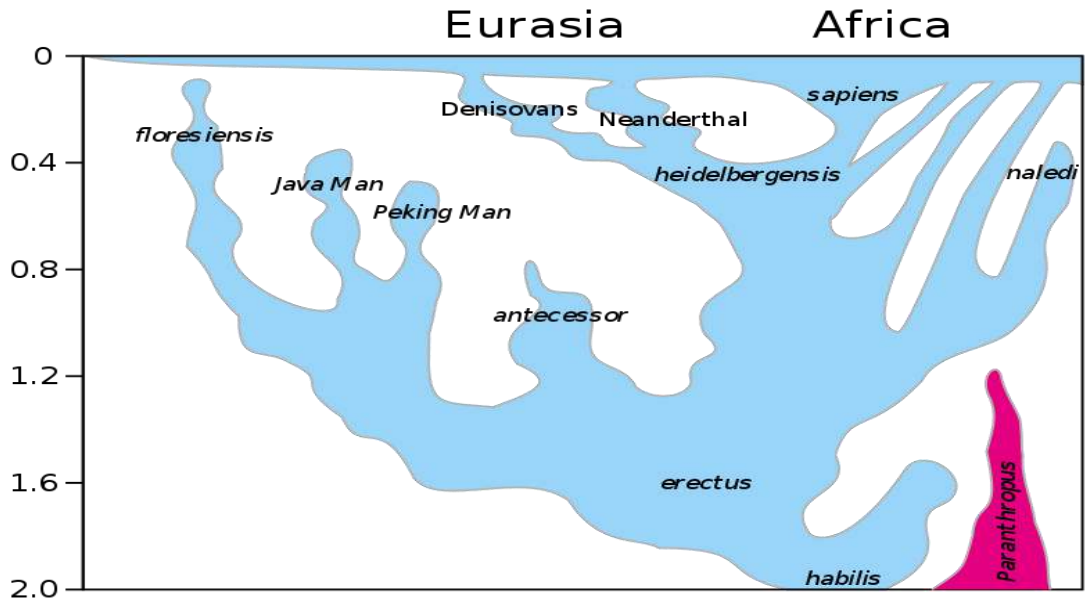



DISCIPLINES
Education
Professions
Archaeology
Area-studies
Geography
Anthropology
Social-sciences
Cultural-Ethnic-studies
Gender-Sexuality-studies
Psychology
Sociology
Economics
Political-science
Physical-performance-Recreation
Environmental-studies-Forestry
Agriculture
Medicine
Family-Consumer-science
Social-work
Public-administration
Public-policy
Law
Human-history
Religion
Literature
Arts
Journalism-Media-Communication
Philosophy
Linguistics
Humanities
Physics
Chemistry
Biology
Earth-sciences
Space-sciences
Natural-sciences
Library-Museum-studies
Intelligence
Military-sciences
Divinity
Computer-sciences
Applied-mathematics
Logic
Mathematics
Pure-mathematics
Statistics
Systems-science
Formal-sciences
Engineering-Technology
Architecture-Design
Transportation
Business

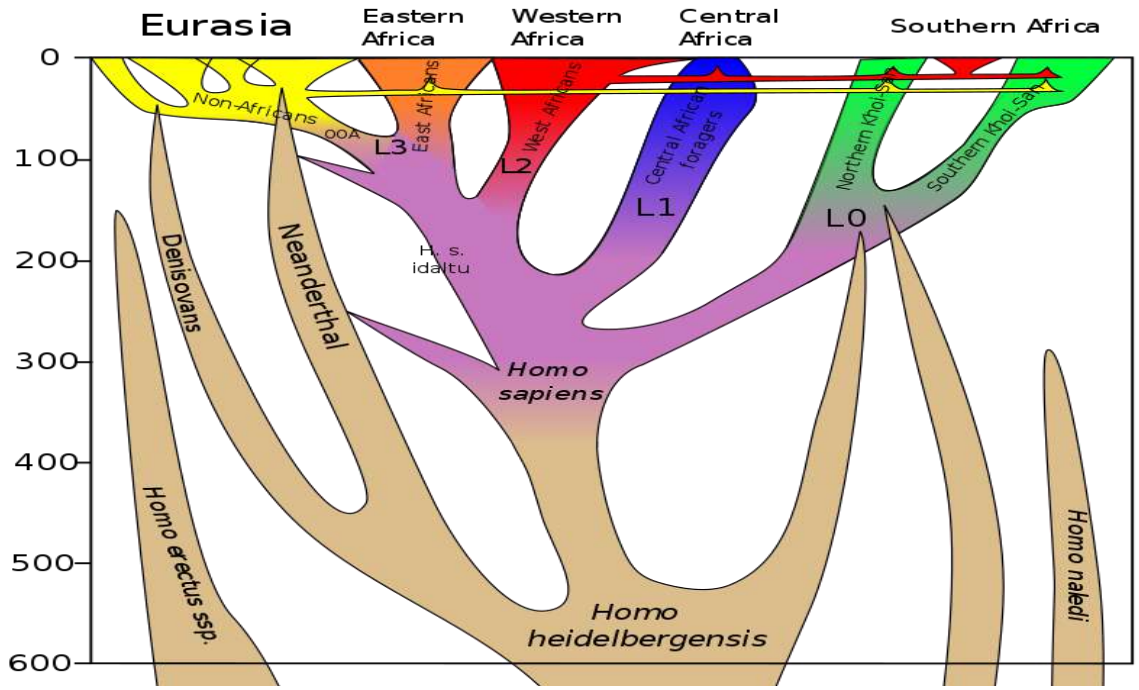
On Religion

In prehistoric times, wilderness, natural disasters and death were fear inducing. Animals in wilderness are exposed to similar natural events and social existence was the resort. Fear transitioned to awe for these phenomena and is postulated to have induced reverence to it. While a rational understanding to the experiences was slowly being made, there was symbolic representations of the fear and reverence inducing experiences. These were both for local circumstances and wider phenomena. However, on extending this pursuit for rational understanding, evolutionary explanations and the ever-infinite progress of knowledge and interactive kaleidoscope of ideas would imply there is no end point. Regarding religion, let's dive in a little to see what's happened so far.

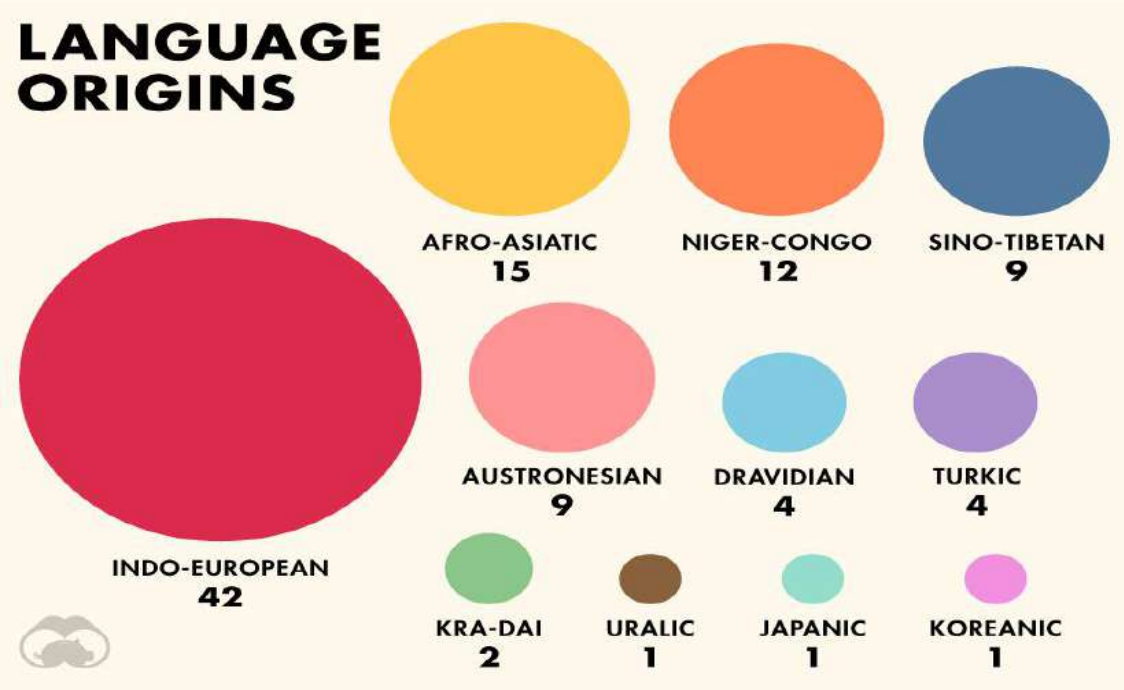
Human evolution from other life forms is believed to have commenced 2 million years ago from Africa. We have archaeological and genetic studies to build this story. Modern humans developed about 200,000 years ago in Africa. Anthropomorphic and zoomorphic statues began to be made from stone, some of these believed to be symbolic of Gods worshipped at the time and region. Humans showed burial practices of gradually increasing complexity between 100,000 to 10,000BC. The earliest cave paintings date back to about 65,000 years ago. Early spoken language, story-telling and music is believed to have shaped during this period. This slowly transitioned to larger burial grounds and to a site of worship associated with it, first noted in Turkey by 10,000BC



The first human species Homo Habilis is postulated to have evolved in Subsaharan Africa about 2.5 million years ago and as there was subspeciation over time, the hunter gatherers slowly migrated. The extant (last) human species Homo sapiens is believed to have evolved around Morocco about 300,000 years ago associated with a dramatic climate change around that time. Homo sapiens started moving out of Africa initially towards the Levant region of Asia about 100,000 years ago. As can be seen from the images, it was not a linear course in evolution and there was admixture of species subtypes, which is reported as often being violent in regions where they intersected.



Human evolution over 2 million years



Over the extensive human evolution, there now remains about 7000 human languages. Their percentage by population is shown above. It is postulated that the number of world languages will reduce over time

Earliest civilizations began developing around the world from about 5000BC with written languages developing, urban construction and huge structures being built over the next 3000 years (Indus Valley, Mesopotamia, Egypt, Britain and Ireland) still maintaining reverence to the dead. Written history and relics in civilization is mostly the history we relate to. The knowledge and cultural practices involving spoken traditions and music has little hard evidence; for example - the Vedic civilisation claims Rig

Veda as the oldest, and before it was written, it was an oral tradition over several generations passed in verses and singing. The oldest artefacts of written language are from around 3200BC with the Mesopotamian cuneiform script. This was also the start of the Egyptian dynasty.

There is no absolute definition for religion; however, we accept the common notion. Some underlying threads in religion are meaning to life, purpose, roots to existence, reverence to the Gods, faith, to reconnect, culture, personal and social conduct in a society, obligation, and have accountability. If we observe these extensive common threads, the themes appear to be philosophy, curiosity of nature, worship and order. The ancient Greeks had two contrasting words for this spectrum of experiences: *Threskeia* (loosely translated to religion) and *deisidaimonia* (excess fear). In other words; love for life vs the fear of life.

Ideas mature with interaction, spurn action, fruitful ones gather momentum, when there is momentum – there is grouping and organising, there is livelihood, regulation and scaling up. There is also a downward spiral and reformation. This is the normal trend for all human ideas even outside of religion. In ancient times, there were changing ideas regarding religion and regrouping over time. A lot of it is rephrased and revised in hindsight.

It is estimated that there are about 4000 religions in the world. The population demographics have changed in absolute and relative numbers, reducing trend in people expressing affiliation to specific religions; however, 85% of the world's population still expresses affiliation to a religion.

History of Religion

Earliest recorded evidence of religion is the Pyramid Text from Egypt from about 2500BC with reverence to the dead and prayers and rituals to guide the dead to the spirits of the Gods. The first known Monotheism is about 1350BC in Egypt. The vedas (Rig, Yajur, Sama, Atharva) are postulated to have been written between 1500BC to 1100BC. During the period 1200BC-600BC, the Vedic era produced the Upanishads which went on to form the central tenets of Hinduism, Buddhism and Jainism. The Greek Illiad and Odyssey were written about 800BC. The religion of the ancient Israelites was Judaism, practised before 700BC. The Hebrew canonicals were written around 600BC. The Romans worshipped their Gods and this was later known as Paganism. Mahavira (24th Tirtankara) of Jainism and Gautama Buddha of Buddhism were teaching around 500BC. At a similar time in Greeko-Roman history, the twelve Olympians were the revered Gods with Greek and Roman equivalents. With the fall of the Greeko-Roman empire and the rise of Abrahamic religions, polytheism and the previous Gods were no longer believed to be Gods and the word Paganism came to describe this. Zoroastrianism began around similar time in Persia and was the first example of a Monarch making a religion official in their empire at about 500BC. Socrates was convicted of moral corruption (asking and teaching his students politico-philosophical questions) and impiety (not believing the Gods of his time) about 400BC in Greece and was sentenced to death by drinking hemlock. Confuciansim began at about 500BC in China and the first Tao Te Ching was written about 300BC. Around 250BC Emperor Ashoka sent groups of Buddhists missionaries to eastern asia and Hellenistic world. Kami as a set of beliefs existed in Japan by 200BC which later became Shinto. Around 100BC, Patanjai in India composed the Yoga sutras.

The semitic religions all worshipped Abraham, their God. It was a monotheistic religion called Judaism. It then separated out into Jews (Rabbinic Judaism – 70AD onwards), Christians (1st century AD onwards – adopted by Roman Empire in 380AD) and Muslims (7th century AD onwards continued as the Caliphates Empire).

In the beginning of AD, Jesus of Nazreth lived in Israel and his followers convened the first Christian council after his crucification. The Roman armies besieged Jerusalem in 70AD and Judaism changed to Rabbinic Judaism. Gnosticism was formed by Iranian prophet Mani around 220AD. The Roman emperor Constantine wanted to settle matters of religious conflicts and called on The Edict of Milan in 313 AD, which decreed religious toleration in the Roman empire. He also convened the first ecumenical council in 325AD which confirmed the primacy of the sees of Rome (head of the world catholic church), Antioch, Alexandria and Jerusalem (head of the eastern orthodox Christianity, Eastern Europe and Asia). The Roman Empire declares Christianity (a west version) as the Empire's state religion in 380AD. The Greek old Testament (Septuagint), the Biblical Canon in Hebrew and a latin translation (Vulgate) was completed around 400AD. In the next 3 centuries, It was followed by the decline of Western Roman Empire (slowly transitioned to coauthority from the See of Rome until the Napoleonic wars of 1800), the ecumenical councils had to meet repeatedly to iron out rising contentions within Christian theology, and the rise of Islam and its continuation with the Caliphates who conquered lands in central asia and Africa.

The see of Jerusalem came under the Caliphate jurisdiction. Islam converted the polytheistic religions of Arab peninsula into monotheism with conquests. The first Quran was completed in 650AD. The Muslims separated into a majority Sunni group and a lesser Shiite group by 700AD. About this time, the Byzantine Empire (Eastern Roman Empire) established the pentarchy; Constantinople was added as a see.

In Japan during this time, Kojiki, a religious Shinto text was written. The Zoroastrians from Persia migrated to India due to the intolerance exhibited by the Islamic Caliphates. The Islamic influence of not using religious images/forms spread through some part of Christianity but Iconoclasm was not accepted by Christianity councils of the Pentarchy. Indian Hindu philosopher consolidated Advaita Vedanta about 800AD. The Masoretic Rabbanic Judaism text was compiled in 850AD. The Great Schism between Western (Roman) Catholic and Eastern Catholic Church began by 1050 AD. Towards 1100AD, Jerusalem was captured by the Roman Catholic Church from the Caliphates leading to the beginning of the religious crusades lasting the next 2 centuries. About 1400AD, three was Western Schism with two Roman Catholic Popes ex-communicating each other and dividing the Western Holy Roman Empire between themselves. Jan Hus, a Czech philosopher, laid foundations for Hussitism that later lead to Christian Reformation. Between 1450 and 1750, witch-hunt was pursued by papal authority in Europe.

Around 1500AD, Guru Nanak founded Sikkhism and Chaitanya Mahaprabhu started the Hare Krishna movement in India.

Colonial period had begun in Western Europe by 1500 AD and missionaries were sent to colonial destinations. Martin Luther started Protestant Reformation in Germany by 1517. King Henry VIII in England separated from the Church of Rome and declared himself the supreme head of the Church of England in 1534. In 1611, the English Language King James Bible was written for the Church of England. The period between 12th to 16th centuries in India were the periods of conquests by Caliphate and Turqo-Mongols. The colonial Portuguese, British and later the French started their trading companies with colonising intentions in different parts of India from 1600 onwards which turned to colonial rule by 1750.

The Sikhs holy book, Guru Granth Sahib was written in 1708. Baron d'Holbach (French-German) published The System of Nature – a prominent work in the French Enlightenment period (17th and 18th centuries) ending in French Revolution. This ended with what is known as the de-christianisation of France with Church being detached from power in Rome and made subordinate to the Government.

It could be said that the interplay between Church Reformation – French Enlightenment/Revolution – British Industrial Revolution and – colonisation, has laid the foundations for the new world order in history.

Other religious developments in the 19th century include Babism and Bahaism sprung from Persia, the church of Christ (with the religious book of Mormon), Adventism, Theosophical society, Christian science and Zions watch tower tract society (Jehowahs witness) From USA and Islamic Ahmadiya movement from British Punjab. Swami Vivekananda's address at the Parliament of World Religions in late 19th century is considered as east meets west in religion meet. Several small movements have sprung around the world with religious or spiritual inclinations since. In 1905, France stopped Government funding of religious institutions. The modern state of Israel was established as a homeland for the Jews in 1948. In 1959, the 14th Dalai Lama sought refuge in India from Tibet and established an exile community. In 1965 Srila Prabhupada from India started ISKON and published vedic material to world audience. In 2008, the world's only Hindu Kingdom of Nepal was declared a secular republic state. There are several reports of pagan revival worldwide. In 2014, it was claimed that Iraq and the Levant region has reclaimed Caliphate status and associated rules with reported loss of minority lives.

It would be important to acknowledge that the word religion was used in western Europe around 1500AD. Prior to this period, it was a way of life and a compendium of knowledge and realisations and beliefs all over the world in its respective societies.

Main themes in major world religions

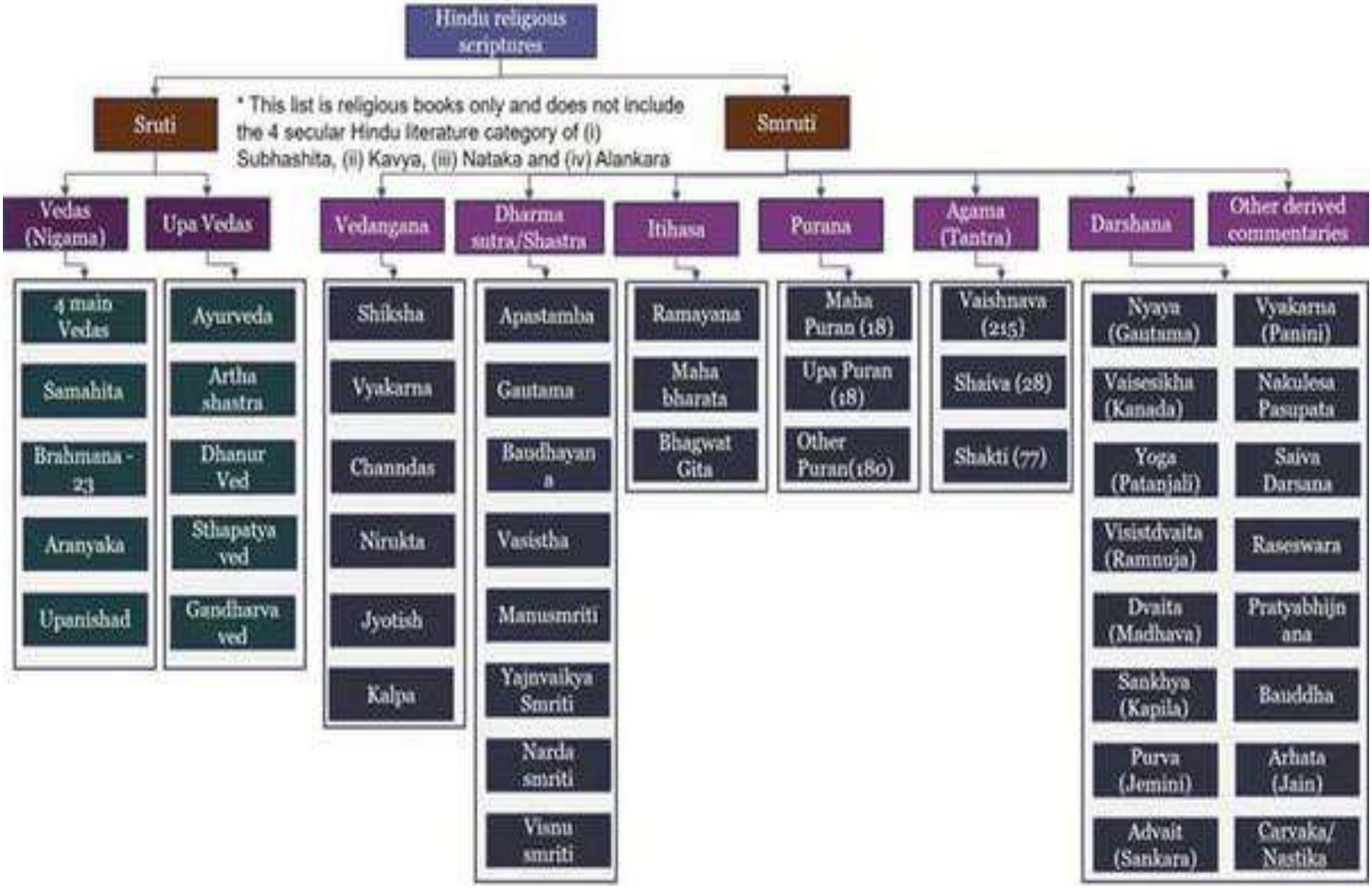
Religious Classification	What/Who Is Divine	Example
Polytheism	Multiple gods	Belief systems of the ancient Greeks and Romans
Monotheism	Single god	Judaism, Islam
Atheism	No deities	Atheism
Animism	Nonhuman beings (animals, plants, natural world)	Indigenous nature worship (Shinto)
Totemism	Human-natural being connection	Ojibwa (Native American) beliefs

<u>Hinduism</u>

Polytheism (inspired by nature and human wishes) and its ritual venerations &
Beliefs:

1. the existence of Samsara, a supra-system of the repeating cycle of birth, life and death.
2. the principle of Karma, i.e., the idea that good deeds entail future happiness.
3. the principle of dharma, which can be understood as the importance of righteousness.
4. the principle of maya, the insight that humans are often misled by illusions and misconceptions.
5. the concept of Brahman, the highest Universal, the Ultimate Reality in the universe

Dealing with ethical conflicts
Societal codes of conduct and its veneration
Holistic health (satvika ahara – right diet to yogasana – physical and mental exercises) and universal peace
The concept of Brahman as a state of consciousness that is universal and its realisation and practice brings everlasting bliss
Several fields of science, grammar, history, mythology, morals, maths, architecture, sexuality, tantra etc all existed simultaneously


Hindu religious scriptures
Sruti
* This list is religious books only and does not include the 4 secular Hindu literature category of (i) Subhashita, (ii) Kavya, (iii) Nataka and (iv) Alankara
Smruti
Vedas (Nigama)
Upa Vedas
Vedangana
Dharma sutra/Shastra
Itihasa
Purana
Agama (Tantra)
Darshana
Other derived commentaries
4 main Vedas
Samahita
Brahmana - 23
Aranyaka
Upanishad
Ayurveda
Artha shastra
Dhanur Ved
Sthapatya ved
Gandharva ved
Shiksha
Vyakarna
Channdas
Nirukta
Jyotish
Kalpa
Apastamba
Gautama
Baudhayan a
Vasistha
Manusmriti
Yajnavaikya Smriti
Narda smriti
Visnu smriti
Ramayana
Maha bharata
Bhagwat Gita
Maha Puran (18)
Upa Puran (18)
Other Puran(180)
Vaishnava (215)
Shaiva (28)
Shakti (77)
Nyaya (Gautama)
Vaisesikha (Kanada)
Yoga (Patanjali)
Visistdvaita (Ramnuja)
Dvaita (Madhava)
Sankhya (Kapila)
Purva (Jemini)
Advait (Sankara)
Vyakarna (Panini)
Nakulesa Pasupata
Saiva Darsana
Raseswara
Pratyabhijn ana
Bauddha
Arhata (Jain)
Carvaka/ Nastika

	Vaishnava Traditions	Shaiva Traditions	Shakta Traditions	Smarta Traditions
Scriptural authority	Vedas and Upanishads	Vedas and Upanishads	Vedas and Upanishads	Vedas and Upanishads
Creator	Vishnu	Shiva	Devi	Brahman principle
Monastic life	Accepts	Recommends	Accepts	Recommends
Ahimsa and Vegetarianism	Affirms	Optional	Optional	Recommends, Optional
Rituals, Bhakti	Affirms	Optional	Affirms	Optional[262]
Avatar	Key concept	Minor	Significant	Minor
Salvation (Soteriology)	Videhamukti, Yoga, champions householder life	Jivanmukta, Shiva is soul, Yoga, champions monastic life	Bhakti, Tantra, Yoga	Jivanmukta, Advaita, Yoga, champions monastic life
Supreme deity	god Vishnu	god Shiva	goddess Devi	None
Philosophy	Dvaita, qualified advaita, advaita	Dvaita, qualified advaita, advaita	Shakti-advaita	Advaita
Metaphysics	Brahman (Vishnu) and Atman (Soul, Self)	Brahman (Shiva), Atman	Brahman (Devi), Atman	Brahman, Atman
Free will, Maya, Karma	Affirms	Affirms	Affirms	Affirms
Epistemology (Pramana)	1. Perception 2. Inference 3. Reliable testimony	1. Perception 2. Inference 3. Reliable testimony 4. Self-evident[266]	1. Perception 2. Inference 3. Reliable testimony	1. Perception 2. Inference 3. Comparison and analogy 4. Postulation, derivation 5. Negative/cognitive proof 6. Reliable testimony

Buddhism

Atheistic
Three universal truths – nothing lasts forever, everything changes, karma (cause and effect)
Eightfold path – Discernment (there is suffering, cause is attachment, it can be ended, right aspiration drives right thinking), Virtue (right speech, conduct and livelihood), meditation (right effort, mindfulness and true consciousness)
Social conduct rules

Jainism

Atheistic and ascetic
Attachment and aversions keep the cycle of Karma in eternal perpetuation and hinders liberation
Colour of skin-based person typology
Soul is eternal with the core element of consciousness, material is not
Soul, matter and space/time/motion (motion/dharma, rest/adharma)– only soul has consciousness
The infinite universe was self-existent made up of occupied and unoccupied space
A hierarchy of: liberated beings – demigods – humans/animals – hellish beings
Time assists matter in transformation and is without beginning or end
Cause and effects of Karma and ways to free oneself from karma so as to realise the quality of the pure soul
The liberated soul is worshipped as a divine being

Taoism

Everything in nature is transforming all the time. This is the flow of Chi energy.
Through the understanding of natural laws, one can find the way
Wu wei – to understand the natural flow of things and not to interrupt it – not forcing things on their way but harnessing the circumstances of the situation in the conduct of an act.
Human must place their will in harmony with nature
Need to abolish dualistic thoughts and acts to be conducted naturally and spontaneously
Passive state of receptiveness is believed to be the true nature of the mind
When following the Wu Wei, the goal is called Pu. Pu is a symbol for a state of pure potential and perception without prejudice, without illusion.
Te is the manifestation of Tao within all things. Thus, to possess the fullness of te means to be in perfect harmony with one's original nature. Nature to express itself unhindered finds its own balance. Describing in words the nature of a thing limits its true nature. It is a life expressing the essence of spontaneity.
Three jewels of Tao – compassion, kindness, love/moderation, simplicity, frugality/humility, modesty
Taoist deities include nature spirits and there is a celebration and reverence to everything in nature
The highest Taoist deity is Jade Emperor – the ruler of all universe
In contrast to the Confucian program of social reform through moral principle, ritual, and government regulation, the true way of restoration for the Taoists consisted in the banishment of learned sageliness and the discarding of wisdom but bounded by the three jewels to prevent running amock

Confucianism

Focuses on family and social values rather than the spiritual

It is the upholding of righteousness and the moral disposition to do good. Their virtue formed a covenant of social harmony which did not depend on punishment or coercion.
Confucianism holds one in contempt, either passively or actively, for failure to uphold the cardinal moral values
society is not as an adversarial system based on contractual relations but as a community of trust based on social responsibility. Individuals may realise their humanity and become one with Heaven through the contemplation of such order.
It formed the ethical foundation for humane government
loyalty is particularly relevant to social class in Confucianism

Shinto

Is a nature religion
Polytheistic, animistic, pantheistic
Belief in Kami – supernatural entities
Buddhism admixture and separated in religious history of Japan

The twelve Olympians

The Greeko-Roman Gods had Greek and Roman equivalents and were revered natural elements or desired human characteristics exemplified. They were anthropomorphic Gods.

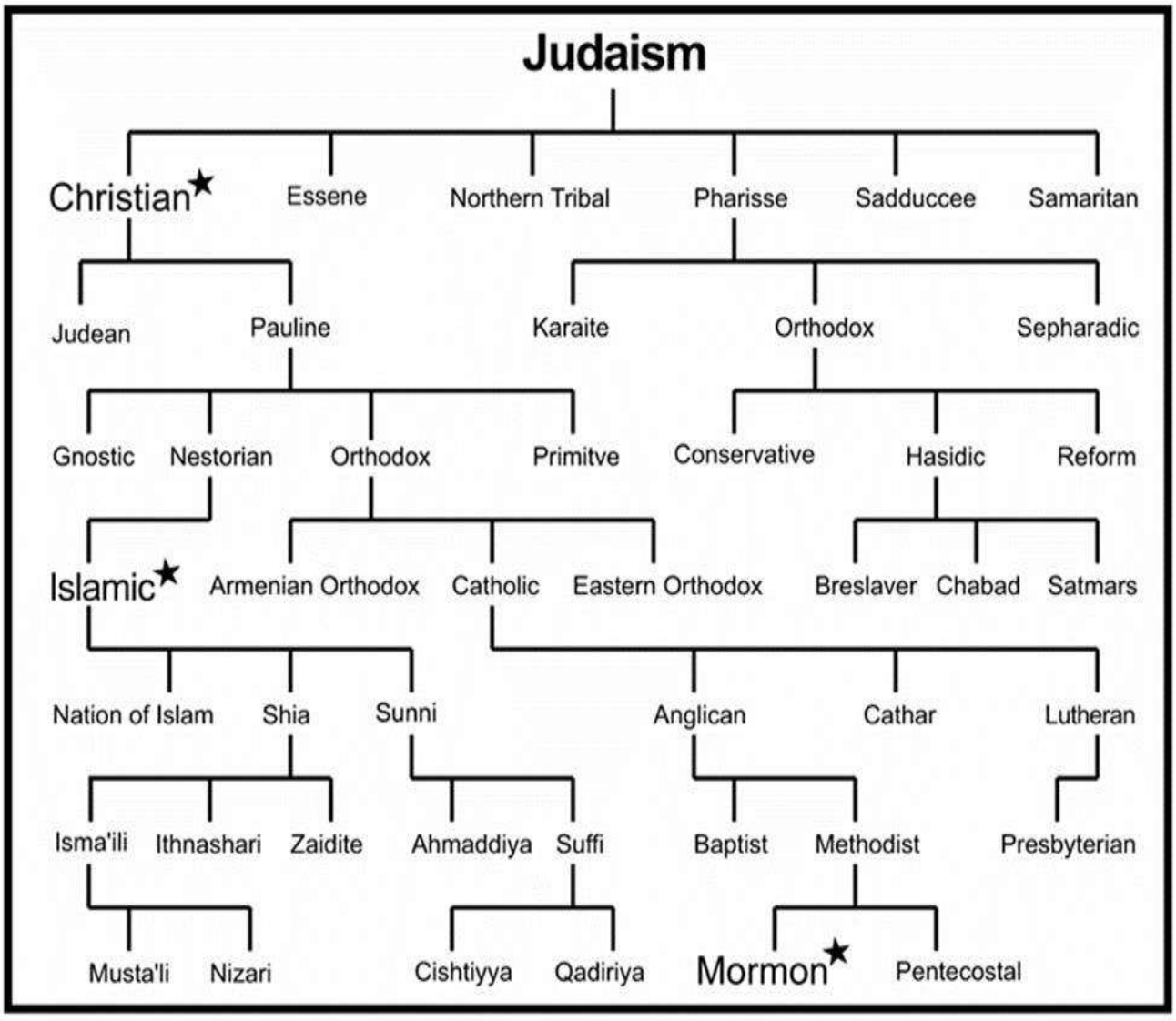
Greek	**Roman**	**Attributes**	**Functions**
Zeus	Jupiter	King of Gods	god of the sky, lightning, thunder, law, order and justice
Hera	Juno	Queen of gods	goddess of marriage, women, childbirth and family
Poseidon	Neptune		God of the seas, water, storms, hurricanes, earthquakes and horses.
Demeter	Ceres		Goddess of the harvest, fertility, agriculture, nature and the seasons.
Athena	Minerva		Goddess of wisdom, handicraft, and warfare.
Apollo	Apollo	Son of zeus	God of light, the Sun, prophecy, philosophy, archery, truth, inspiration, poetry, music, arts, manly beauty, medicine, healing, and plague
Artemis	Diana	Daughter of zeus	Goddess of the hunt, the wilderness, virginity, the Moon, archery, childbirth, protection and plague
Ares	Mars		God of war, violence, bloodshed and manly virtues.
Aphrodite	Venus		Goddess of love, pleasure, passion, procreation, fertility, beauty and desire.
Hephaestus	Vulcan		Master blacksmith and craftsman of the gods; god of the forge, craftsmanship, invention, fire and volcanoes.
Hermes	Mercury		Messenger of the gods; god of travel, commerce, communication, borders, eloquence, diplomacy, thieves and games. He was also the guide of dead souls.
Dionysus	Bacchus		God of wine, the grape vine, fertility, festivity, ecstasy, madness and resurrection. Patron god of the art of theatre.

Abrahamic Religions

One God, common ancestry and revered disciples, prophet had direct realisation from god and passed it to followers, judgement and salvation, morality and sins, heaven and hell.

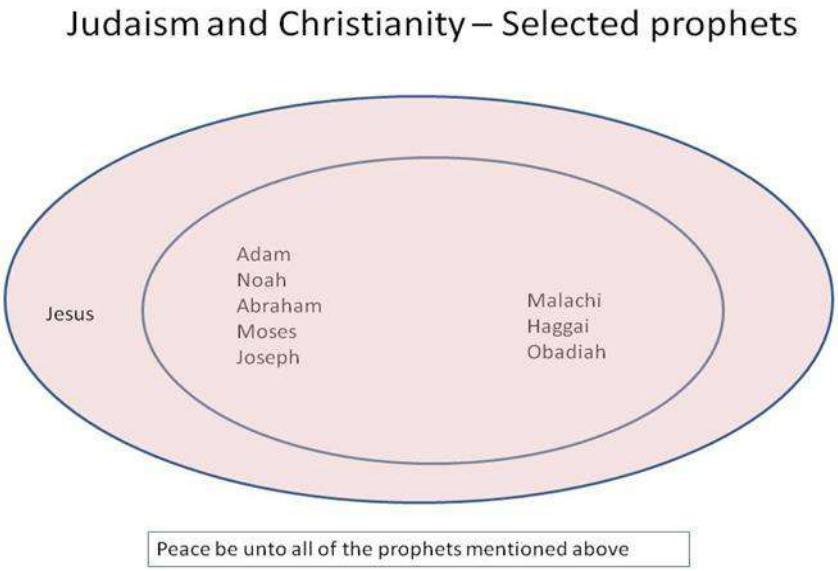
Judaism

Hebrew Bible or Tanakh is a canonical collection from about 400BC. It was recompiled as the Rabbinic Mesoretic Text around 800AD.
It is a collection of origin, history, stories, wisdom, lessons from struggle, psalms, hymns, prose, songs, relationship between God and humans, parables, fables, instructions to encourage the travelling Jews to find and claim by battle, their promised land of Israel by their lord Yahweh, passed through Moses and his disciples to the Jews.



Christianity

The Hebrew Bible/Tanakh has close parallels with the Christian Old Testament Bible. It is a collection of origin, history, stories, wisdom, lessons from struggle, psalms, hymns, prose, songs, relationship between God and humans, parables, fables, instructions to live a good life, on salvation, on sins, passed through Moses and his disciples to the Jews. Jesus of Nazreth, a Jew, who had divine revelation, revealed the truths of Christian faith through his apostles to the believers. God is in a human form and he sacrificed himself for the collective human sins.

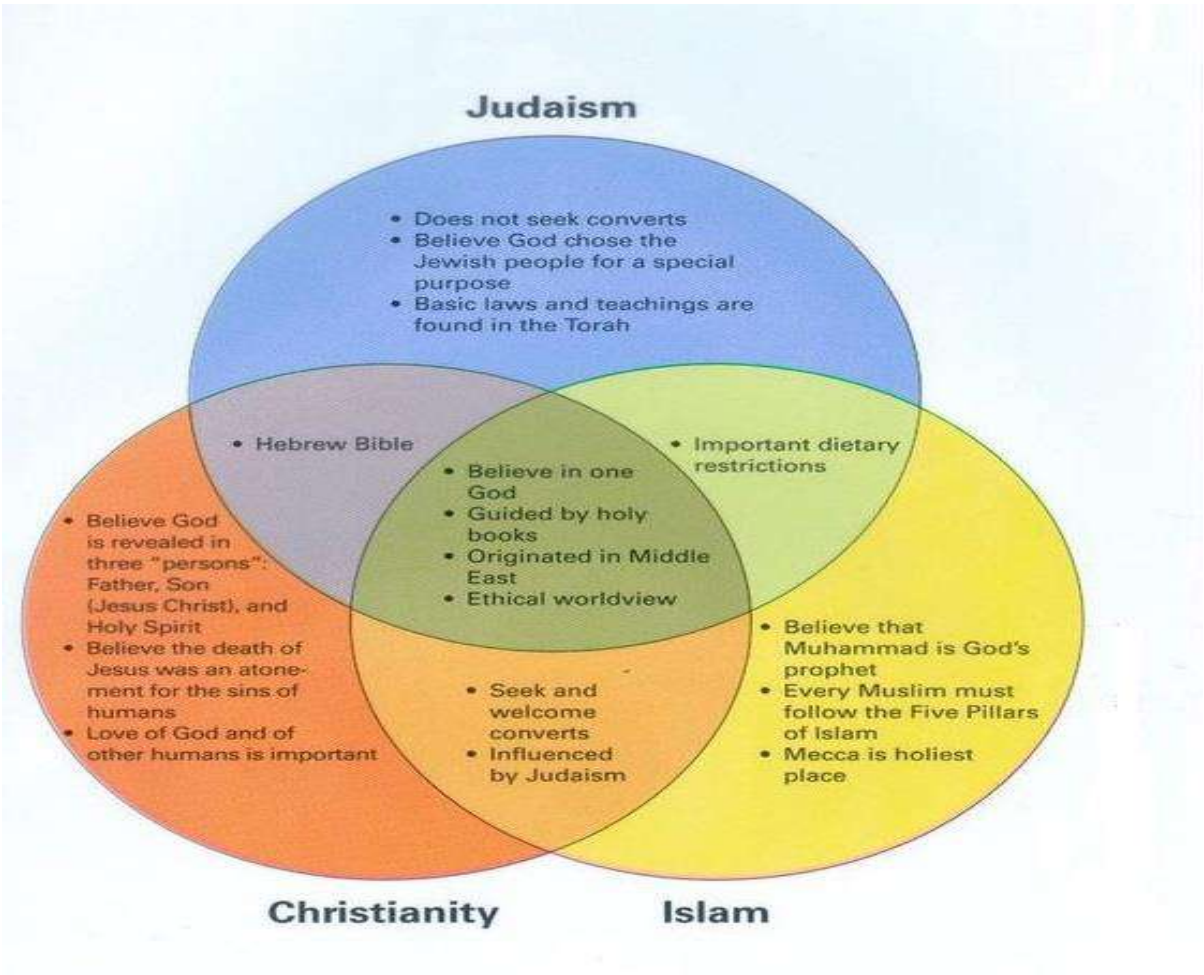


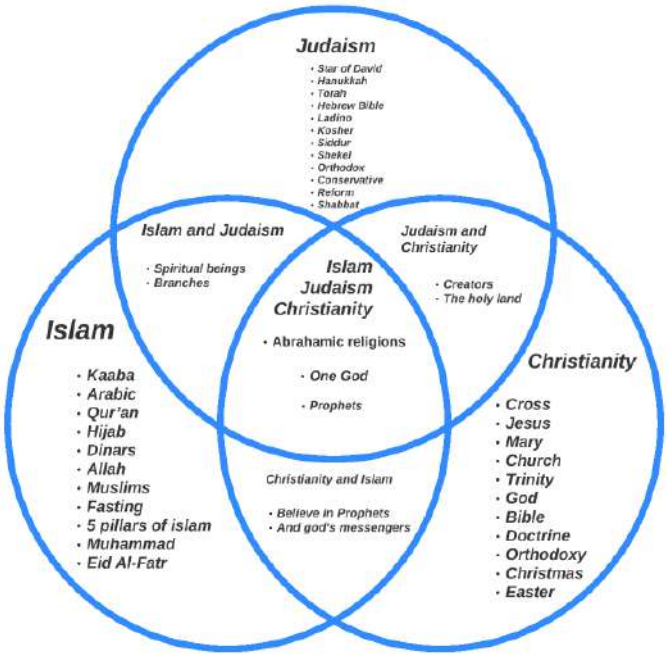
Islam

Belief in one formless God
Gods teachings conveyed by enlightened prophet to the believers
Belief in the books of God before and currently to the Prophet Mohammed. The Quran is hence what remains.
Belief in the day of judgement
Everything is governed by divine decree but humans do have to make their choice.
5 main pillars: faith, prayer, alms, fasting and pilgrimage

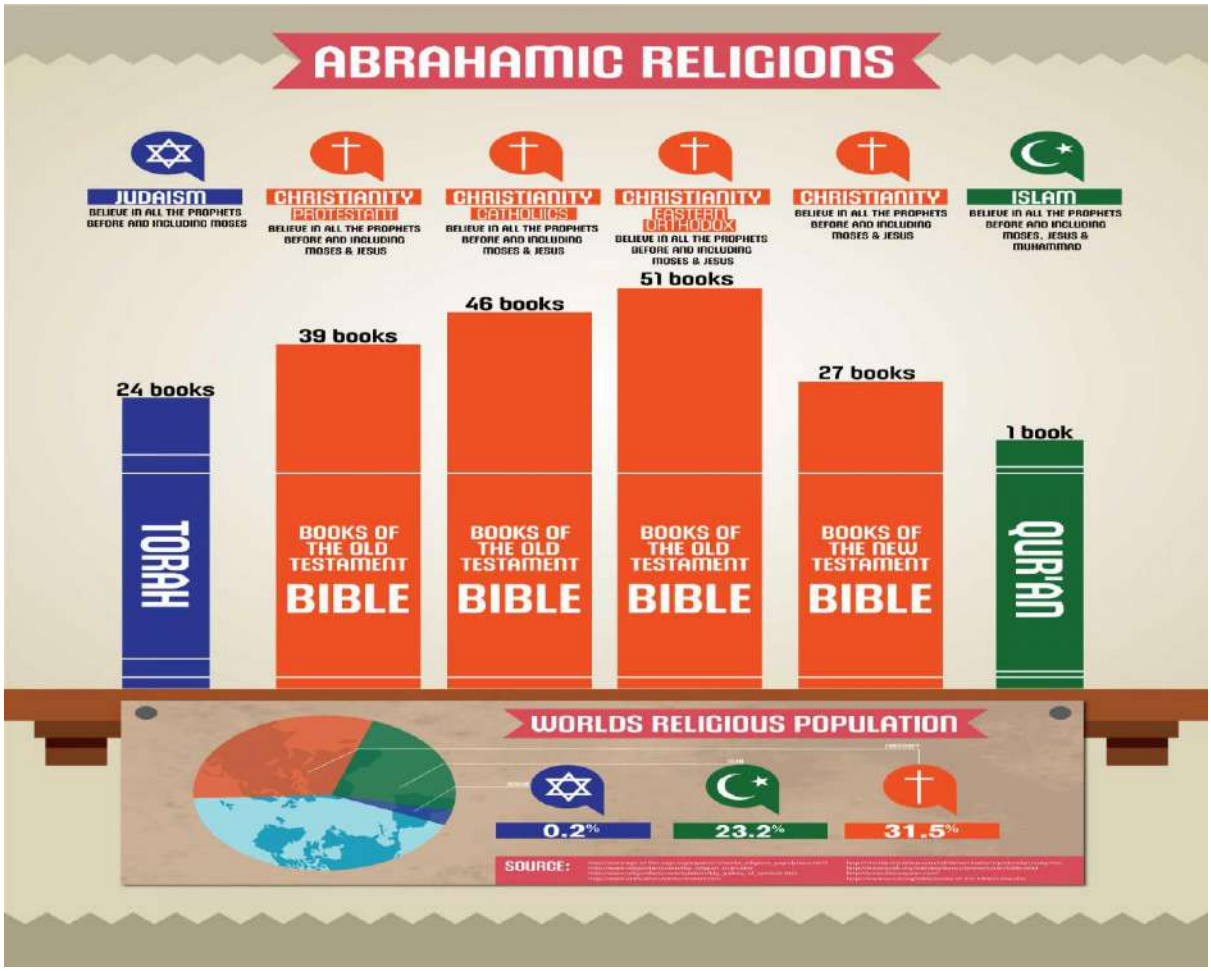
Comparative Religions

Religion	*Judaism*	*Christianity*	*Islam*
Diety	God Yahweh, Elohim	God	God Allah
Holy Book "People of the book"	Torah (Old Test.)	Bible (Old and New Test.)	Qur'an (Koran)
Religious Law	Halakhah	Canon Law	Sharia
Place of Worship	Synagogue	Church Chapel Cathedral	Mosque
Clergy	Rabbis	Priest, Minister, Pastor	Imam





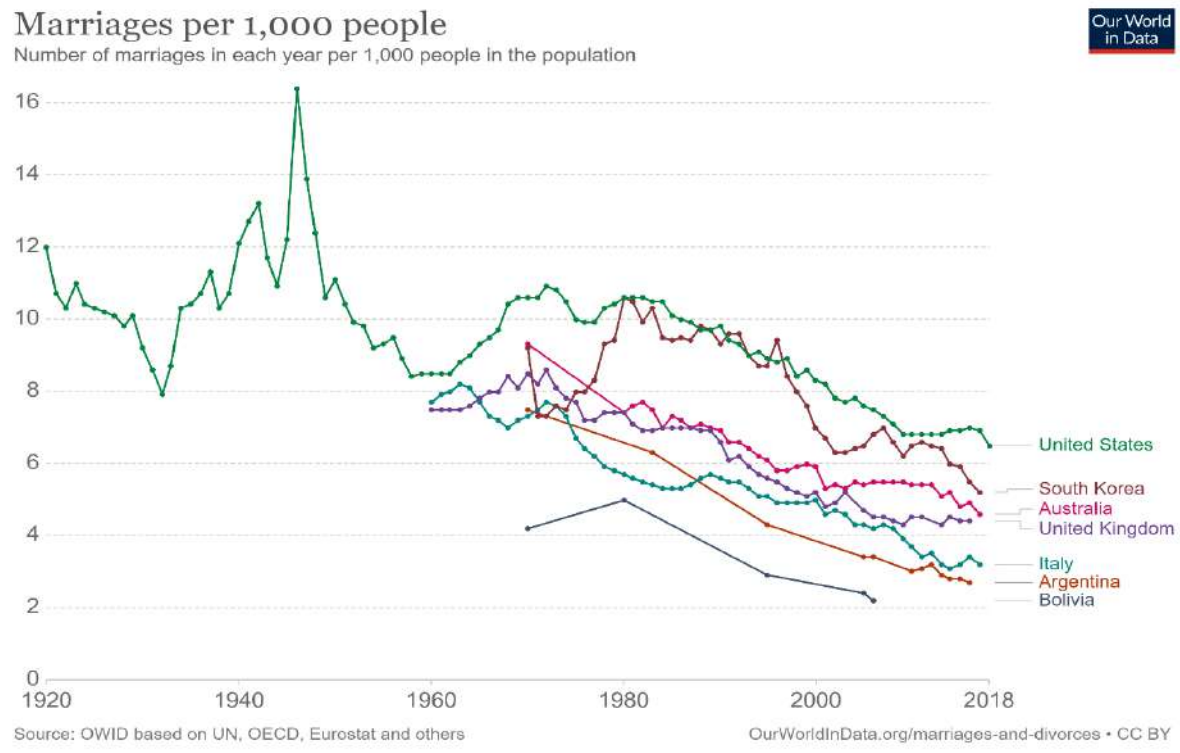
Abrahamic Venn diagram

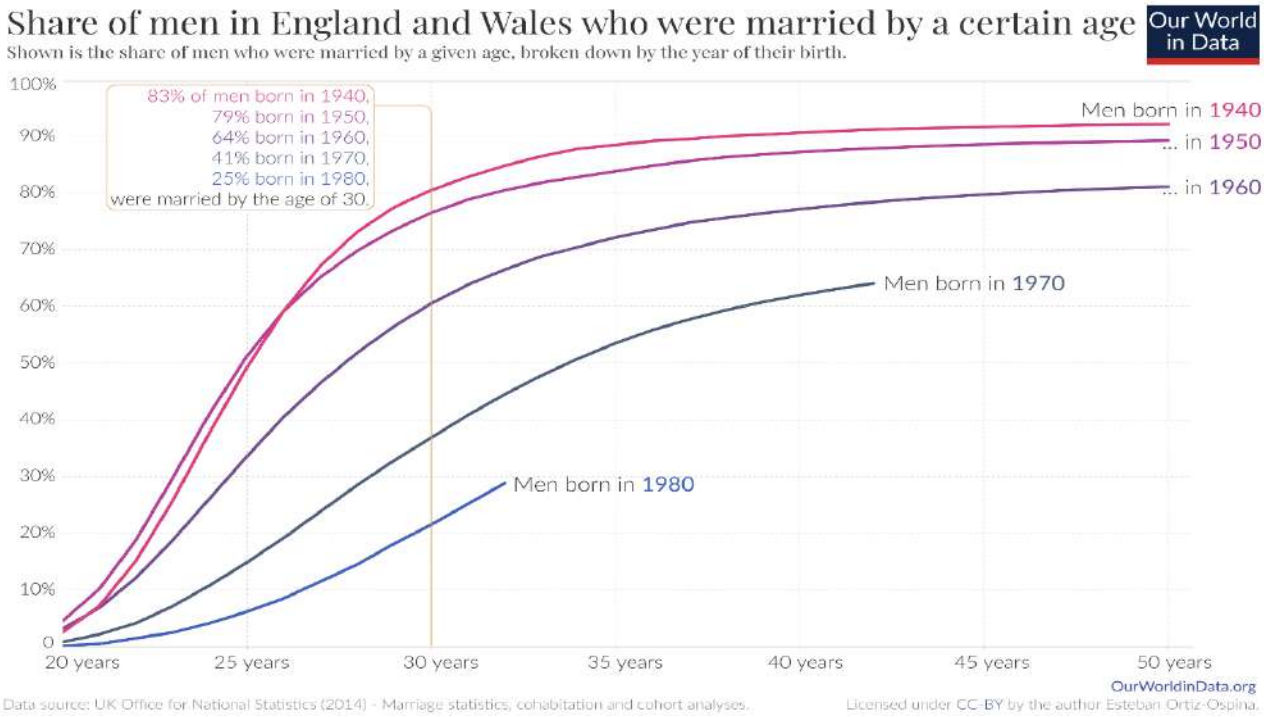


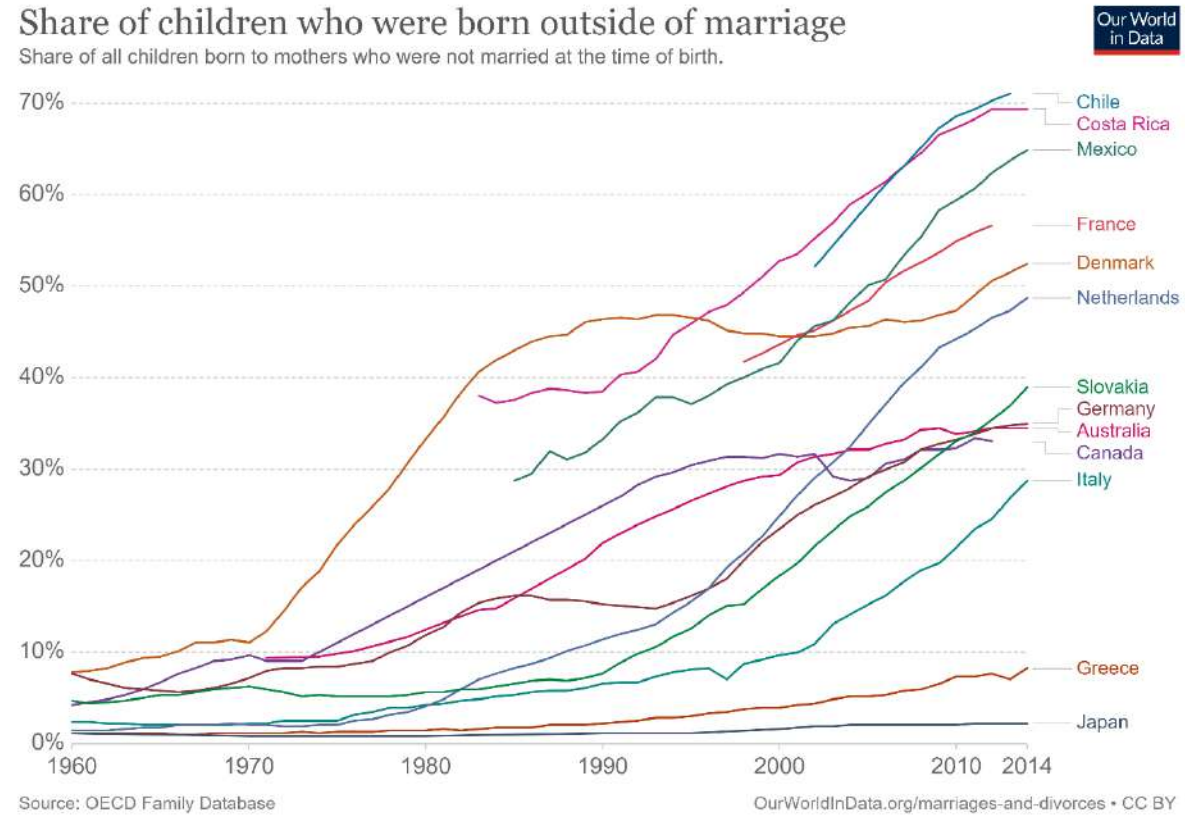
On Sexuality

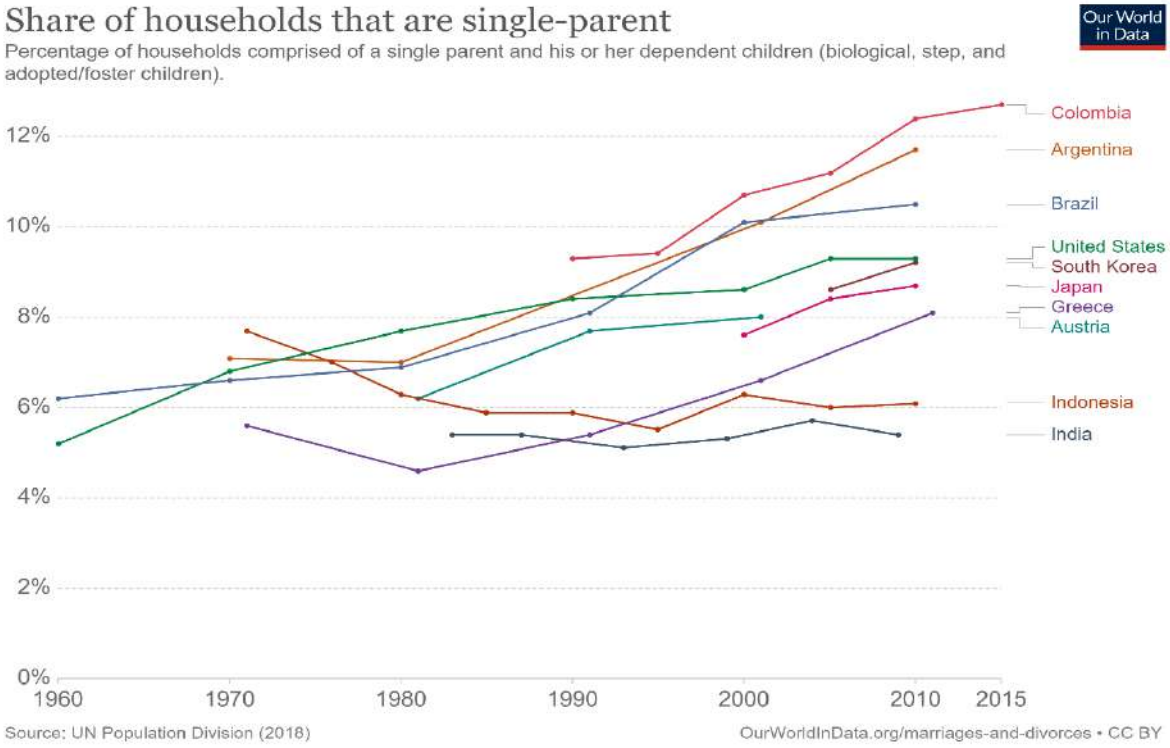
Fertility has been both celebrated and revered in all human history and there are several relics across various civilisations to support this practice. There are some rights and legitimacy associated with marriage with some variation across cultures. Bearing children and nurturing them to free living individuals has mostly been the identified key goal of marriage in most cultures; some defining this as institutional. However, a relationship with many shared goals, values and interests; various dimensions of intimacy (physical, emotional, intellectual, spiritual), support and partnership has also been considered as key long-term interests. Kamasutra – World's earliest treatise (Vatsyayan 2nd century AD) on sexuality ascribes the central importance of health, emotional and sexual awareness and sexual acceptance as significantly important to maintaining one's virtues. As more dimensions to a marriage are added, the definitions are blurred and the association in a dynamic flux; providing immense flexibility to partners to define their marriage in their own terms. Sexuality unrelated to marriage has mostly been seen with disdain and disapproval; moral and legal sanctions from society often followed such practices when occurring outside a marital relationship. The conventional sexuality in human history has been monogamous heterosexual within a marriage.

Marriage can be monogamous, serial monogamous, polygamous, polygyny, polyandrous, polyandry, plural, child marriage, temporary marriage, cohabitation, same-sex and third gender marriages. In most parts of the world currently, serial monogamous is often the convention. Marriages are less common, average age at marriage has increased, there is decoupling of marriage and parenthood, same-sex marriage is possible and social trends are changing more quickly than ever before. In the USA, marriage rates have decreased from ~ 12/1000 population to ~ 6/1000 population in the last century while divorce rates are ~45% of all marriages. Divorce rates increase with duration of marriage and current trends are 12% - 55% depending on country data. In most developed countries, ~ 95% women marry at least once in their lifetime and ~ 60% of adult women are married. Divorce rates among psychologists, psychotherapists and psychiatrists reported as between 20 – 50%. Natsal-3 survey from 2018 reported an average 14 partners for men and 7 partners for women in a lifetime.

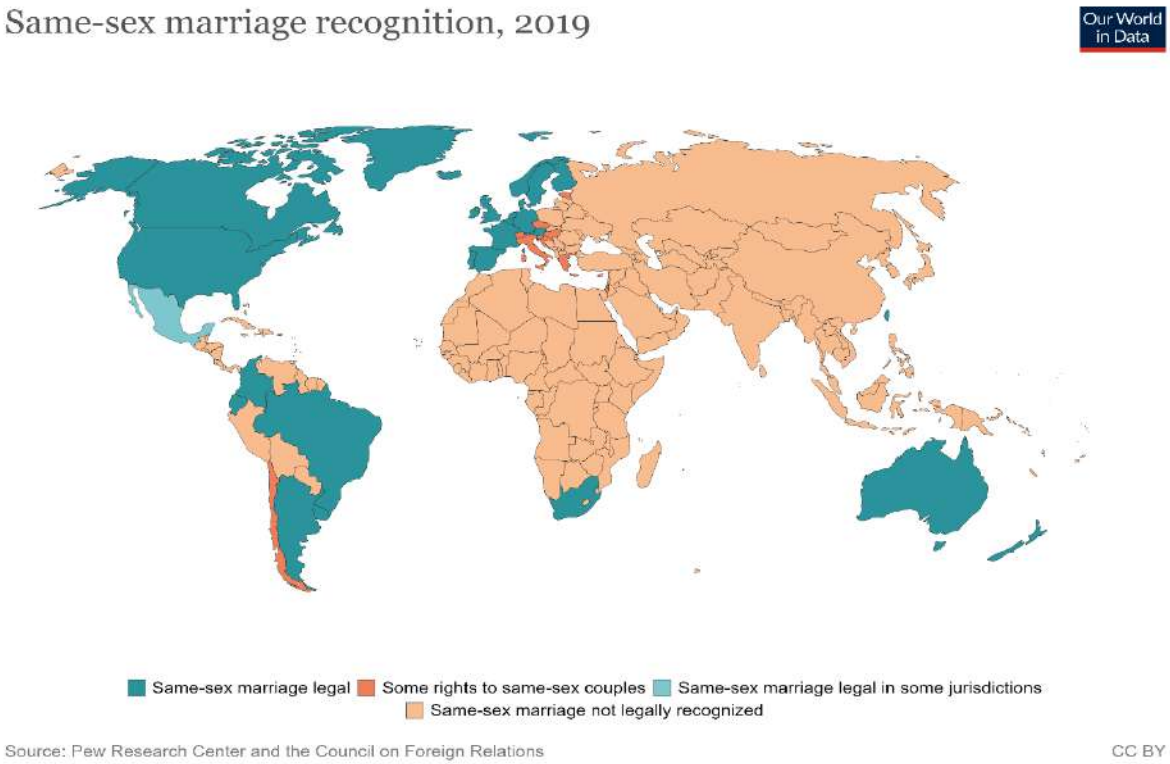


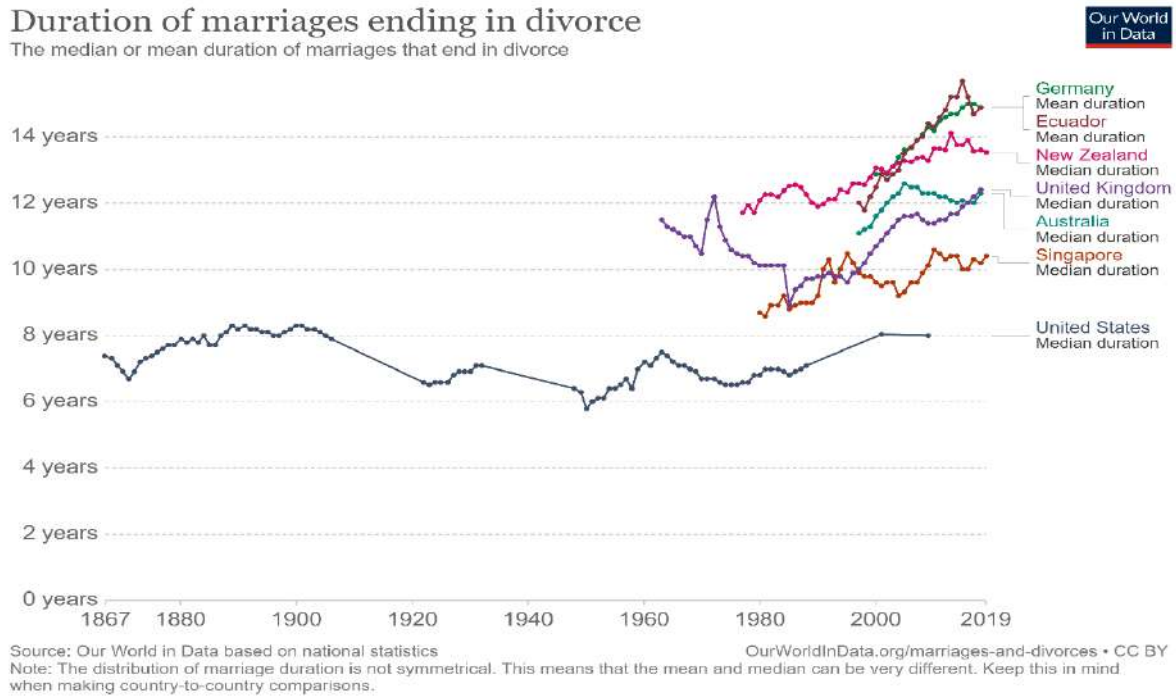

Share of men in England and Wales who were married by a certain age
Shown is the share of men who were married by a given age, broken down by the year of their birth.
Our World in Data
83% of men born in 1940,
79% born in 1950,
64% born in 1960,
41% born in 1970,
25% born in 1980,
were married by the age of 30.
Men born in 1940
... in 1950
... in 1960
Men born in 1970
Men born in 1980
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0
20 years
25 years
30 years
35 years
40 years
45 years
50 years
OurWorldinData.org
Data source: UK Office for National Statistics (2014) - Marriage statistics, cohabitation and cohort analyses.
Licensed under CC-BY by the author Esteban Ortiz-Ospina.


Share of children who were born outside of marriage
Share of all children born to mothers who were not married at the time of birth.
Our World in Data
70%
60%
50%
40%
30%
20%
10%
0%
1960
1970
1980
1990
2000
2010
2014
Chile
Costa Rica
Mexico
France
Denmark
Netherlands
Slovakia
Germany
Australia
Canada
Italy
Greece
Japan
Source: OECD Family Database
OurWorldInData.org/marriages-and-divorces • CC BY



The range of single parent households is 3% - 30% across the world.





Onset of puberty in humans is by 13 years (earlier for girls than boys) and is called precocious if sexual features develop before 8 yrs of age. The legal age for sexual consent in most countries is between 16 – 18 yrs of age although ~ 40 % of children report sexual activity before age 16 in USA and ~ 5% before age 13. Sexual consent requires attaining legal age and capacity to consent (not under the influence of drugs and alcohol and of sound mind to make such a decision). The legal age for marriage varies between 18 – 21 years across countries and may be different for males and females. Birth control measures were known since 2000BC in Mesopotamia and Egypt. Barrier methods using softer materials were reported since 15th century AD. Condoms were widely available for common use by the late 18th century that also witnessed a reducing trend in birth rates. Use of male/female/barrier/chemical methods of contraception was intensely debated over the centuries from moral, ethical and efficacy viewpoints. Rise in abortion rates was also an associated phenomenon for unwanted pregnancies that was also an intense dilemma for various societies. Barrier methods were used for prevention of STI's and pregnancy while oral contraceptive methods were used to avoid pregnancies. The Intra uterine device (IUD) was developed in early 20th century but is associated with higher Pelvic inflammatory disease rates (PID). Oral contraceptive pills developed in the 1950's became more popular. The morning after pill was developed in the 1970's. Teen pregnancies, STI rates, fertility rates reduced with use of contraceptives.

There are about 25 known human STI's but 7 among them cause most of the disease burden. 15-24yr age group develop half the known annual incidence. More than a million people develop STI a day. When all bacterial, viral, reversible and irreversible causes of STI's are included; the annual incidence is ~ 0.75 billion cases or 10% of world population per annum. Although other versions of treatment existed for treating infections in different civilisations and countries, antibiotic was invented in its modern sense in 1928 and mass produced in 1945; paving way for the treatment of syphilis. The first antiviral drug was developed in 1963 and the first retroviral drug came out in 1987. Other treatments evolved for bacterial and viral STI's gradually. Condoms (male and female versions), vaccinations (Hep B, HPV), preexposure retroviral medications, circumcision for vaginal and anal sex; dental dam and tongue-mouth condoms for oral sex, are useful interventions in reducing STI's.

GROUP	AGENT	DISEASES
BACTERIA	a. Neisseria gonorrhea	Gonococcal infection
	b. Chlamydia trachomatis	Non-gonococcal, non-specific urogenital infections lyhpogranuloma venerum.
	c. Ureaplasma Urealyticum	Non-goncoccal Urogenital infection.
	d. Mycoplasma hominis	-
	e. Haemophilus ducreyi	Chancroid
	f. Treponema pallidum	Syphilis
	g. Various vaginal anaerobes	Non-specific vaginitis anaerobic vaginosis, bacterial vaginosis
	h. Calymmatobaterium granulomatis	Granuloma inguinale
	i. Group B streptococcus	Neonatal sepsis.
VIRUSES	a. Herpes simplex virus	Genital harpes
	b. Human papilloma virus	Genital warts, cervical cancer
	c. Pox virus	Molluscum contagiosum
	d. Hepatitis virus	Hepatitis B, C, D
	e. Cytomegalo virus	Congenitall infection: birth defect; varied manifestation in immunosuppressed host
	f. Human Immunodeficiency Virus (HIV)	Acquired Immunodeficiency Syndrome (AIDS)
FUNGI	Candida albicans	Genital candidiasis
PROTOZOA	Trichomonas vaginalis	Trichomoniasis
ARTHROPODS	Phthirus pubis sarcoptes scabies	Pediculosis scabies

Adopted from Arya *et al*, (2000)

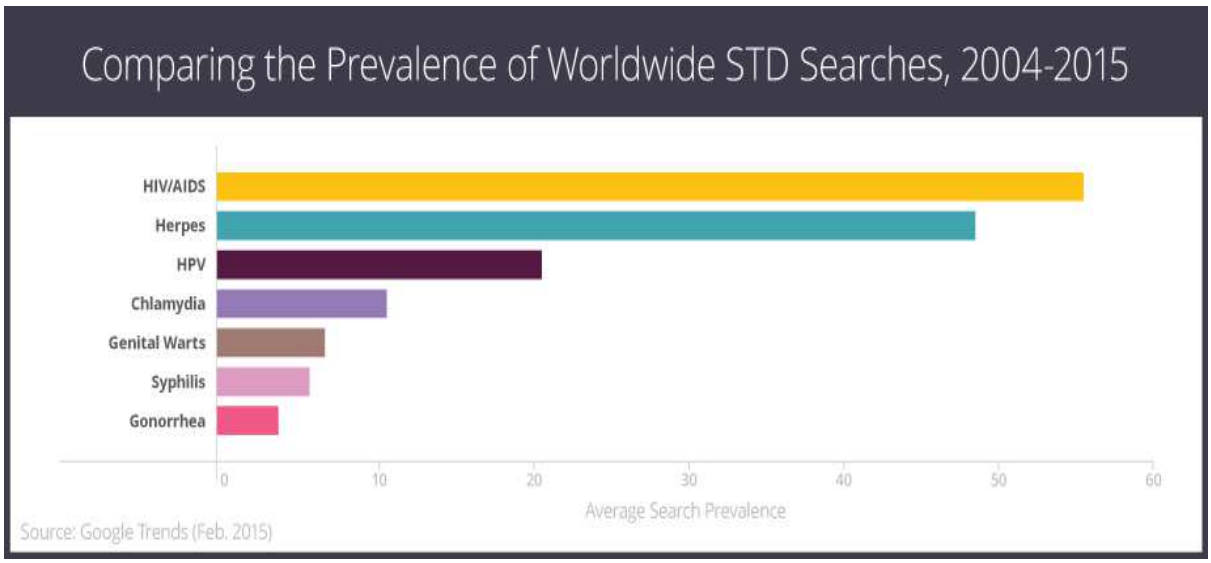
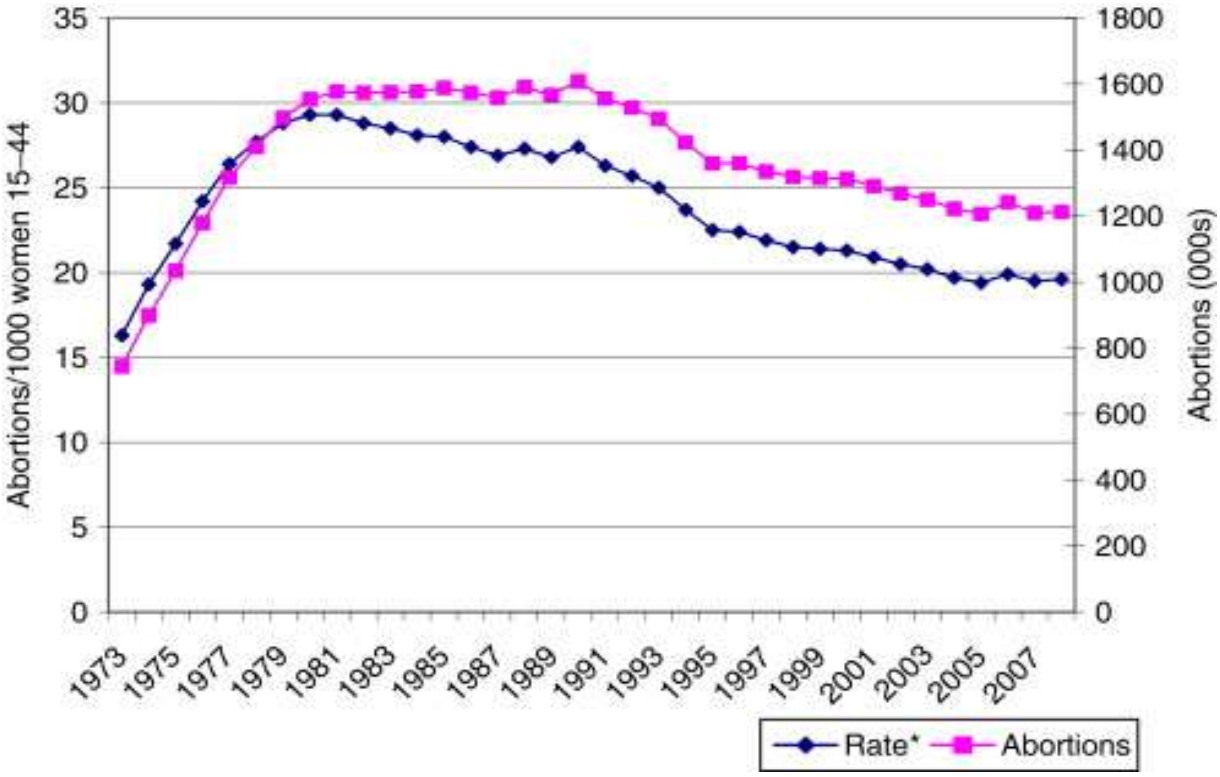
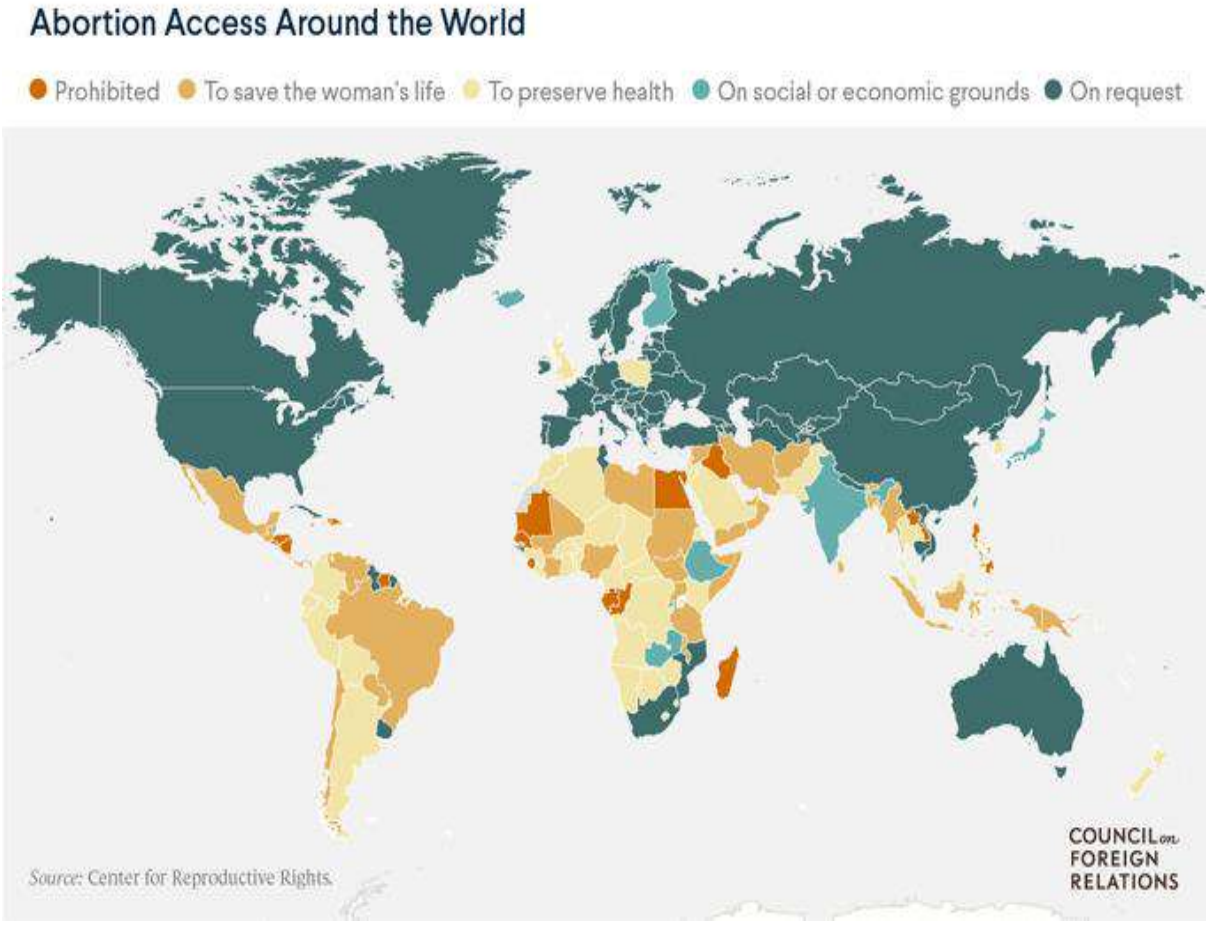


Table 1.1. Global estimates of new cases of curable STIs in 2016

Sexually transmitted infection	No. (million)
Chlamydia	127
Gonorrhoea	87
Syphilis	6
Trichomoniasis	156
Total	376


Abortions/1000 women 15–44
Abortions (000s)
35
30
25
20
15
10
5
0
1800
1600
1400
1200
1000
800
600
400
200
0
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
Rate*
Abortions


Abortion Access Around the World
Prohibited
To save the woman's life
To preserve health
On social or economic grounds
On request
Source: Center for Reproductive Rights.
COUNCIL on FOREIGN RELATIONS

Puberty onset includes surges in male and female hormones that have other significant physiological roles in addition to development of sexual anatomy and physiology. This includes brain neuronal development and synaptic plasticity. There is gradual gender role and gender identity development in the individual. Sexual activity is related to grooming, bonding and strengthening attachments in a couple. The process of sexual orientation, sexual awakening and the elements of intimacy between partners has been a critical element of artistic expression in several forms of art and music. The process of love transforming to sex within love leading to good families has been a major genre of romance in movies. < 5% of adult population identify themselves as LGBT; fewer so in less-expressive societies.

Age appropriate sex-education is provided in most modern facility schools from primary. Under the EU's SAFE project: Younger audiences within the primary setting would be instructed by their classroom teacher in areas of puberty, sexual development, and bullying while secondary audiences would be instructed by a multi-dimensional staff in the topical areas of racism, homophobia, sexual violence, abstinence, safe sex, sexually transmitted diseases, pregnancy and contraceptives, as well as the biological, emotional, and social effects of sexuality.

Drug abuse is common in teenage and young adult sexual practices. All classes of drugs alter sexual behaviour and experience. Stimulants enhance sexual experience & increase confidence and depressants at times are used to disempower their victims for sexual abuse (ex: GHB and alcohol). Sexual incidents and violence are commonly a collateral occurrence in drug induced states. Drug use increases the at-risk behaviour in sexual activity such as STI's and non-consenting sexual activity. Some Rave parties, music festivals, beach destinations are known for allowing such combination. There are some medically approved products to facilitate sexual activity.

Sexual activity within a couple's dynamic is often defined by their ability to spontaneous expression with each other, their own individual sexual autonomy and awareness; and their psychological states. It is sometimes associated with use of sex toys and sexual media to supplement (in less abled individuals) or complement their sexual activity and experience. These include vibrators, gels, objects for insertion, dolls, cobots and other modes of stimulation. There are sexual practices that does not involve a sexual couple but practised by an individual usually with self-stimulation. Sex shops provide a variety of such media or objects.

Certain sexual practices are conventionally outside accepted norms of sexual expression and are considered perversions; especially when they lack the expressed consent of a capacitous participating adult. While sexual violence is specific to an incident, abuse can shape over time through manipulation, exploitation and coercion. Sexual harassment can occur at work, public or online and is often some form of persecution/control/dominance and can be legally reported.

Sex escorting is a worldwide profession; often poorly regulated and sometimes controlled by violent methods by a group. Individual sex workers are either coerced or make this life choice for various reasons. There are certain worldwide destinations that are known for such activities and is called Sex tourism. Amsterdam is an example of regulating this profession which allows access to security, preventing exploitation and providing health assessments to sex workers. Pornography is the visual media of sexual activity available in digital media or publishing. Sexting is the use of mobile messages to further sexual activity. Certain social media sites/apps allow for coming together of partners to pursue consenting activities. Several social web sites for chatting use bots to generate conversation threads to lure online participants. Several online websites (excluding established organisations) are attached with external cookies and pop ups that open adult content websites against a web surfer's intention or control. There are certain web sites that further illegal sexual media and is brought down by cyber-security such as child pornography or violent sexual practices.

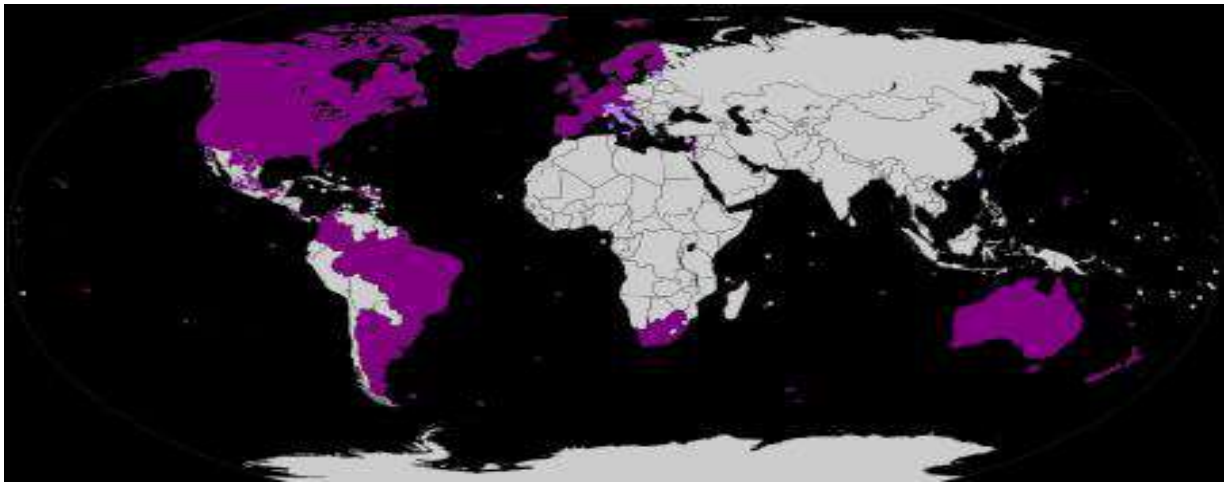
Sex education, changing social norms, contraception, availability of abortion on request, treatments for STI, late age of marriage; has allowed for sex as a pursued activity that can occur premarital and in between

marriages. Infidelity is often destructive to a marriage as is significant emotional discord (intra-individual, inter-individual, internal or casted from outside) between the partners. However, individual views and cultural norms, both overt and covert, widely vary on the subject. Sex is considered more appropriate in healthy adult (mental, physical, emotional, psychological) relationships that can afford the welfare for a family if required; and able to provide a nurturing environment. These requirements are hardly met by a small proportion of the population.

Sexual violence is a major concern for individual's autonomy; mostly perpetrated by men. Nonconsenting and legally underage sexual activity is a sexual crime. Soliciting escorts and pornography are being debated to be considered as crimes across some jurisdictions. Running a building facility for escorts service is a crime. Exhibitionism, frotteurism, voyeurism received or displayed by nonconsenting individuals is a crime. The environmental, social, gender and cultural contexts contribute to some of these relative definitions. There are some licensed zones across the world for nudists gathering. Groups/individuals exhibiting themselves to harass or incriminate an individual is also a crime.

A woman's monthly periods can lead to emotional disturbances due to change in hormonal levels. Male hormone levels have shown some association with hypersexuality and violence. Menstrual cycle related behaviours have some degree of known heritability. Hormone imbalances and benign tumours in the female reproductive tract can lead to low or increased blood in amount and duration in a menstrual cycle. Menopause usually from 40y onwards in women completes the reproductive period; however, the production of sperms continues in a male as long as he remains reasonably healthy. A woman typically produces one mature ovum per menstrual cycle while a males' ejaculate typically contains several million sperms motile in a spinning thrust to reach the ovum in the fallopian tube for usual fertilisation by a single sperm; only a portion of the sperms reaching the ovum, many clearing the ovum's surface for sperm penetration and once one single sperm enters, the ovum shuts down all further sperm entries. IVF, Embryo transfer, artificial insemination, enriching sperm count and surrogate motherhood have all increased the chance of artificial fertility.

Control of the senses including abstinence from sexuality had been a major pursuit of many religious practices and sainthood across the world in history. This is sometimes explained as subconscious repressed sexuality in certain schools of psychotherapy. On the contrary, many religious and other institutional establishments have often condemned and persecuted sexual practices in its relative context and timeframes. An example is of homosexuality which began to be decriminalised by some countries in late 18th century and same-sex marriage was first legitimised in 2001.



Legal status of adoption by same-sex couples around the world:
Joint adoption by same-sex couples allowed
Second-parent adoption allowed
No laws allowing adoption by same-sex couples

On Sports

Sport has its origin in military training. Prehistoric archaeological findings from as old as 70,000 years ago depict spear throwing; sprinting and wrestling by 15,000 BC; and swimming and archery by 10,000 BC.

The first recorded history is noted in the Sumer's cuneiform tablets about wrestling in 3000BC. The story of Gilgamesh also describes wrestling by 2700 BC. Fishing hooks have been found in Ur (at the mouth of Euphrates opening into the Persian Gulf) dating to 2600BC. The Sumerians also practised funeral games around this time.

Monuments to the Pharaohs found at Beni Hasan dating to around 2000 BCE[15] indicate that a number of sports, including wrestling, weightlifting, long jump, high jump, javelin throwing, wrestling, swimming, rowing, archery, fishing and athletics, as well as various kinds of ball games, were well-developed and regulated in ancient Egypt. The Minoans were bullfighting by 1500 BC. The Mycenean Greeks held extensive funeral games in honour of deceased warriors by 1500 BC.

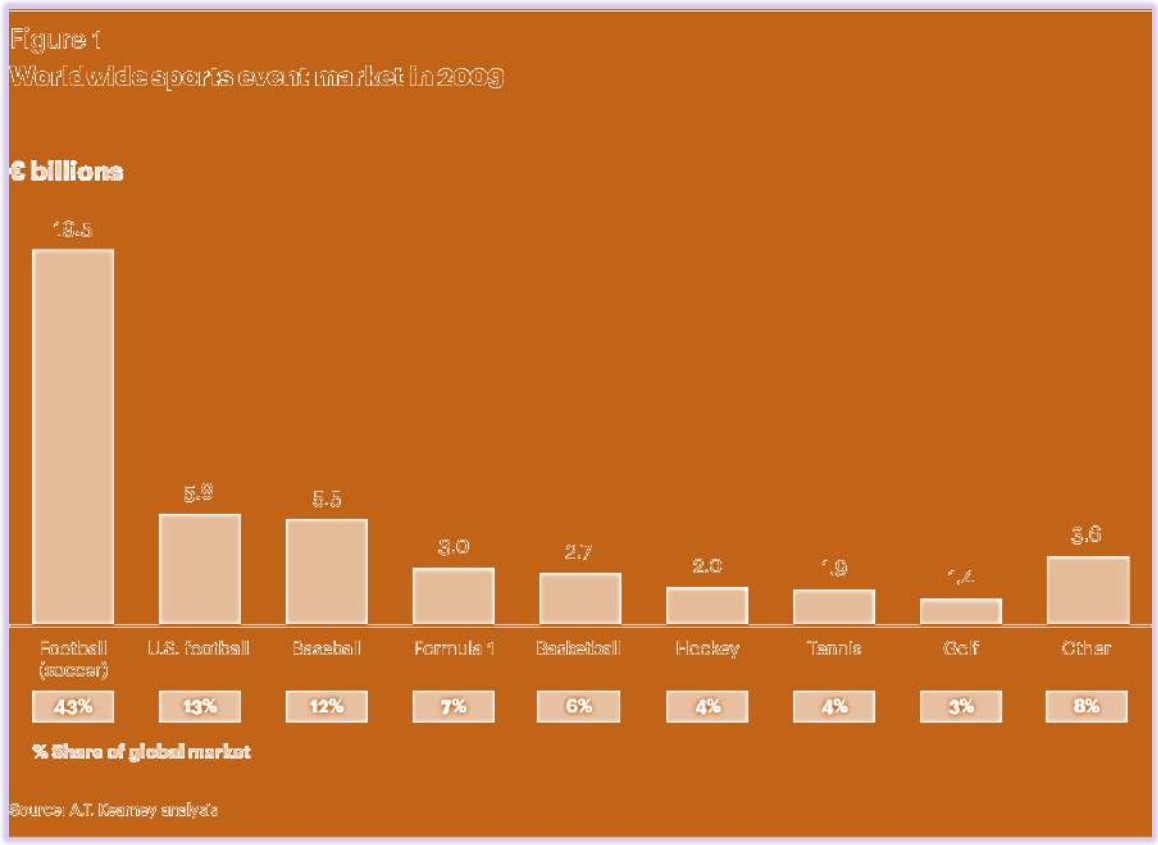
The first Olympic Games were held at Olympia in 776 BC. There were 3 other significant games held in other cities at the time. There was an Olympic truce for each event allowing people around the Hellenistic world to come and participate without fear of safety. The prizes were laurel wreaths to celebrate their triumphs. The Heraean games for women started by ~ 500BC in Olympia. In other parts of the world during ancient history – hurling in Ireland, Shinty (like hockey) in Scotland, Cujju (like football) & Gymnastics in China and Polo in Persia were played. The gladiatorial sports were known in the Roman Empire between 300BC and 400AD; with the biggest Colosseum in Rome built around 75AD. The Mayans had their great ballcourt at Chichen Itza, Mexico, between 600-1200 AD. It is felt that opium was already in use since the ancient Olympic games (doop for opium)

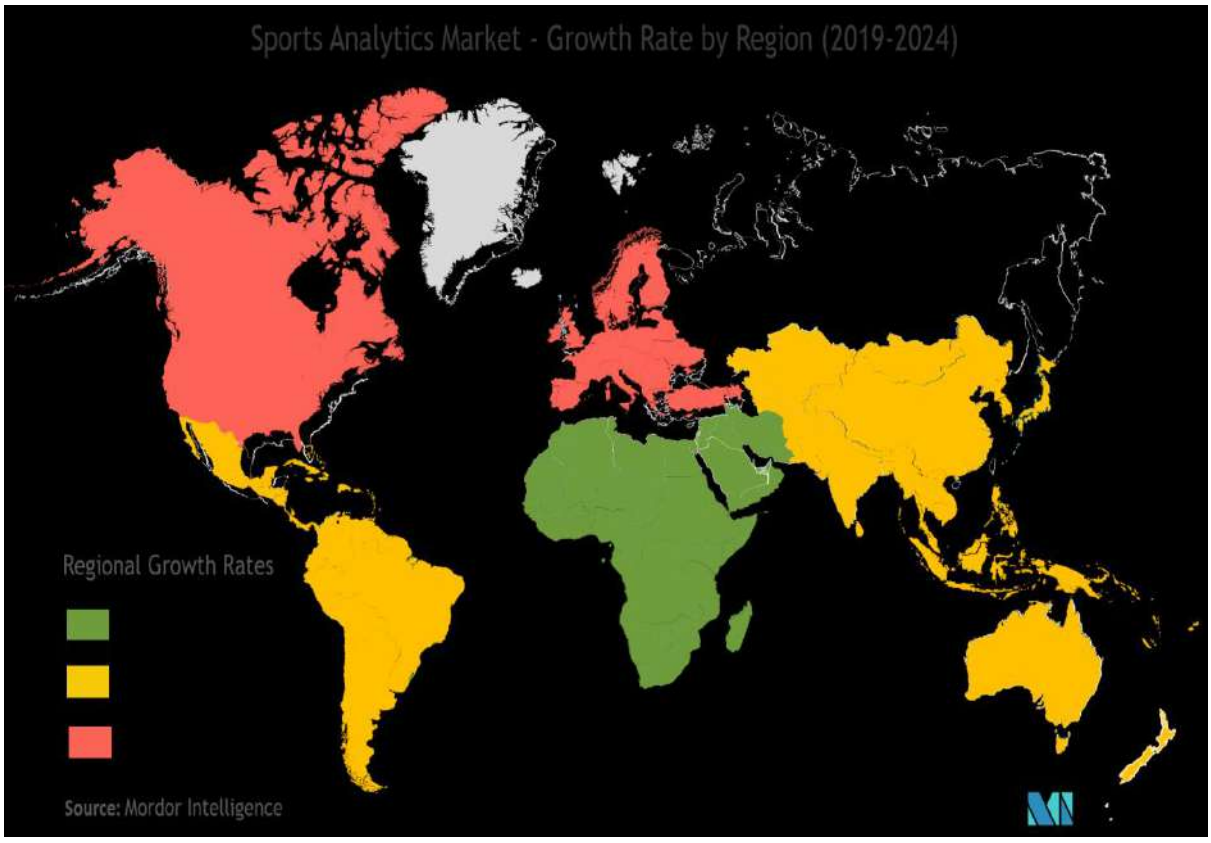
In Europe, the Parish initially sponsored the teams before they became county games. By the 17th century, Gambling Act was passed in Britain to curtail gambling related to sports. The games were modified, standardised, codified, made team play and refined in 19th century (In Britain and Europe) with the Industrial revolution, when it became more popular and affordable among the common public. The modern Olympic games were reborn in 1896 in Athens. In 1968, official drug testing of participating athletes began. There are an estimated 8000 indigenous sporting events around the world.

Today, an Olympic sports team has an extensive coaching and managing team with state-of-the-art materials, dietary plan and fitness regimes to enhance sports performance. Sports medicine, psychology, physiotherapy are integral parts of the sporting process.

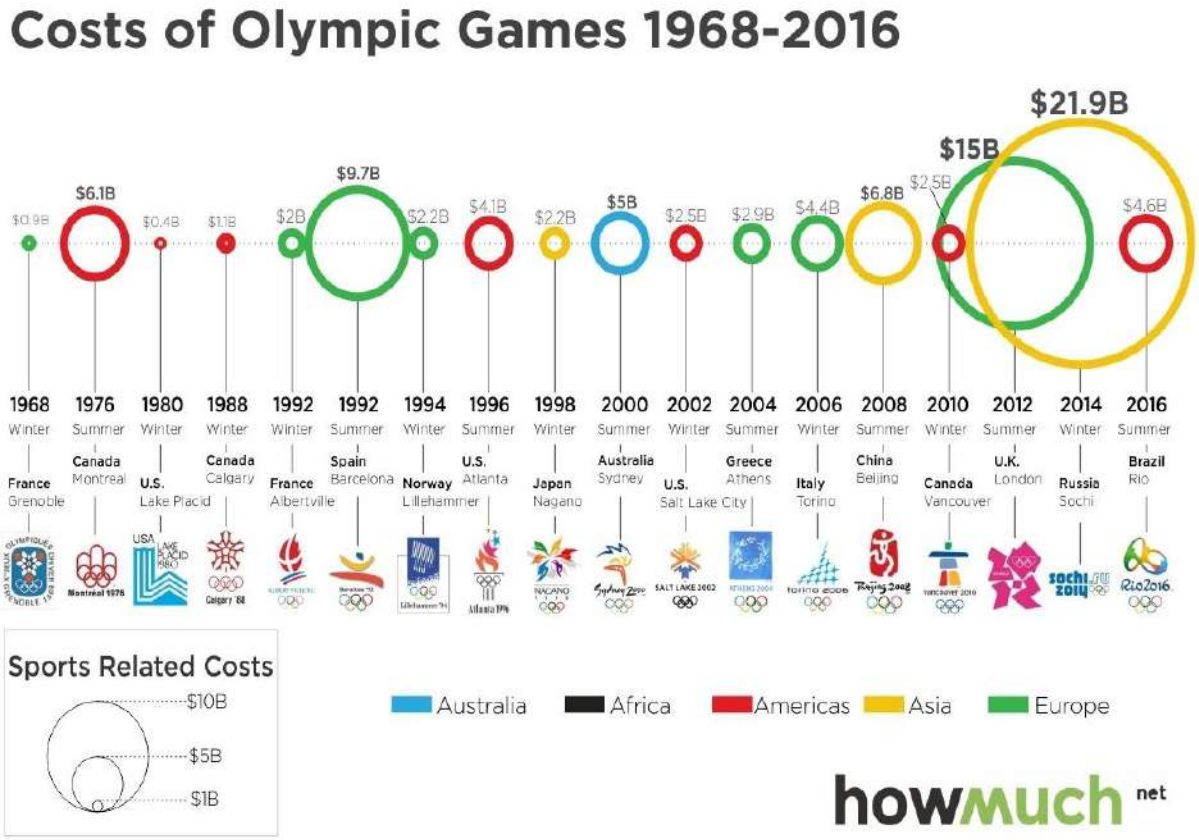
The average training time for an Olympian is about 2 decades. The current olympic games have 339 events across 33 sports. The official sponsorship for an Olympic 4-year cycle for a participating team is ~ 100 million dollars.

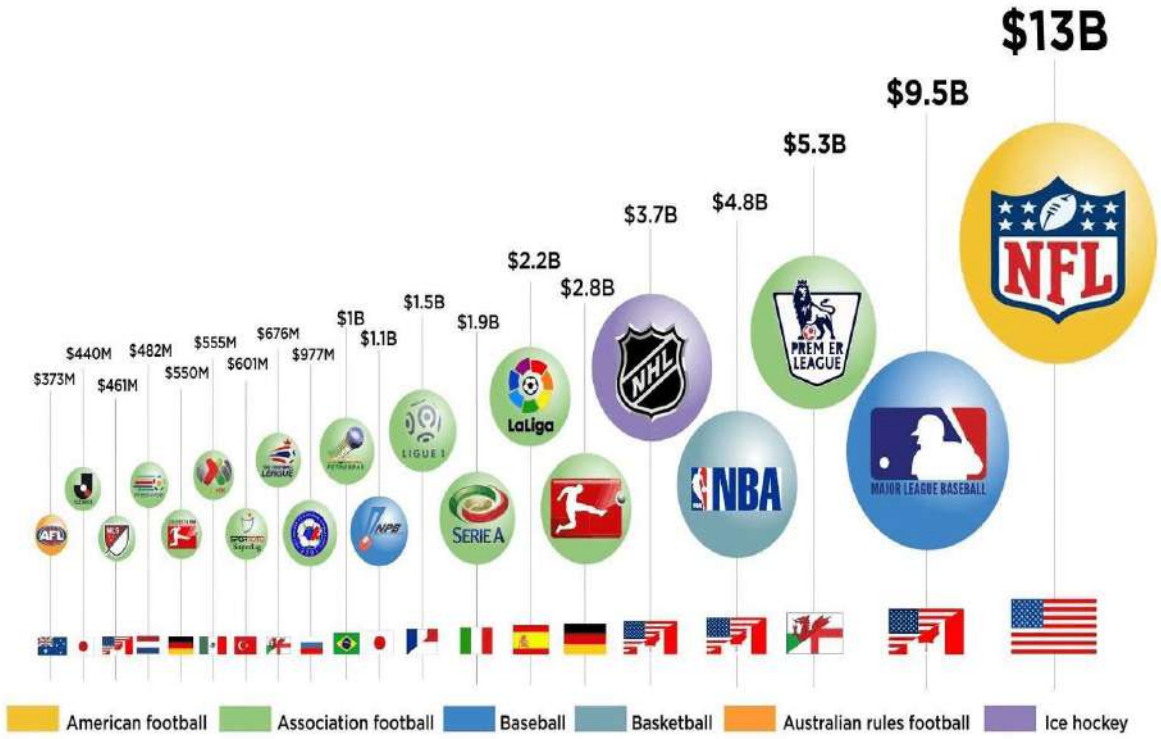
The current Global sporting industry is estimated at ~ $550 billion dollars. The annual revenue market from events is ~ $60 billion. The estimated sports gambling market is ~ $60 billion. However, most of this revenue lies within favoured current trends in the sports world.





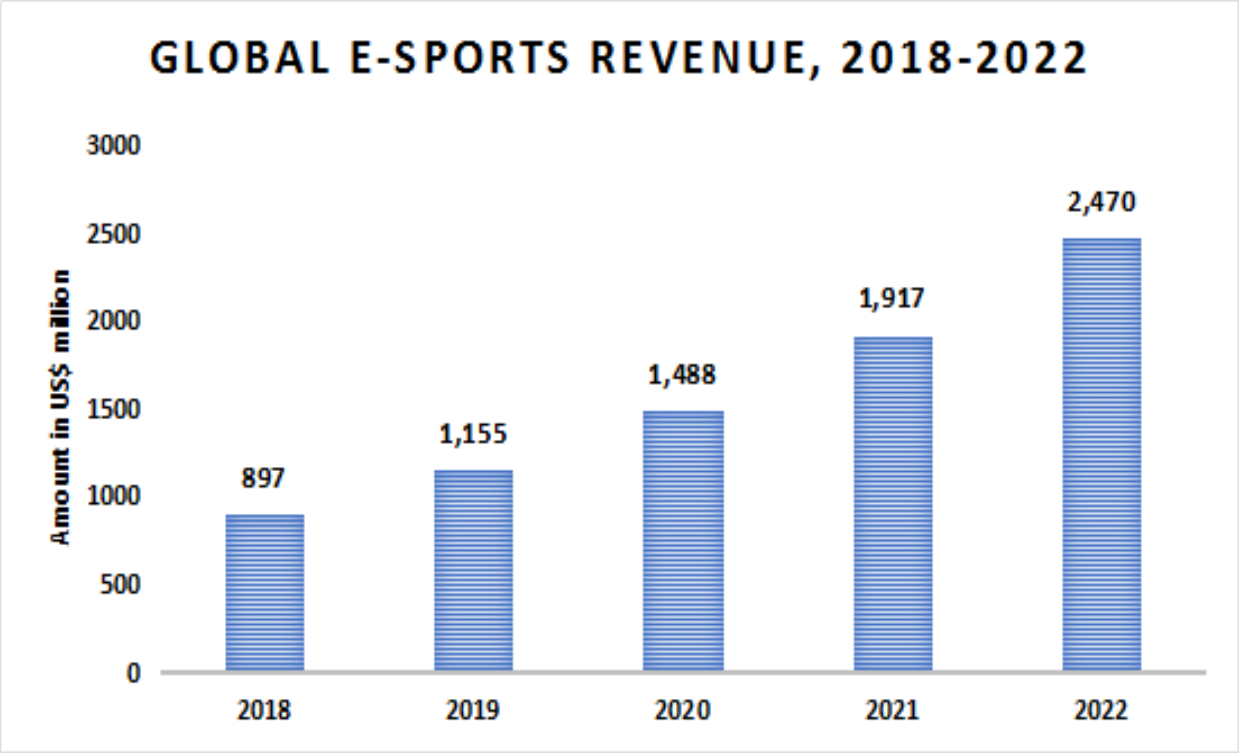
Green – high, yellow – mid, red – low, Growth rates of sports





The annual revenue of established sporting leagues

There is an increasing trend in online sports (excluding gambling) such as gaming.



On Drugs

The Shamans from Siberia are the first known to have used plant extracts for their effects on humans about 10,000 years ago. Coca leaves (containing cocaine) were chewed by South Americans since 8,000 BC. There was some form of alcohol in China by 7000 BC. Native Americans in northern mexico used peyote cacti (containing psychedelic alkaloid mescaline) since 5700 BC. The Persians and Indians used Soma rasa (likely combination of poppy, ephedrine and cannabis) by 4000 BC. Beetel nut chewing (contains alkaloids) was known in south east asia over 4000 years for its relaxant effects. Safrole is found in camphor oils [east Asian trees] and sassafras oils [eastern north American and east Asian trees]. Camphor was used in Hindu worship since 2000 BC. Opium was being used by 400 BC in the Greeko-Roman period, poppy (contains opiates) a native plant in Turkey. Tobacco was used in Mesoamerica by 100 BC for multiple purposes. Magic mushrooms and Ayahuasca were probably being used by meso-americans as psychedelics by 1000 AD. Tea was found in the sub-himalayan regions of India/Tibet/China by ~ 300AD. It is told that coffee was discovered in the 10th century in the Ethiopian highlands but the earliest known roasting and brewing practices go to the 15th century in Yemen due to Afro Asian Arab trade. It was known as the coffee trade of Mocha in Yemen; then during British colonial period in Yemen in the 19th century, was distributed further around the world. Illicit drug trade in the world is estimated at about $400 billion annually from about at least 200 different illicit drugs.

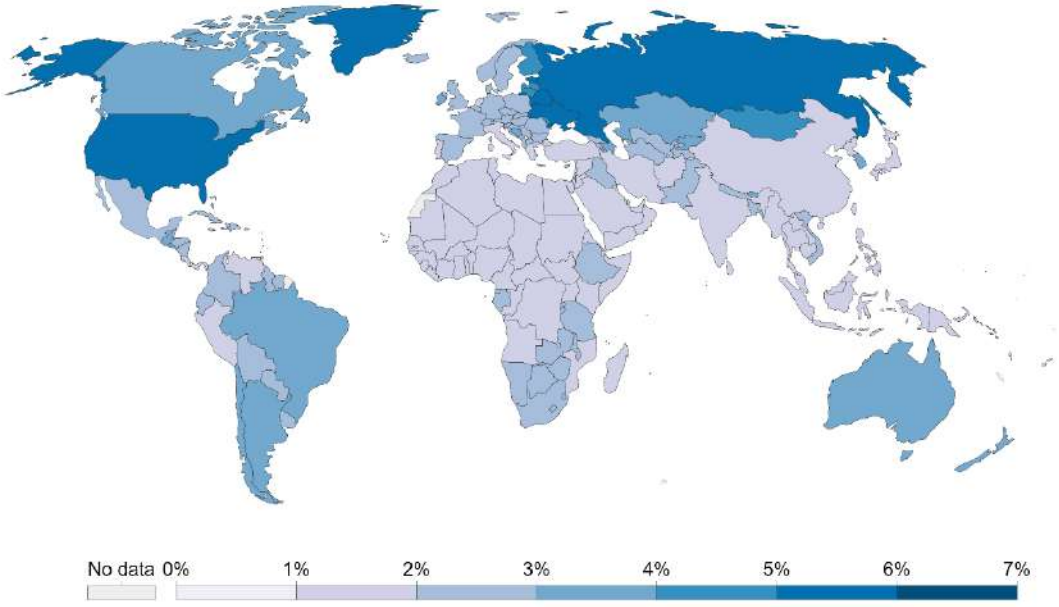
These psychotropic plant materials were used for their mind-altering effects, increasing physical tolerance, reducing hunger and other medicinal uses. They were integral part of religious ceremonies in many cultures. There was reported military application for drug uses in World War II and after. safrole is a main ingredient in the making of ecstasy) MDMA was invented in 1912 but found no suitable medical use and appeared in the black market by the 1980's as ecstasy.

The application of herbal medicine goes back centuries in Traditional Chinese, Ayuverdic (India), Unani (Perso-Arabic evolving from Greek medicine) and other cultures. The Royal Botanic Society estimates ~18,000 plant species with medicinal uses. The Patanjali Herbal Encyclopedia in India lists ~ 10,000 medicinal plants. The first synthetic drug to be manufactured was morphine (1804) from a plant extract. It is estimated that over 20% of current medicines are plant derived. Most are now synthetic medications from some base ingredients (natural or synthetic). The industrial use of coal tar advanced organic chemistry leading to the new age pharmaceuticals. However, coal tar was also historically used for its medicinal properties in regions with rich sources of petrochemicals. Drug bank statistics suggest ~ 11,400 drugs currently. FDA in America has approved about 1600 animal drug products and ~ 400 biologics products.

Share of the population with alcohol or drug use disorders, 2016

Our World in Data

Alcohol or drug use dependence is defined by the International Classification of Diseases as the presence of three or more indicators of dependence for at least a month within the previous year.



Source: IHME, Global Burden of Disease (GBD) OurWorldInData.org/substance-use • CC BY

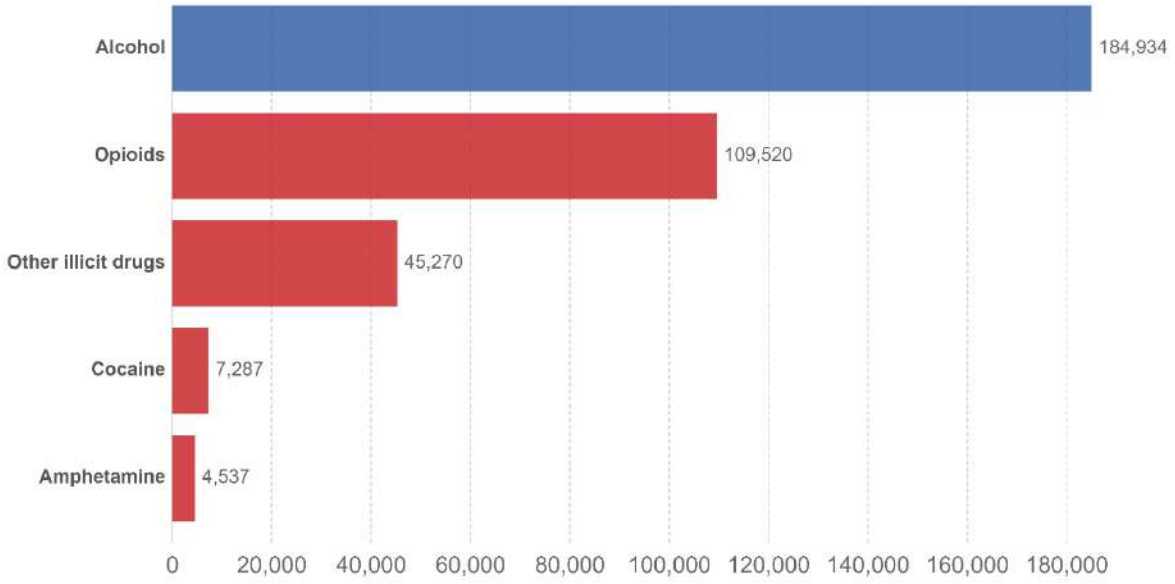
Note: Tobacco smoking is not included. Due to the widespread under-diagnosis, these estimates use a combination of sources, including medical and national records, epidemiological data, survey data, and meta-regression models.

Number of deaths from substance use disorders, World, 2017

Our World in Data

Substance use disorders refers to direct deaths from drug overdoses. This is distinguished from substance use as risk factor for premature death, which results when alcohol or drug use increases the likelihood of the development of disease or injury.

Substances shown in red are collectively termed 'Illicit drug use' in addition to cannabis, which is not shown here since it is not attributed to direct deaths from usage.



Source: IHME, Global Burden of Disease OurWorldInData.org/drug-use • CC BY

On Energy

Energy drives all machines. A simple definition is: A machine is a thing that is created by people to make a defined work easier. It is a tool or invention which multiplies the effect of human effort.

Improved agriculture and livestock/fisheries feed human energy needs. Heat energy in the form of fire is postulated to have occurred on earth 500 million years ago with evolution of plants giving out more oxygen into the environment. Fossilised plants became charcoal that hastened wildfires.

Fire

The evolution of grass about 7 million years ago would easily dry up and catch fire, hastening spread. It was the first energy source (fire as a source of heat energy) to be used by humans.

Evidence of cooked food is reported from 2 million years ago. Over last 100,000 years, mankind pursued better control of fire and making charcoal and finding a range of uses from cooking, lighting, heating to clearing landscapes. Stones were ground using flint and obsidian (themselves rocks) with human hands in the stone ages. Bulls were used to plough fields & horses for transport & granaries were humans' first proxy engines.

Wind

Wind energy was first used naturally in sailing. The first sail boat is recorded from Netherlands in 8000BC. The Egyptians were probably using wind energy for their boats in river Nile by 5000BC. The Polynesians (multiple east Asian origin) had used the knowledge of winds, currents and star directions to explore the pacific and resettle and are postulated to have reached as far as Madagascar crossing southern tip of South America and Southern tip of Africa.

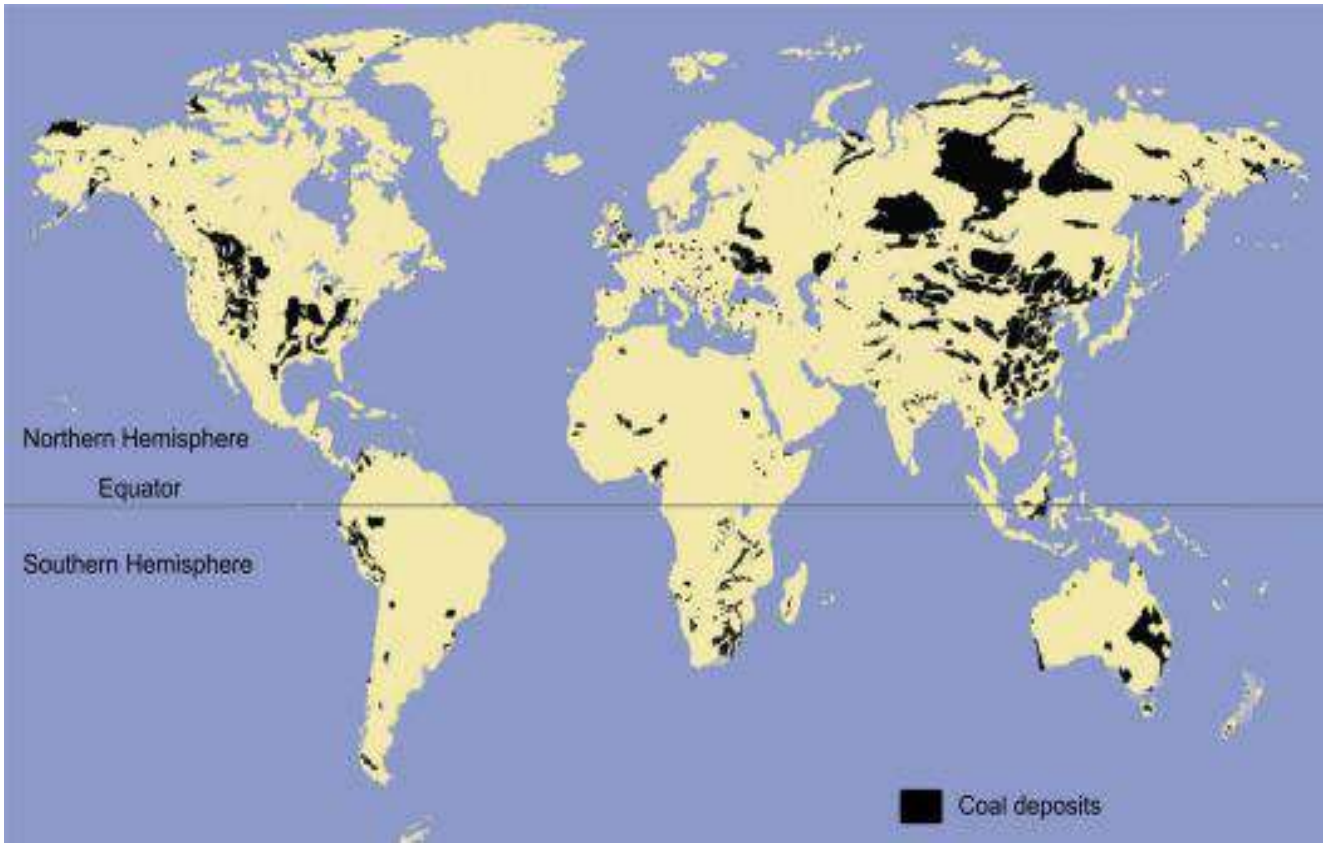
China was using wind powered water pumps by 200BC. Wind energy was used by Persians by 500AD to grind grains. The crusaders, caliphates and traders introduced wind energy to Europe. The Dutch introduced windmills in the 15th century and developed large wind-pumps to drain lakes and marshes

in the Rhine River Delta. The Portuguese (Spanish sponsorship) and the British then completed the world sailing routes culminating in colonial era. The steam ships then took-over from 1820's.

Heat

Plants go under the ground and either get fossilised into charcoal or slowly over millions of years get converted to a sedimentary rock called coal. Charcoal and coal became the primers to raise temperatures of burning. Kilns were used to improve combustion and raise heating temperatures. China had developed some specialised kilns by 2000BC leading to their renowned pottery.

Melting point of Tin is 230C and of copper is about 1000C. Hence Bronze (copper plus tin) age started earlier in human history. Near Israel, copper was being smelted by 7000BC. Britons were smelting bronze (copper plus tin) with coal by 3000BC. Iron melts at around 1500C and was the last metal age in 1000BC until early AD. Each of these metal ages transitions were known to be associated with violence. The Roman advances into Britannia was partly due to Britain's high coal reserves.



World coal reserves (Science Direct.com)

The first use of steam energy in 1st century AD by Hero of Alexandria (Greek) in Roman Egypt was the making of the aeolipile. Further designs on pumps were added. Further developments in 16th and 17th centuries ultimately led to piston and cylinder steam engine by Thomas Newcombe (Britain) in 1712. This started the commercial use of steam energy which ultimately replaced wind and water energy by late 18th century. Burning coal was the main energy source to produce steam. First the external combustion engine (was used in industries and big transport modes) in 1817 and then the internal combustion engine (for mobile transport) in 1872. Coal for producing steam was the foremost fuel until 1950 (although oil use was creeping up from 1850 mostly for internal combustion engines).

Egyptians had known of the electric fish in the river Nile since 2750BC. Similar numbing effects from electric catfish and ray were known. Thales (Greek) had reported his findings of static electricity by 600BC. William Gilbert (British) in 1600 differentiated lodestone effect (magnetic) from electricity. From the 17th to the 19th century, several scientists around Europe worked on Electricity, magnetism, their integration and engineering. The first battery was invented by Alessandro Volta (Italy) in 1800. The electrical telegraph (British) was the first commercial use of electromagnetism in 1837.

A short detour about lamps for lighting in the dark. Kerosene lamps, candles, fireplaces, and gas lamps were some of the ways you could light up your home after dark if you lived before the advent of electricity. Animal fats are largely used in the production of margarine (20th century onwards), shortening and compound fat. They also enter into many processed food products. Industrial and non-food uses of animal fats include the production of soaps, fatty acids, lubricants and feedstuffs. Tallow, which is rendered and purified animal fat, has been used for lighting since early Egyptian civilization. Sources of fuel for oil lamps include a wide variety of plants such as nuts (walnuts, almonds) and seeds (sesame, olive, castor, flax). Also widely used were animal fats (butter, fish oil, shark liver, whale blubber, seals).

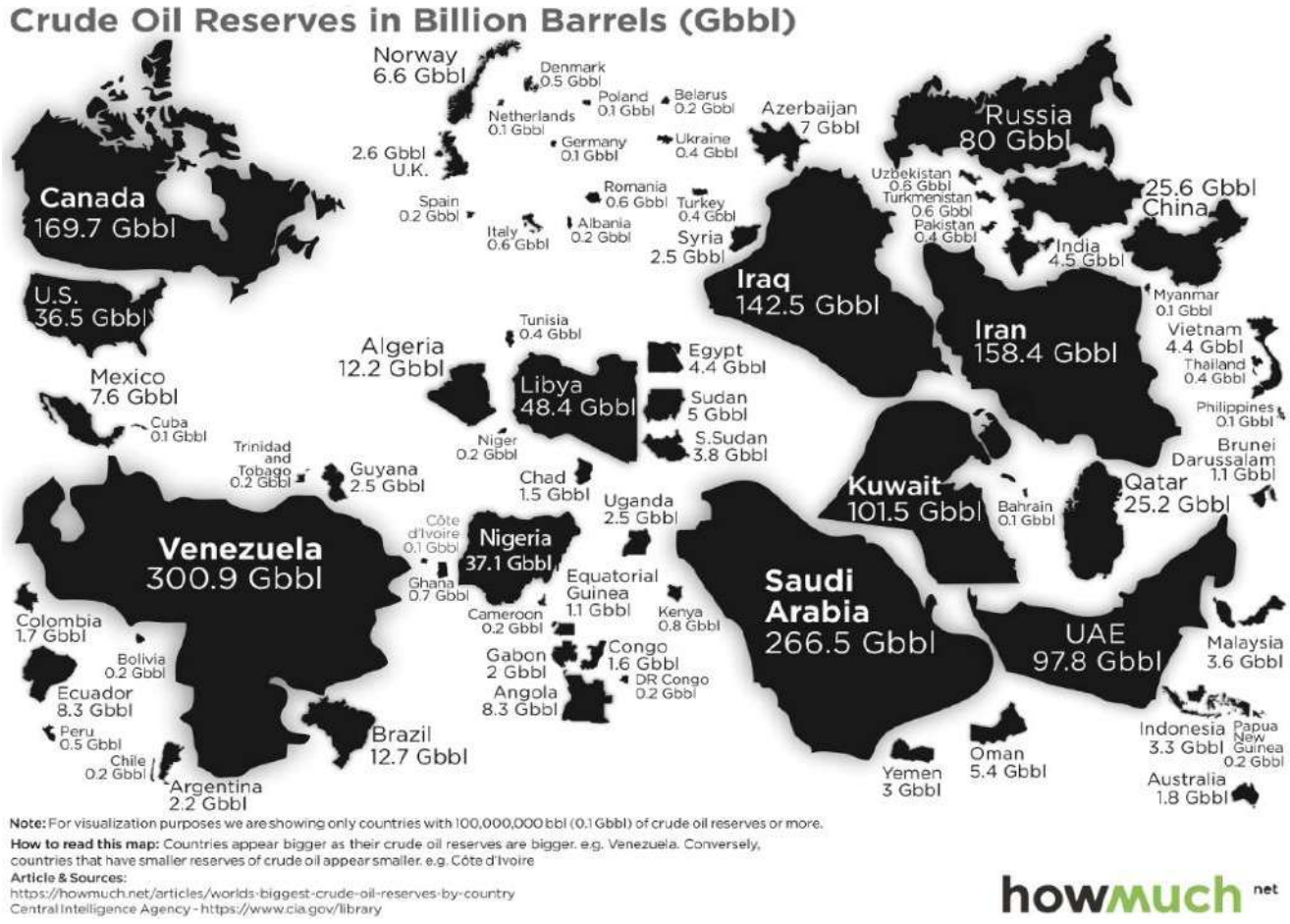
Whaling was practised from 6000BC (Korea) to 1980's in many parts of the European seas and Oceania until International Whaling Commission banned commercial whaling. it was an organised industry by 900AD in the Atlantic and whaleships were used by 17th century which headed out to artic seas as well. In early 20th century, 50,000 whales were killed annually. Different whale blubbers produced different types of whale oils with differing properties. The oil was used heavily during the industrial revolution. Sperm whale oil was the most priced. Commercial whaling was more for its oil than its meat. Most carcasses were thrown back into the sea due to their heavy dead weight. Camphene (oil from pine tree resin) and kerosene from crude oil in the late 19th century slowly outstripped the use of whale oil for lighting.

Candles were made from animal fat tallow since 500BC by the Romans, earlier used by Egyptians. The Han Chinese made candles from whale fat in 200BC. Bees wax candles were more expensive but burnt cleanly and used in Church ceremonies. In 18th and 19th Centuries, spermaceti, a waxy substance from Sperm whale was used to make candles. Industrial production of candle was achieved in 1834. Paraffin was refined in 1850's from petroleum and paraffin wax was used to make candles. By the late 19th century, steam distillation was used to harvest many different forms of fat and further enhanced industrial production.

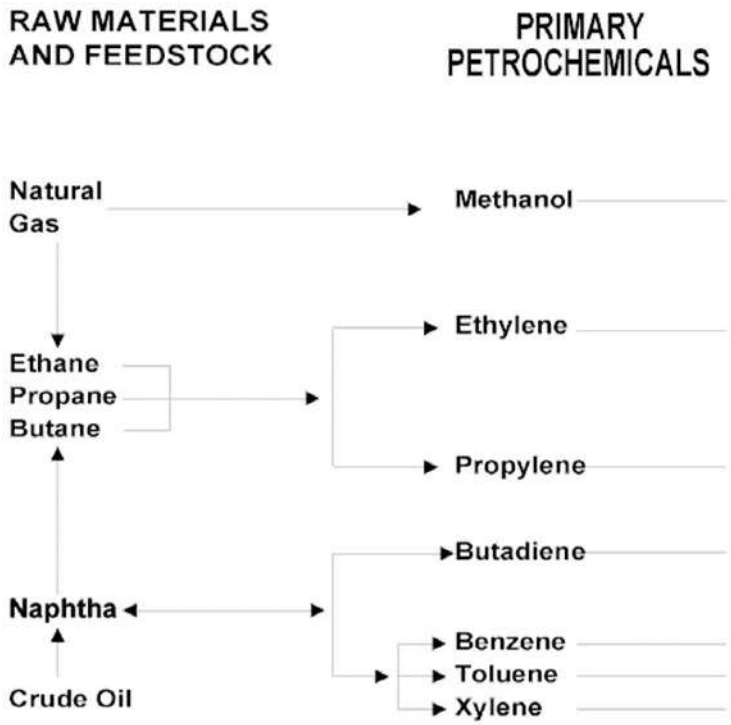
The 100 years between 1780 and 1880 had multiple scientists and entrepreneurs around the world to produce the first commercial light bulb. The first hydroelectric power plant was built in USA in 1882.

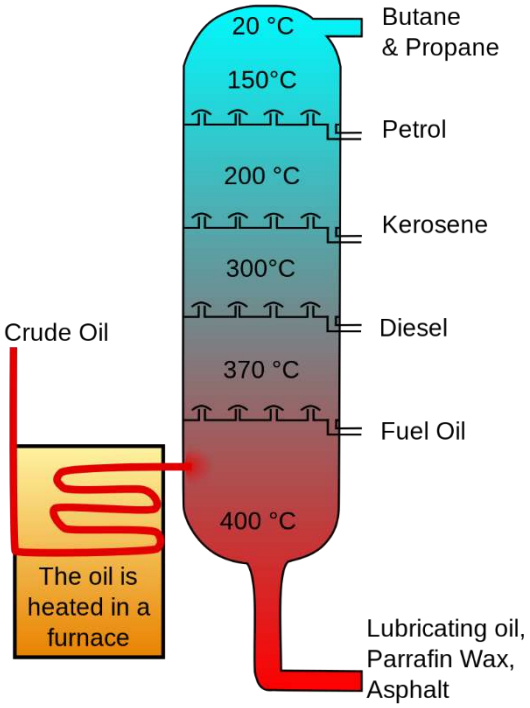
Asaphalt was used in Babylonia since 4000BC. The Chinese had documented use for petroleum as a fuel by 400BC. By 350AD they produced oil by bamboo drilled wells. The Persians had medicinal and lighting uses for petroleum. Distillation of petroleum was known to the Caliphates and introduced into Iberia. During colonial period, petroleum was found in many oil rich sources of the world (example Dutch east india company in Indonesia) where it was already being used by the locals. Russian Major Alekseev drilled the first modern oil well near Baku, Azerbhaijan in 1846. In 1848, James Young distilled lamp oil, machinery lubricating oil and paraffin wax from petroleum in Britain. This led to the formation of the world's first refinery in West Lothian, Scotland. Abraham Pineo Gesner of Canada refined Kerosene from petroleum in 1850. Ignacy Lukasiewicz of Poland invented the kerosene lamp that led to the first street lights in Europe in 1853. The early major oil wells were in Poland, Romania and USA. British engineer Edward Butler used petrol in internal combustion engine in 1884. By the end of the 19th century, the Russian empire's Branobel company was leading world production of crude oil from Azerbaijan. Global oil production increased from 2000 Barrels in 1859 to 125 million barrels in 1905. WWI & WWII involved strategic conquests of oil producing zones and still continues.

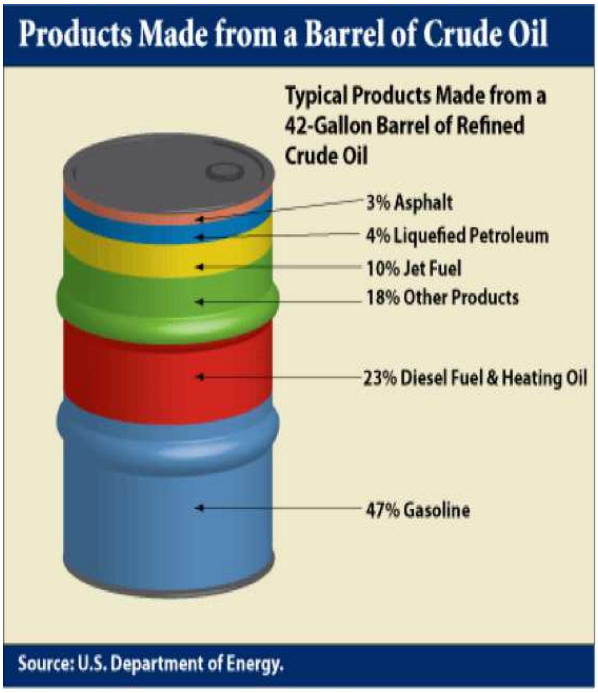
Till date, oil is the most portable and dense energy source for 90% of transportation in the world, domestic, commercial, space and warfare.

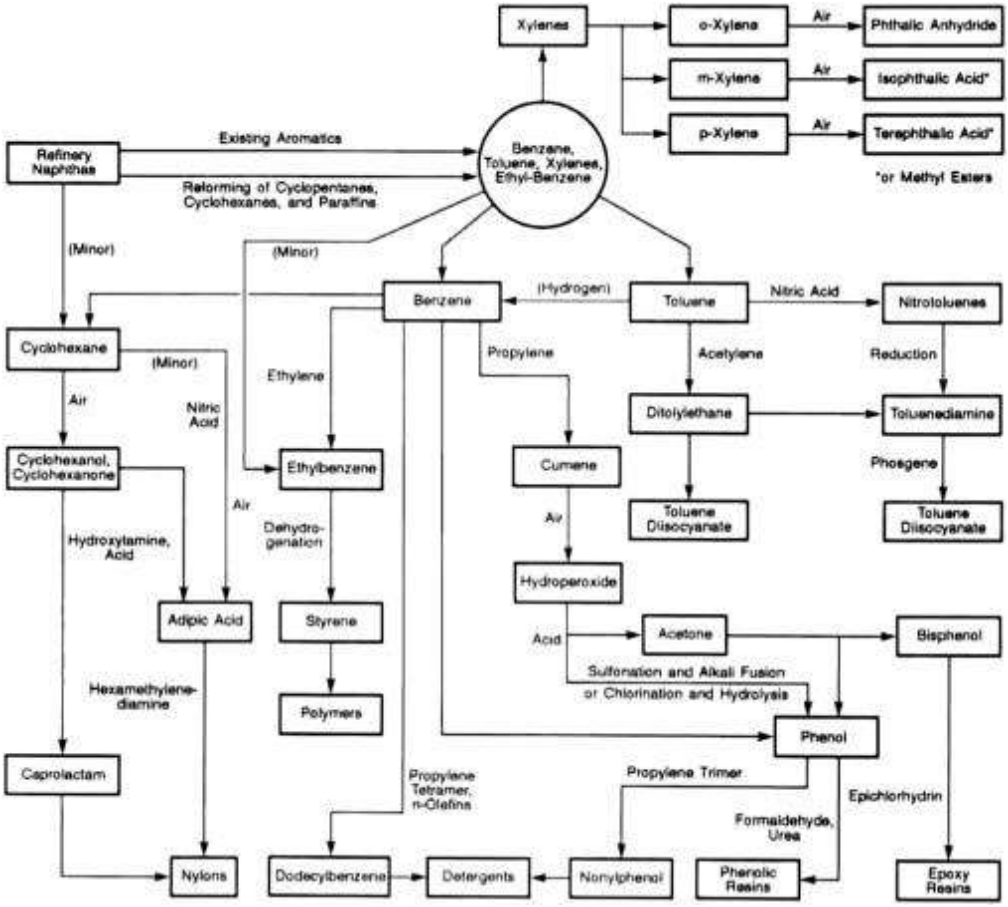


Naphtha is a flammable liquid hydrocarbon mixture. Mixtures labelled naphtha have been produced from natural gas condensates, petroleum distillates, and the distillation of coal tar and peat.


RAW MATERIALS AND FEEDSTOCK
PRIMARY PETROCHEMICALS
Natural Gas
Methanol
Ethylene
Ethane
Propane
Butane
Propylene
Butadiene
Naphtha
Benzene
Toluene
Xylene
Crude Oil

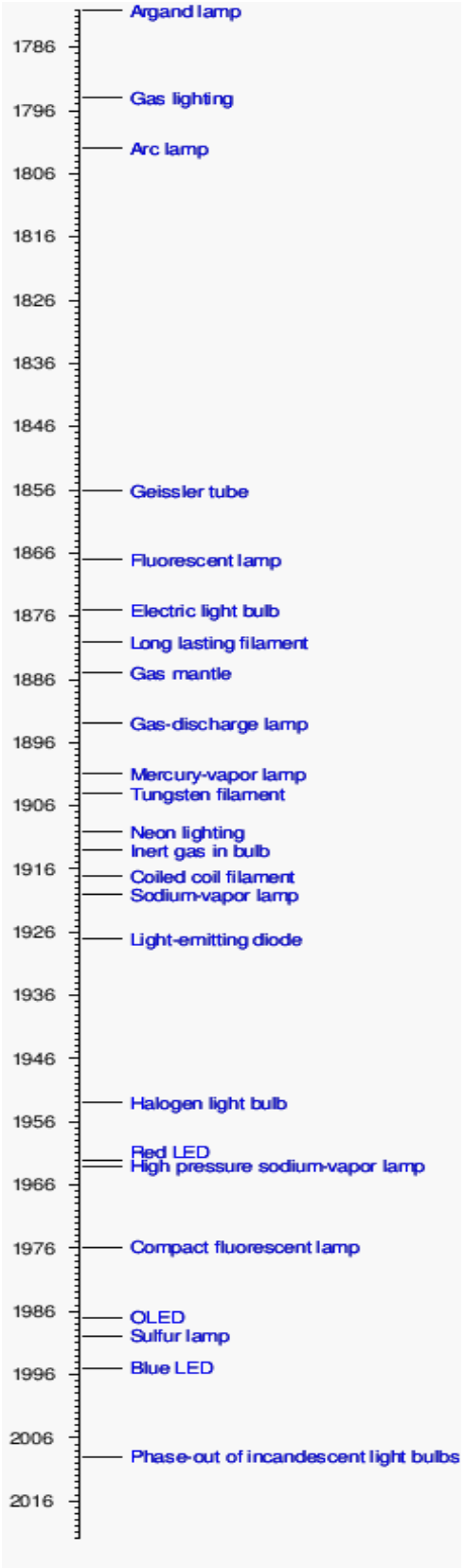

20 °C
150°C
200 °C
300°C
370 °C
400 °C
Butane & Propane
Petrol
Kerosene
Diesel
Fuel Oil
Crude Oil
The oil is heated in a furnace
Lubricating oil, Parrafin Wax, Asphalt


Products Made from a Barrel of Crude Oil
Typical Products Made from a 42-Gallon Barrel of Refined Crude Oil
3% Asphalt
4% Liquefied Petroleum
10% Jet Fuel
18% Other Products
23% Diesel Fuel & Heating Oil
47% Gasoline
Source: U.S. Department of Energy.



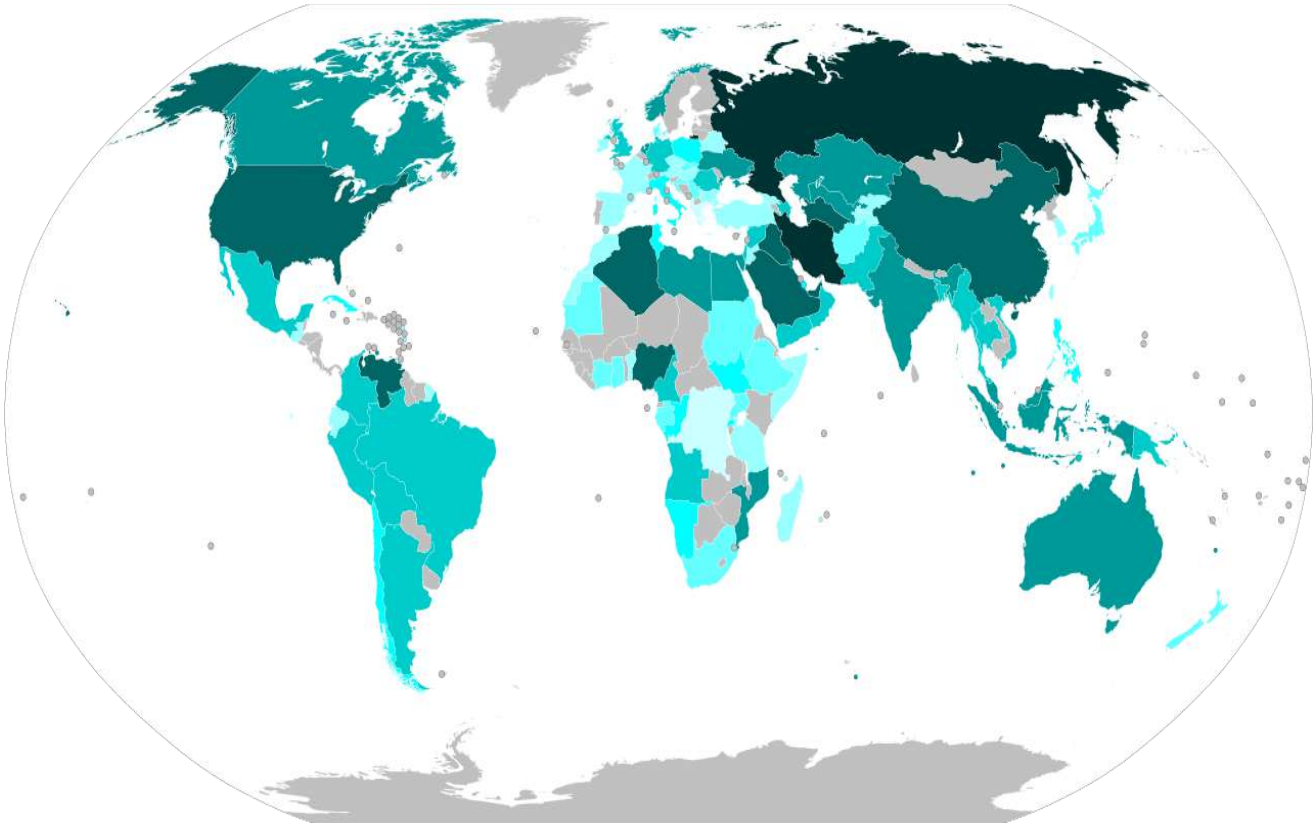
Xylene, Benezene and Toluene – primary petrochemicals leading to the synthetic manufacturing industry (Science Direct, 2011).

The industrial revolution of 1750-1900 starting in Britain but engulfed Europe and USA led to many salient inventions. It's a history of ideas to see how a finding in nature is used by humans over time and enriched to a product with desired properties and how this keeps evolving.


Argand lamp
1786
Gas lighting
1796
Arc lamp
1806
1816
1826
1836
1846
Geissler tube
1856
Fluorescent lamp
1866
Electric light bulb
1876
Long lasting filament
Gas mantle
1886
Gas-discharge lamp
1896
Mercury-vapor lamp
Tungsten filament
1906
Neon lighting
Inert gas in bulb
1916
Coiled coil filament
Sodium-vapor lamp
1926
Light-emitting diode
1936
1946
Halogen light bulb
1956
Red LED
High pressure sodium-vapor lamp
1966
Compact fluorescent lamp
1976
OLED
Sulfur lamp
1986
Blue LED
1996
2006
Phase-out of incandescent light bulbs
2016

In about 1000, B.C., the Oracle at Delphi, on Mount Parnassus in ancient Greece, was built where natural gas seeped from the ground in a flame. Around 500 B.C., the Chinese started using crude bamboo “pipelines” to transport gas that seeped to the surface and to use it to boil sea water to get drinkable water.

Natural Gas was discovered in 1626 when French discoverer in Colonial USA observed American Indian Natives igniting seeping gases around lake Erie. The first commercialized natural gas occurred in Britain. Around 1785, the British used natural gas produced from coal to light houses and streets. In 1816, Baltimore, Maryland followed. The first well was dug in New York in 1821. In 1885, the Bunsen burner opened new opportunities to use natural gas. Once effective pipelines began to be built in the 20th century, the use of natural gas expanded to home heating and cooking, appliances such as water heaters and oven ranges, manufacturing and processing plants, and boilers to generate electricity. It is considered one of the cleanest and safest to use fossil fuels.



Global Natural Gas reserves

The estimated ONG pipeline distribution in 120 countries of the world is 2.5million miles, 60% of which is in USA. Natural Gas pipelines are above ground and Oil pipelines are underground and made of different materials.

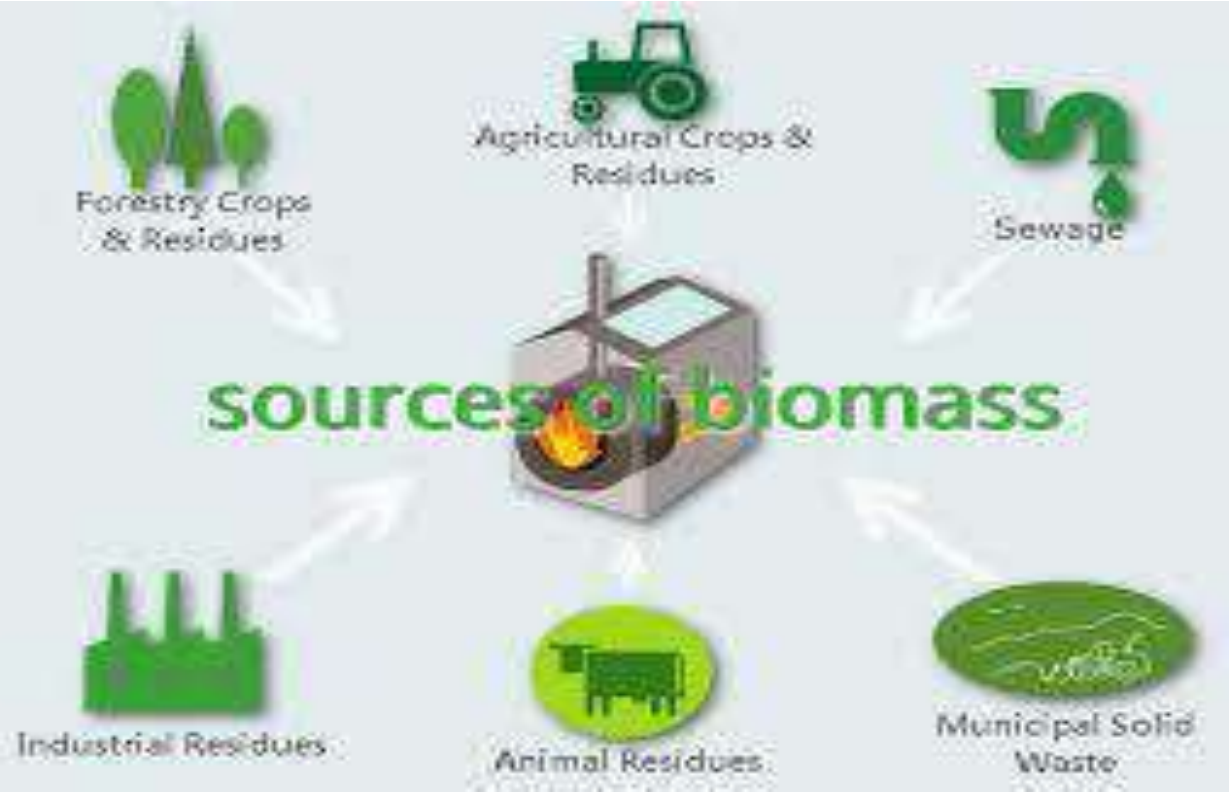
Biomass has been used as heat source of energy since the beginning of human civilisation by burning wood. It has now entered industrial scale.

Biomass can be burned to create heat (direct), converted into electricity (direct), or processed into biofuel (indirect).

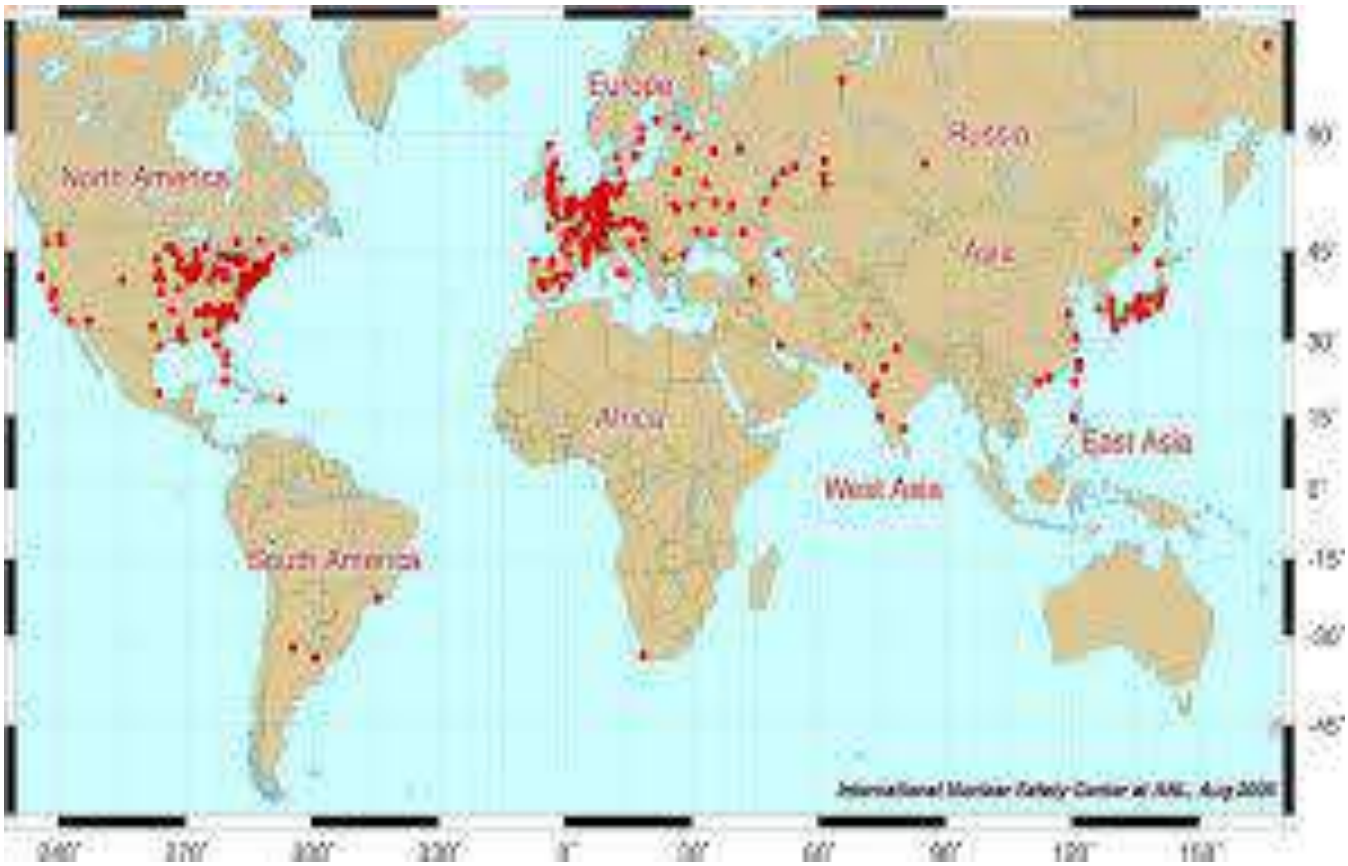
Pyrolysis oil, sometimes called bio-oil or biocrude, is a type of tar. It can be combusted to generate electricity and is also used as a component in other fuels and plastics. Scientists and engineers are studying pyrolysis oil as a possible alternative to petroleum.

Biochar is a type of charcoal. Biochar is a carbon-rich solid that is particularly useful in agriculture. Biochar enriches soil and prevents it from leaching pesticides and other nutrients into runoff. Biochar is also an excellent carbon sink. Carbon sinks are reservoirs for carbon-containing chemicals, including greenhouse gases.

Slag forms as a glassy, molten liquid. It can be used to make shingles, cement, or asphalt. Syngas can be converted into fuel (such as synthetic natural gas). It can also be converted into methane and used as a replacement for natural gas. Syngas and Slag are formed by a process called gasification (heated to more than 700C)

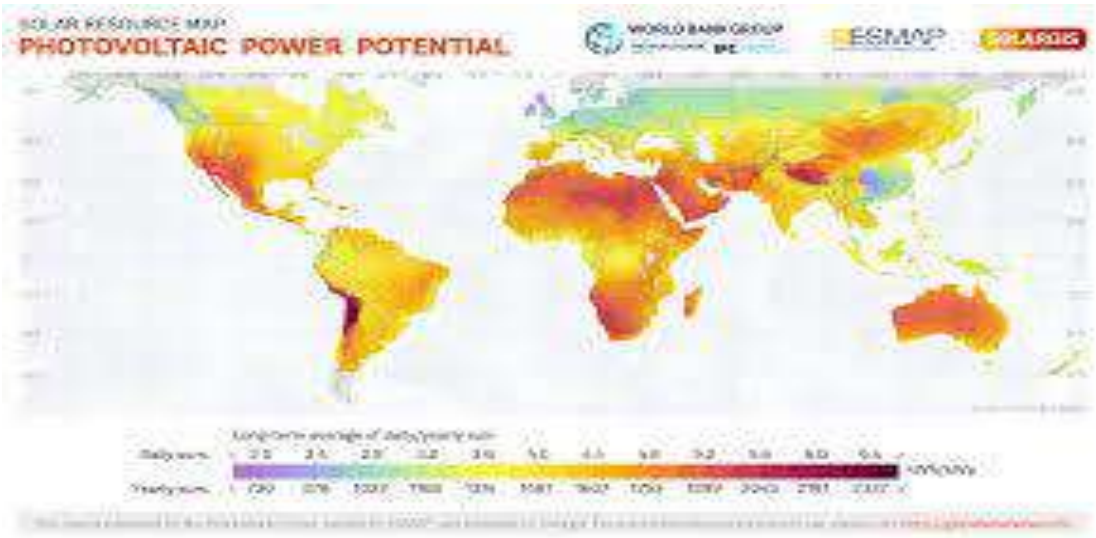


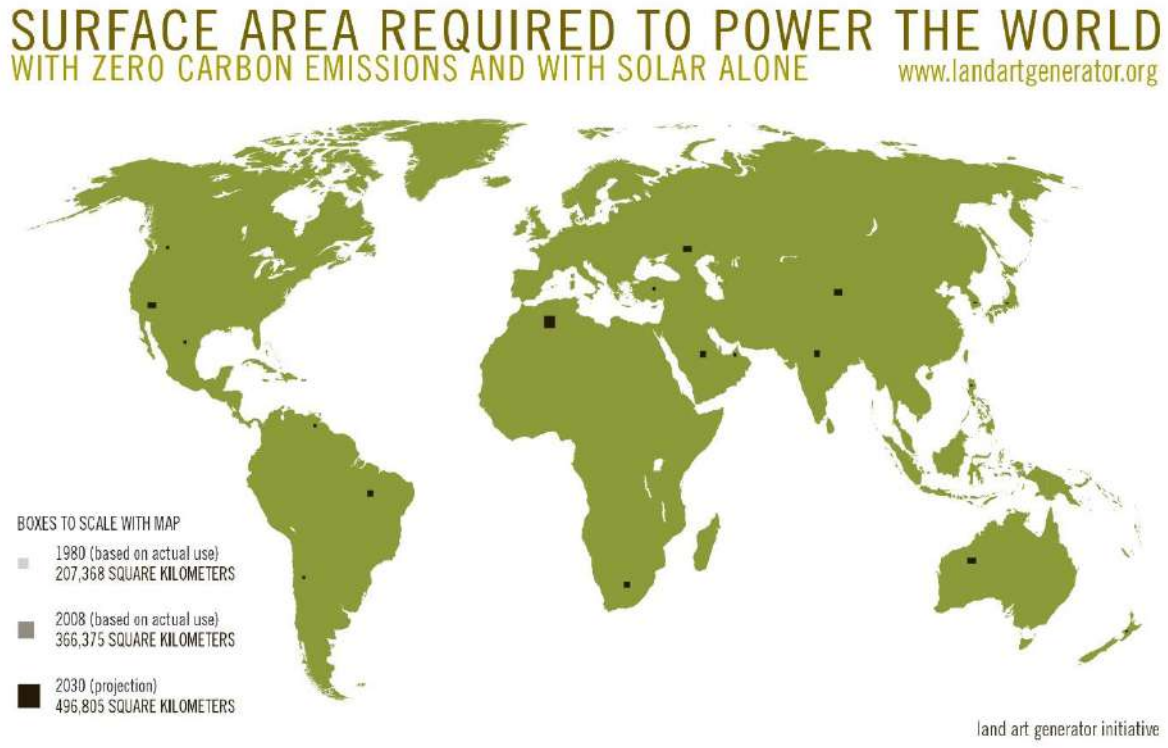
Nuclear power has the lowest recorded fatalities per unit of energy produced in comparison to coal and petroleum; however, one nuclear accident can lay waste vast amount of lands and become carcinogenic to those exposed in high doses. It is air pollution free although nuclear pollution is a problem under study. The story starts from 1932 with Ernest Rutherford's experiment of splitting the nucleus, where he observed release of huge amount of energy; but this was not accepted by his peers as capable of being harvested in the near future. The Curie's discovered induced radioactivity and the nuclear chain reaction. German scientists found that uranium when bombarded with neutrons split into two big fragments rather than just a miniscule fragment as was previously believed. This was the cusp of world war II and the allied countries supported their governments to develop a nuclear bomb. The scientists working in Germany on this area of research emigrated to USA where they were part of the Manhattan project involved in designing a nuclear weapon. This landed in Japan in 1945 within a month of its first test, ending the World War II. The USA Navy converted its naval fleet to nuclear powered right away. After the war, light water and heavy water thermal fission reactors were developed that form the backbone of thermonuclear reactors in nuclear power generation. Electricity was generated by a nuclear reactor in 1951. The world's first commercial nuclear power station opened in England in 1956. USA was already providing industrial capacity electricity generated from nuclear power stations to commercial grids by 1957. A global nuclear stock pile was reached during cold war and some disbanded since with growing global concerns. France produces 75% of its electricity by Nuclear power, most developed countries in the range 20-30%, in comparison to 3% in India.



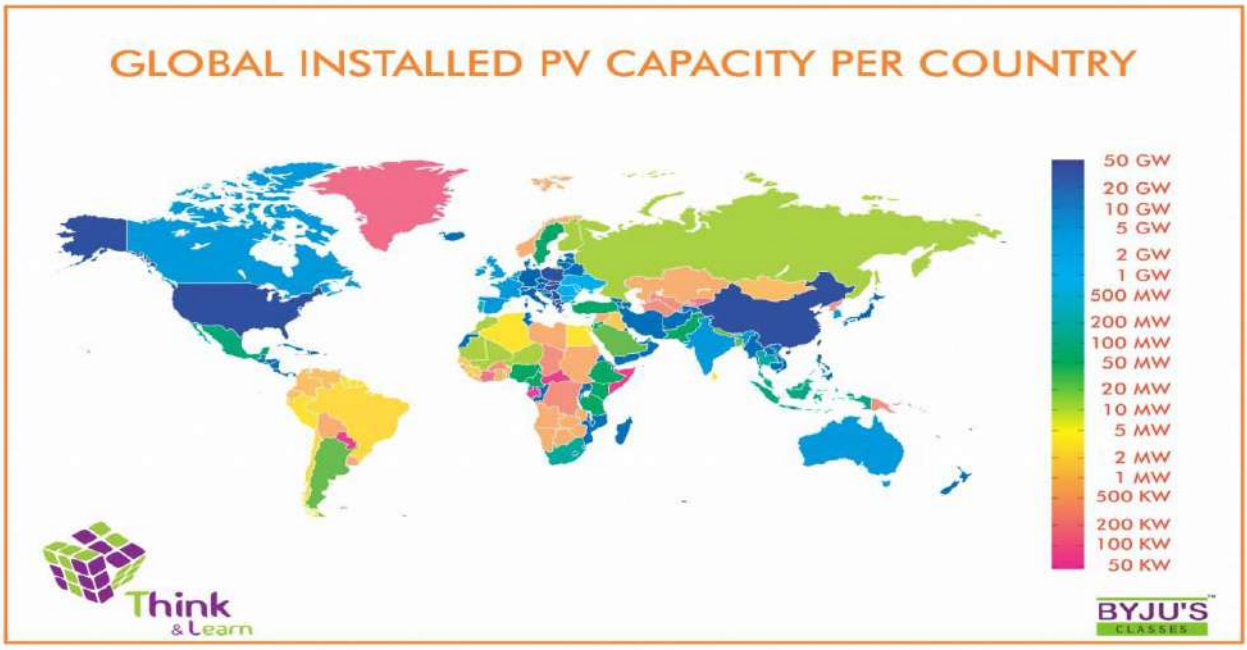
Nuclear power stations worldwide

The first reported use of *solar energy* was to cause fire with a magnifying glass in 700BC. Burning mirrors were used by Greek, Romans and Chinese to light ceremonial fires. Roman bathhouses also used sunrooms. In the 18th and 19th century, sunlight was used to heat ovens in voyages and to boil water to produce steam in a powerboat. First the photovoltaic effect was demonstrated in mid 19th century soon followed by using selenium, a natural element, when exposed to sun produced electricity. Albert einstein provided the explanation for photoelectric effect in 1905 for which he later received the Nobel prize. The silicon photovoltaic cells were found by Bell Labs in 1954. The first use was in space science where NASA had already put a fully automatic observatory on solar panels into orbit by 1966. The first solar building was built in USA in 1973. From 1950 to 2016, research around the world has improved solar electric production from silicon panels from 10% to 35%. Solar powered airplanes are being tested and one has already flown around the world. The pricing of solar panel has dropped from $300 a watt in 1956 to $0.5 a watt.

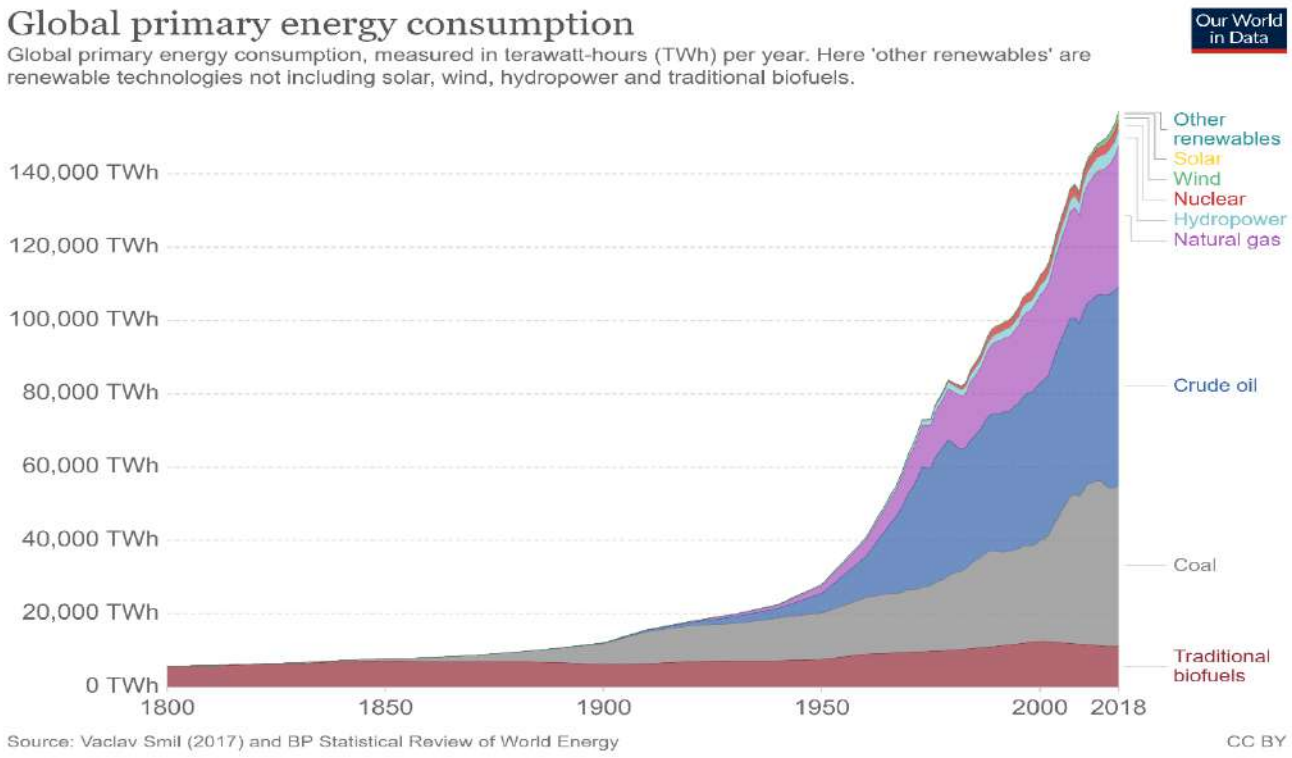




India initiated the International Solar alliance in 2019 for a global solar electric grid of photovoltaic capacity 1 terawatt, with a pledge to invest up to 1 trillion dollars by 2030.

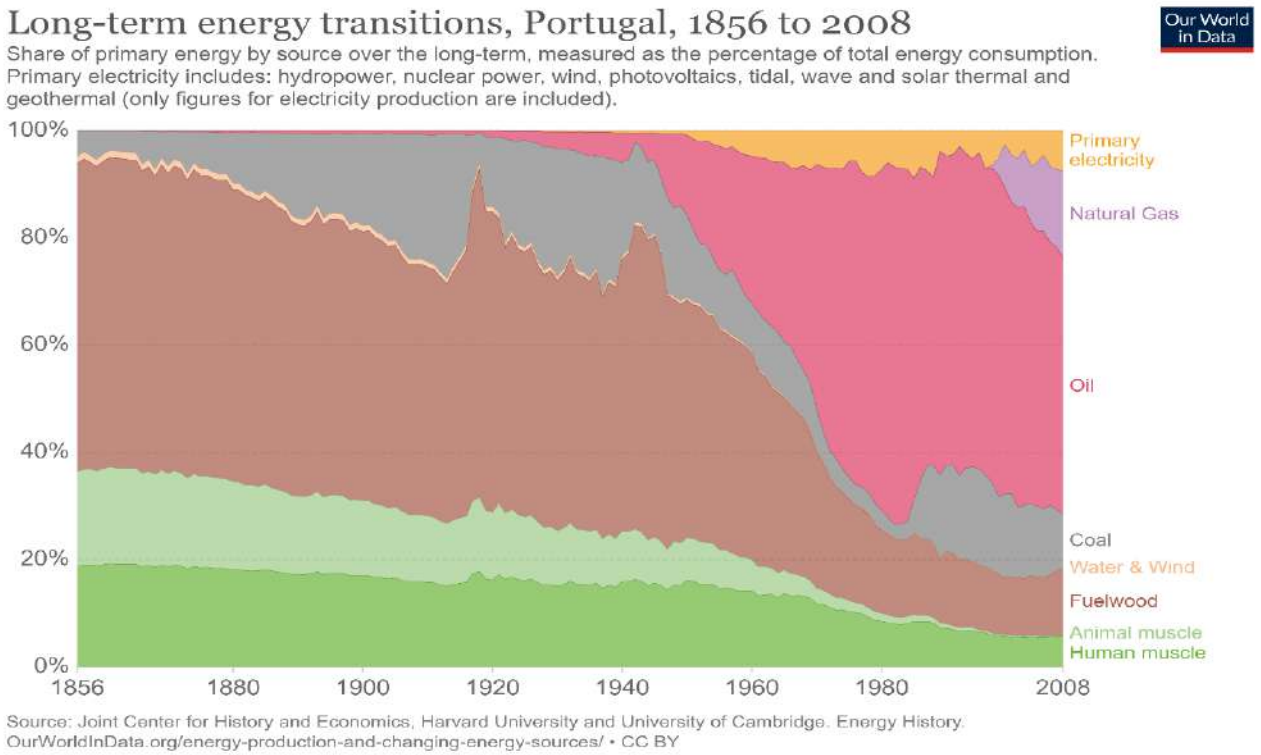


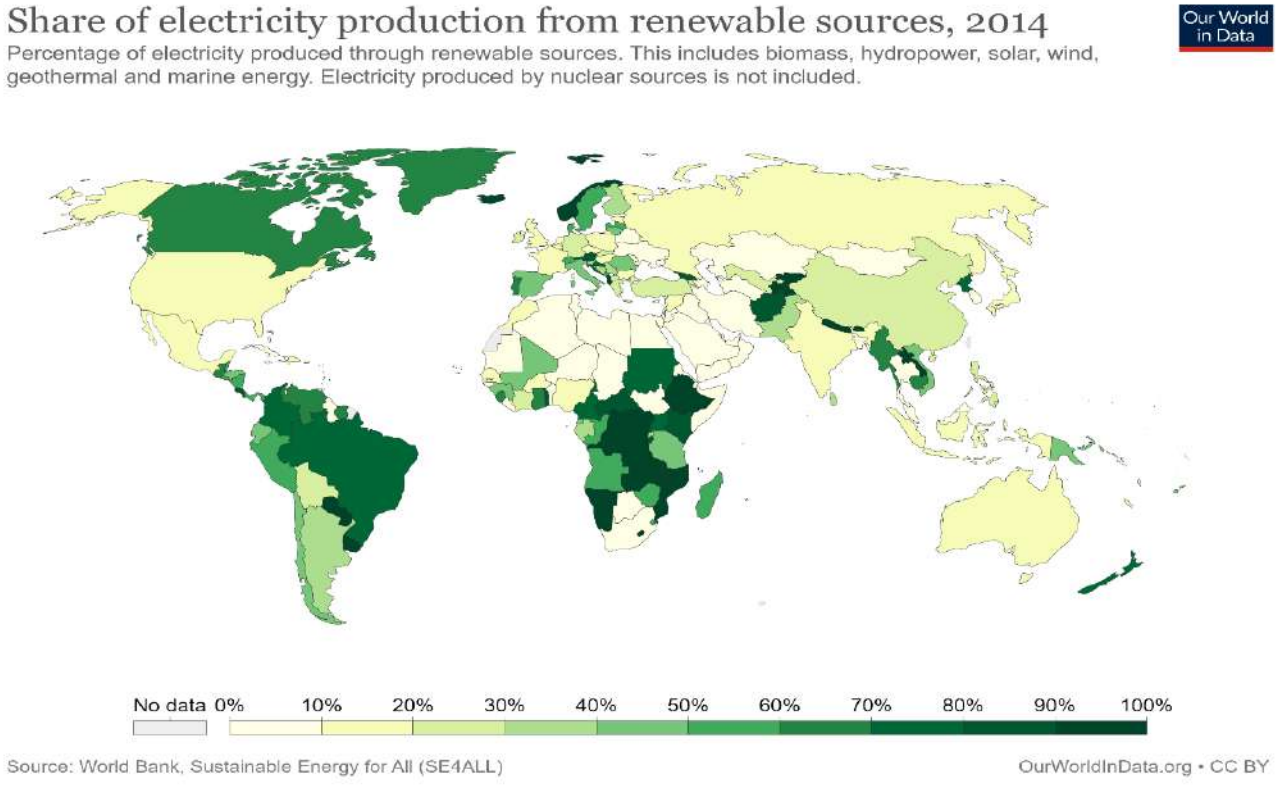
Summary illustrations on Energy:

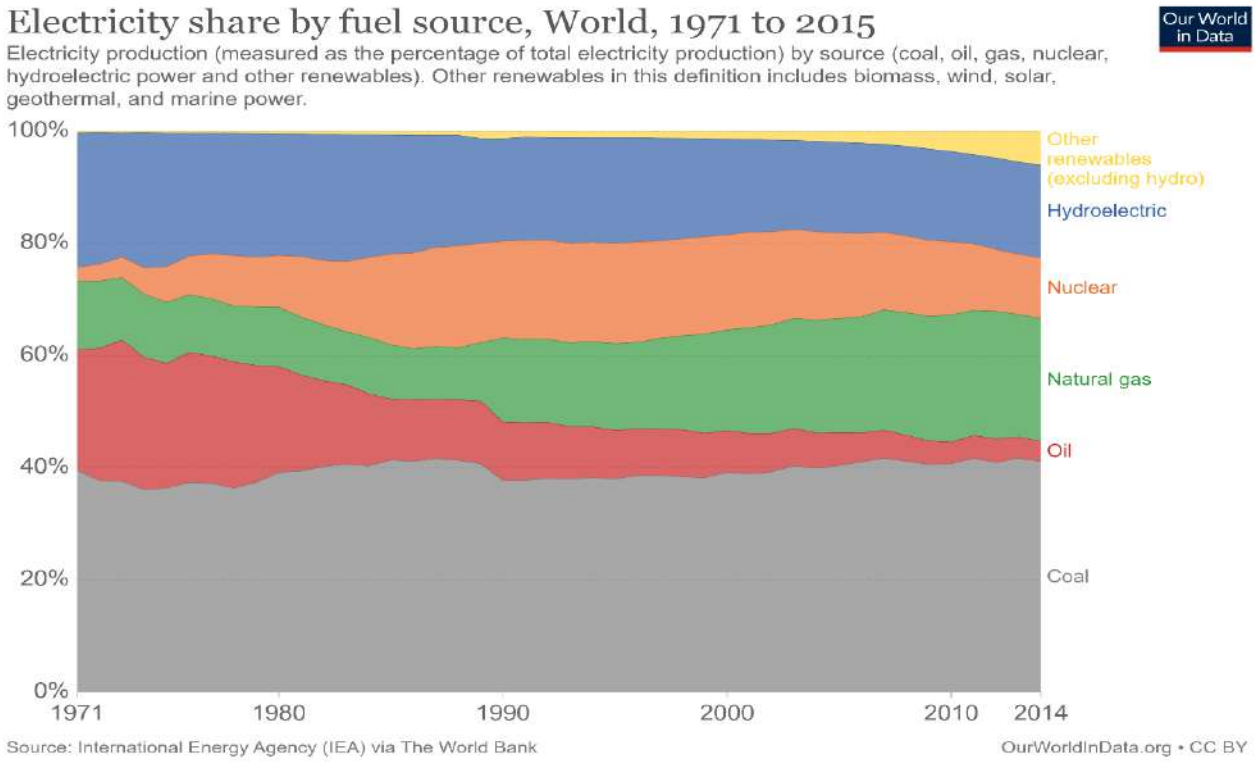


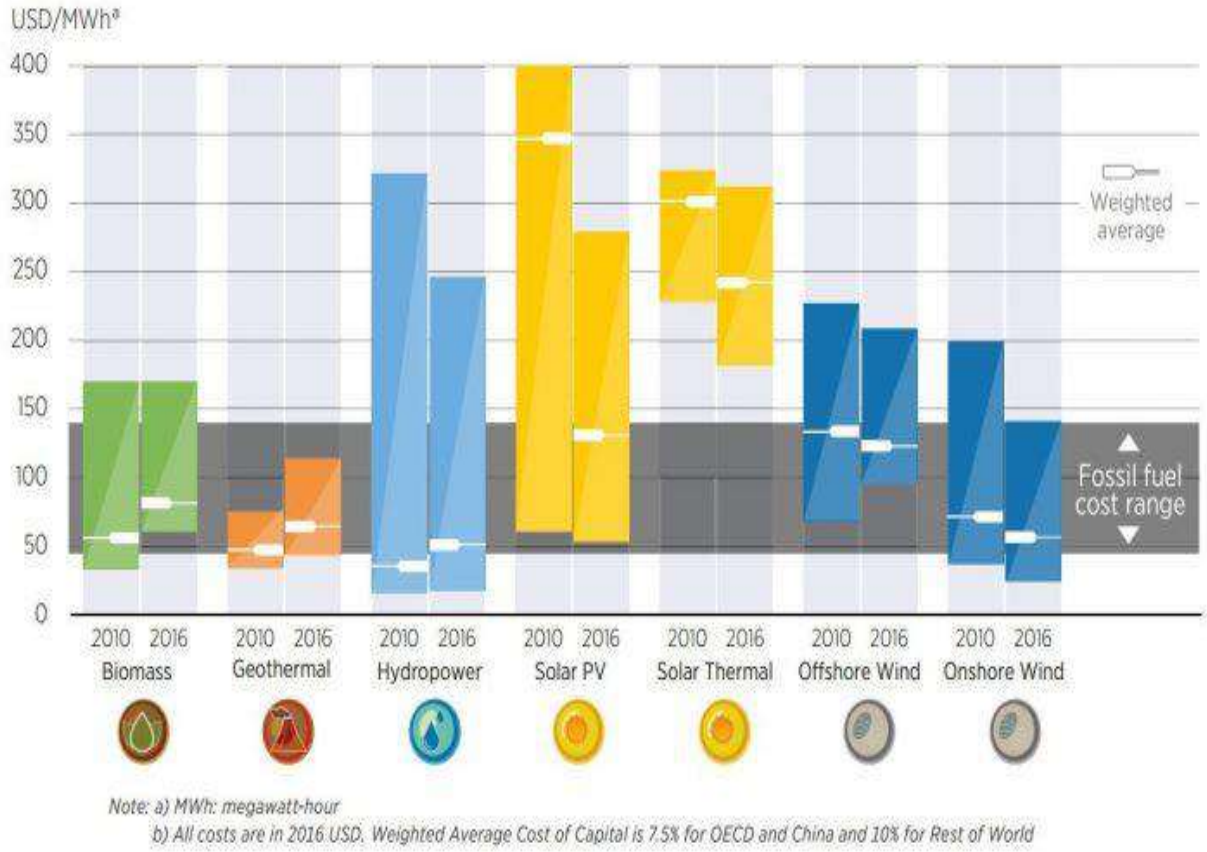
As can be seen in the picture above, >90% of world energy requirement is still fulfilled by fossil fuels. And about 50% is consumed by asia pacific region. Most energy sources are used as electric energy or thermal energy.

This picture uses the example of Portugal over 160 years to illustrate human effort to machine energy use over time. Human physical effort reduced by half.









Relative cost of energy source in USD per Mega Watthour

On Mining

During the Stone age, flint and chert stones found in chalk reserves (chalk formed from sub-microscopic phytoplankton in the sea), a sedimentary rock, was used to grind stones to sharpness. Chalk cliffs were easily accessible around Dover Cliffs in England and its counterpart cliffs in the northern border of France. Obsidian rocks from south Italy was traded around the Mediterranean and in Ppaua New Guinea. The oldest known mine in the world from the middle stone age was a haematite mine in Swaziland. Haematite was used to make the pigment red ochre.

Towards the end of stone age, kilns made it possible to reach high temperatures required to smelt ores and produce metals. This made it possible to bake clay into porcelain for pottery. They probably dug the ores out with stones initially (sharpened with flint from France, England and Poland) and then used the bronze tools itself to clear further ground. They usually happened in high ore density areas, available near the surface, almost in similar time frames around the world; possibly suggesting a similar idea occurring to inhabitants in similar surroundings or the knowledge and experience was shared in time.

Bronze (Copper plus tin) were the earliest metals in dominant use starting in the period known as Bronze age, at heating temperatures of about 1000C. The first known copper mine was in Timna Valley near Israel by 7000BC. Tin was suspected to have been first used in Erzgebirge, Germany in 2500BC. The Mesopotamians used soap containing alkali by 2200BC. The Egyptians mined ores in the Sinnai peninsula and the Nubian region for copper and gold. They practised embalming techniques which some trace back to as the origins of alchemy. The Indian civilisation had a name for their alchemy – Rasayana, practised ~ 1200 BC. It also endeavoured to prolong longevity. The Greeks had access to Silver, Gold and Marble mines in their mainland with which they minted their currencies and built marble temples. With Alexander's founding of Alexandria ~330 BC, it became an intellectual hub of Greeks, Egyptians and the Arabs. This passed on to the Islamic world by ~ 700 AD. The Taoist Chinese started alchemy ~ 400 BC and wanted to find an elixir for longevity. They believed gold and mercury served this purpose. Gunpowder was one of the later findings from this pursuit and Chinese traditional medicine also developed further from this. The Indians were using high carbon steel by 300BC in construction and was being exported to asia and Europe.

The Romans enhanced the scale of mining with hydraulic mining using aqueducts, fire-setting and quenching with water to crack it open by thermal shock (tin and lead ores in Britannia), sluicing alluvial deposits with multiple aqueducts from local rivers (Las Medulas in northern Spain was the largest gold mine in Roman Empire) and mined lead+silver combined ore at multiple sites in Spain. The Greeks in Roman empire invented the air pump and screw pump which was put to use in mining. Roman Britannia (~ 40 – 400 AD) had multiple sources of gold, silver, tin and lead and there were other areas in the empire where such activity was carried out. After exhausting open surface mining in rich sources of the empire, they devised methods to dig through the ore veins like in Carmarthenshire, Wales (using techniques of stoping – underground horizontal mining providing roof support to prevent caving; adit – ground entrance to underground stopes also providing draining and ventilation access; water was pumped out of the stopes using a new mechanical wheel invention). Best engineering from Hispania and Rome contributed to the development of practical solutions in mining and construction.

14th century Europe used iron extensively for personal armour and weapons resulting in heightened iron ore mining (as the norm, from open to pit mining depending on richness of source). There were little silver deposits left in Europe by the 15th century and deeper mining was limited by available technology. In medieval Europe, all mineral deposits belonged to the crown; in England, only gold and silver belonged to the crown but there were no gold/silver deposits in England but was rich in iron,

tin, lead and copper. It belonged to the estate landlord, along with the coal deposits in his estate. By mid-15th century, capital from 3 countries (England, Holland and Germany) and technicians/skilled workers from Germany; about 4000 foreigners were mining in the Lake district of England. By this time the centrifugal pump, a mud lifting machine had been invented by an Italian. The important acids such as sulphuric and hydrochloric acids needed to dissolve metals were invented.

The gunpowder (invented in China in 9th century for medicinal use by Taoists, first used in warfare by 1000AD and introduced to mining in Slovakia in 1627) was used for blasting in mining, which was quicker and needed less water and could reach deeper ore veins. In the Islamic golden age ~ 900 AD, glycerine was separated from olive oil and soaps were made in the Levant region. Arrastra (a grinding tool tied to an animal that would walk around the fulcrum) developed by the Lebanese Mediterranean Phoenician traders about 1000BC for grain grinding was introduced by the Spanish to European mining in the 16th century, powered by animals. It would pulverize ore blocks to a powder. The new colonies in central and south America found naturally occurring gold/silver amalgam deposits in certain places and the process of mercury amalgamation and steam distillation was introduced in Europe by metallurgists to obtain pure silver and gold. This replaced the previous smelting method to separate ore from metal. The Mindoro people of Phillipines were excellent metallurgists as their land had several ores and the Dutch east India company absorbed some of their methods and transferred it to Europe. Flooding of shafts was a serious problem in mining and multiple types of pumps were invented to drain the accumulating water. The gear pump was invented by a French scientist by the late 16th century. These further advanced mining. The Spanish dollar made with silver became the international currency exchange unit in trade settlements.

arrastra

stoping

aqueduct

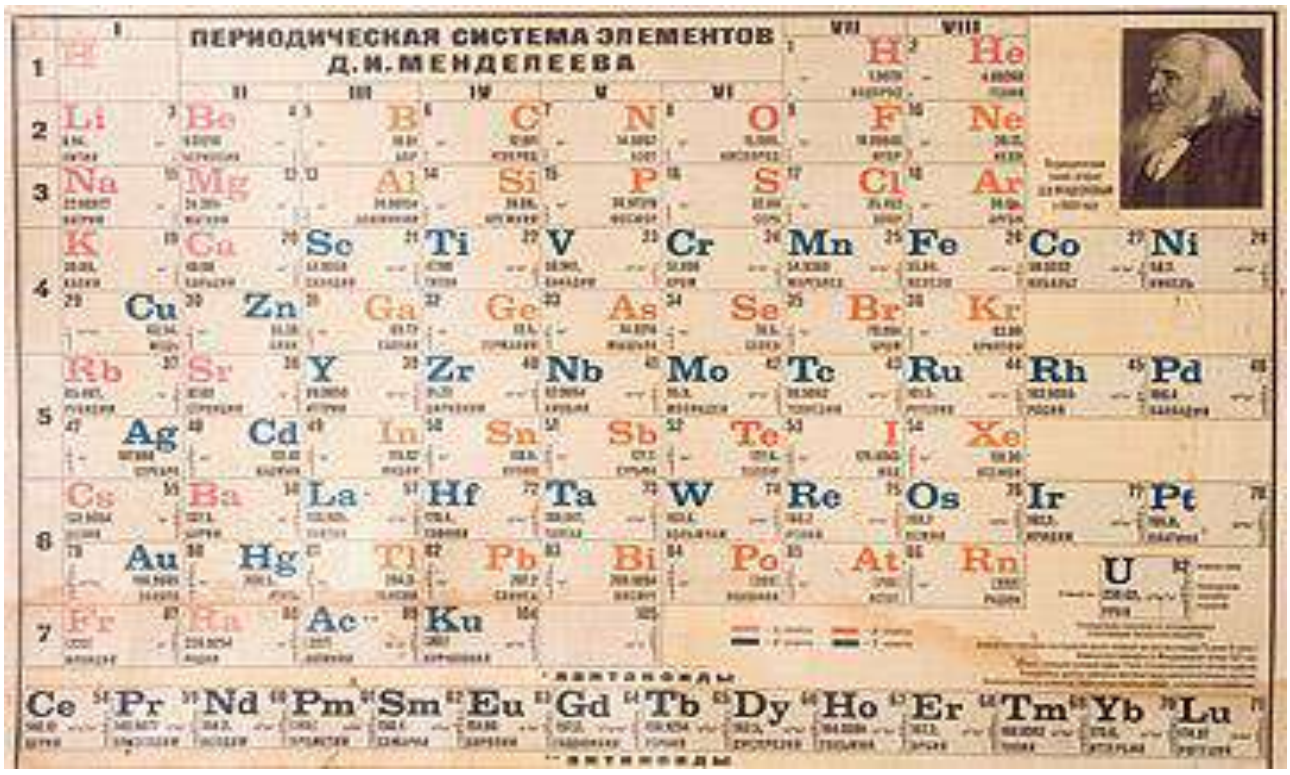
copper ore

tin ore

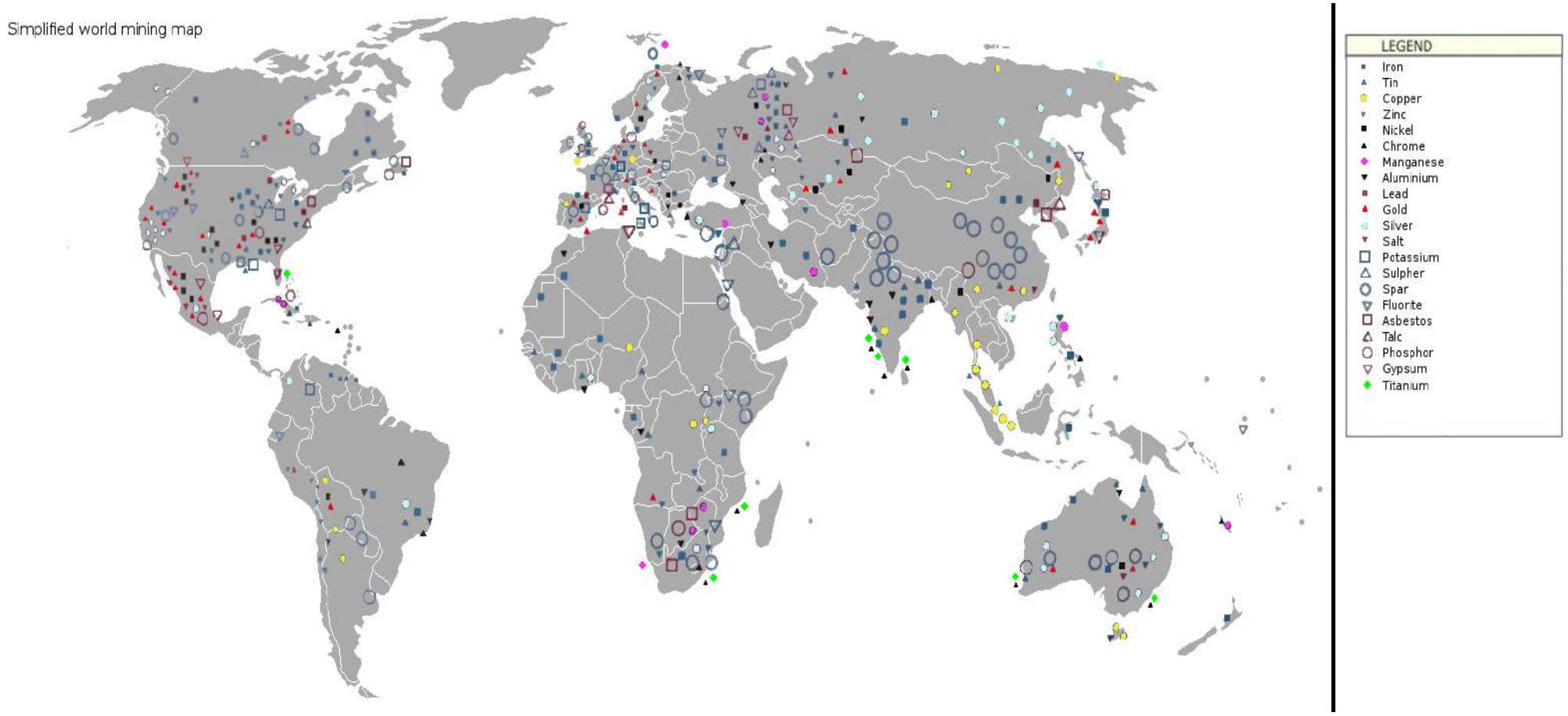
silver ore

gold ore

The story of metals from the 17th century AD is one of West – East Alchemy re-emerging in Western Europe. For an illustration, Isaac Newton and Robert Boyle (Father of modern chemistry) were both alchemists. Alchemy gave birth to Chemistry. Industrially manufactured soap appeared in late 18th century in Europe. Organic chemistry developed from Vitalism – a school of thought that believed in the vital force of animal derived products. In 1828, Frederich Wohler (German) made organic urea (carbamide) from urine and inorganic material. By 1869, Dimitri Mendelev of Russia had developed the first periodic table. By the late 19th century, Petrochemicals were being mined out and distilled into different fractions. In a way, it could be said that the new age of alloys, admixtured elements and carbon materials had started. This progressed to fusion materials in the 20th century.



The first periodic table by Demetriev Mendelev


Simplified world mining map
LEGEND
Iron
Tin
Copper
Zinc
Nickel
Chrome
Manganese
Aluminium
Lead
Gold
Silver
Salt
Potassium
Sulpher
Spar
Fluorite
Asbestos
Talc
Phosphor
Gypsum
Titanium

Iron ore

lead ore

gold amalgam

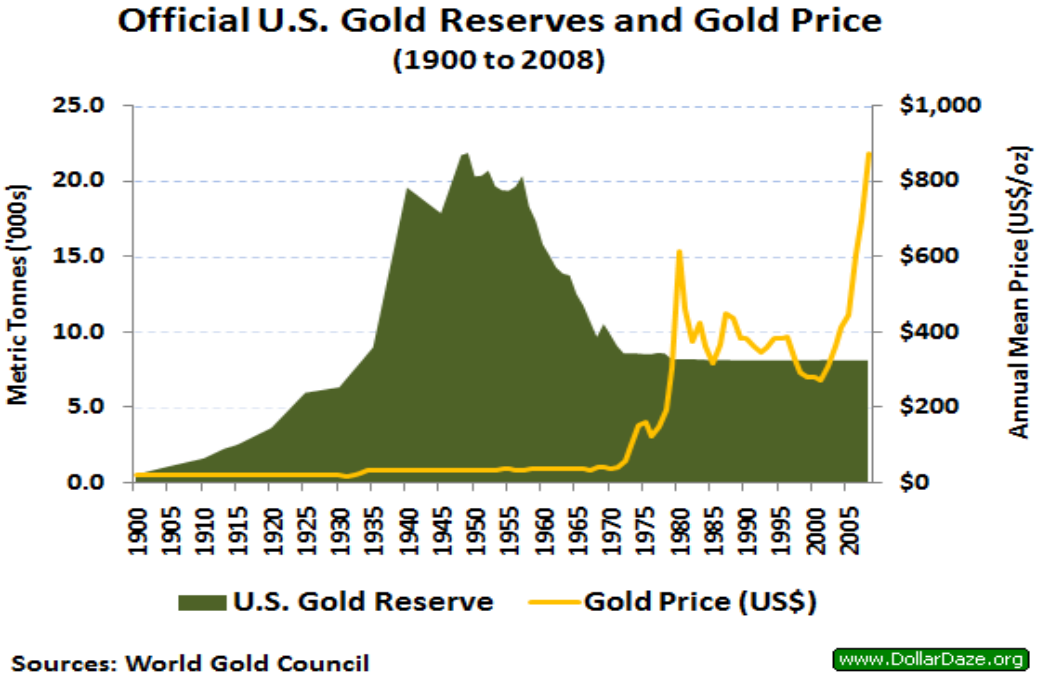
silver amalgam

Total above-ground stocks (end-2019) of gold: 197,576 tonnes

1. Jewellery: 92,947 tonnes, 47.0%
2. Private investment: 42,619 tonnes, 21.6%
3. Official Holdings: 33,919 tonnes, 17.2%
4. Other: 28,090 tonnes, 14.2%
5. Below ground reserves: 54,000 tonnes (20% of known gold ore left in ground)

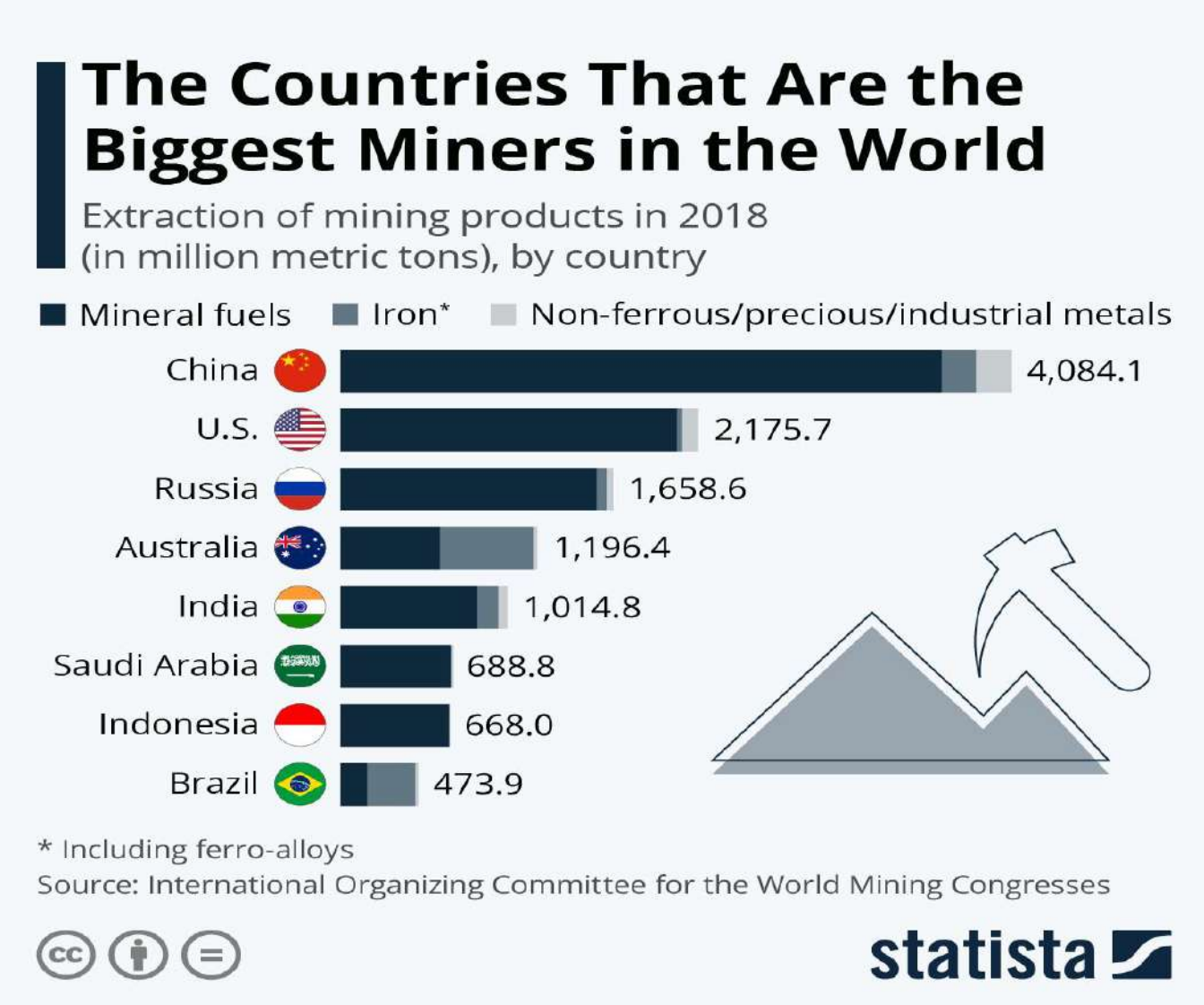
Source: Metals Focus; GFMS, Thomson Reuters, US Geological Survey, World Gold Council (gold.org)

An example above takes Gold mining over the millenia. An estimated 190,000 tonnes of gold have been mined in the world or ¾ gold reserves of the world have been mined already.

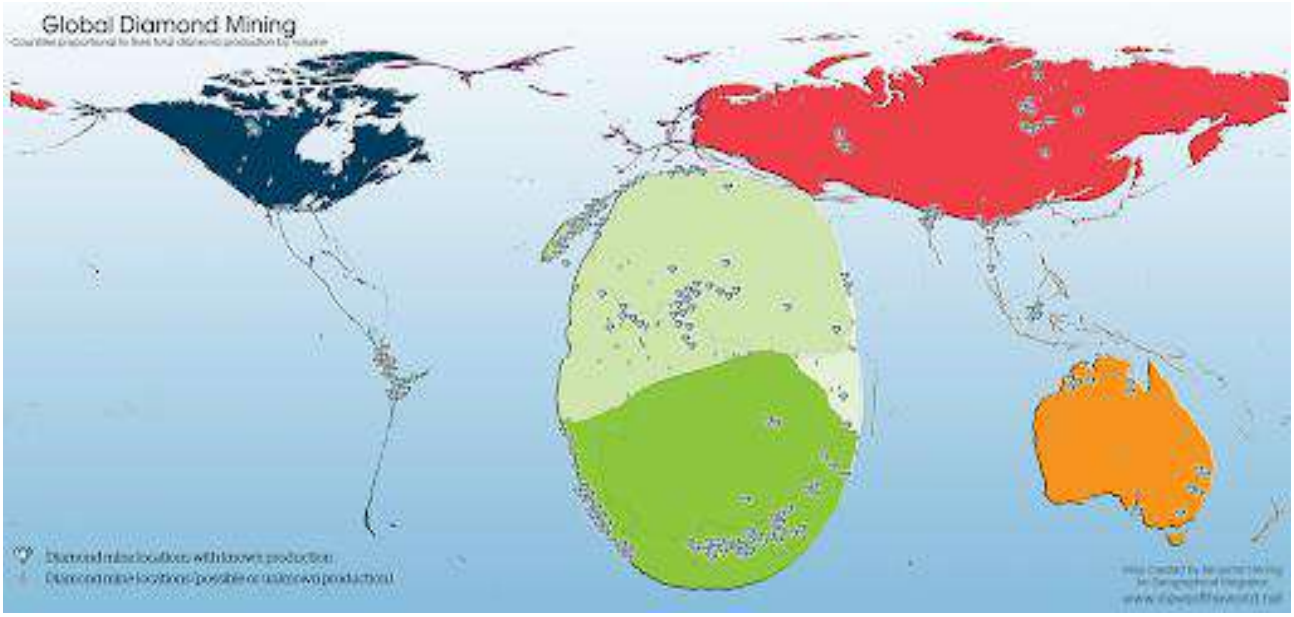


In a recent article (Sackett 0214) went so far as to assert that the majority of Earth's reserves have already been consumed: "80% of the world's mercury reserves, 75% of its silver, tin, and lead, 70% of gold and zinc, and 50% of copper and manganese had already been processed through human products". However, as history confirms, newer technologies allowed greater production of metals from their ores and hence the above suggestion of earth running out of metals to mine is unlikely. However, the economic feasibility may impair production. However, newer technologies and newer sources (including Mars planet and asteroids) are being explored.

Mining has led to metallurgy which has led to Alchemy and in turn to chemistry. The colonial period was another scale up of mining activities in the world, albeit the largest known. The mined metals and ONG products open the doors to manufacturing products which refeed further innovations in practice to mine some more. The precious metal reserve of gold and silver has always worked as economic measures of any culture/locality and the gold bullion market is still the gold standard and standardised around the globe.



Diamond was first mined in Golconda, South India by alluvial mining about 5000 years ago.



Status of 5 most used minerals in the world:

Mineral	Max exporter	Max producer	Max consumer	World reserves	Current consumption/yr
coal	Australia and Russia	China (40%)	China	1 trillion tonnes to last 150 years	7.4B tonnes
Iron		Brazil, South Africa, USA and china			4.6B tonnes
Bauxite		India, guinea, brazil			289M tonnes
Phosphate rock		China (50%)			276 M tonnes
Gypsum		China & Iran			267 M tonnes

Gold, silver and carbon (diamond and graphite) are known as native minerals as they occur by themselves. There are about 2000 known minerals that are used from mining sources currently that always occur in admixtures within rocks (except native minerals). Viable mining needs higher proportions of a desired set of minerals from the rock types available in an area.

40 Common Minerals and Their Uses

Aluminum

The most abundant metal element in Earth's crust. Aluminum originates as an oxide called alumina. Bauxite ore is the main source of aluminum and is imported from Jamaica, Brazil, Guinea, Guyana, etc. It's used in transportation (automobiles), packaging, building/construction, electrical, machinery and other applications. The U.S. was 52 percent import reliant for aluminum in 2016.

Antimony

A native element, antimony metal is extracted from stibnite ore and other minerals. It is used as a hardening alloy for lead, especially storage batteries and cable sheaths. It's also used in bearing metal, type metal, solder, collapsible tubes and foil, sheet and pipes and semiconductor technology. Antimony is used as a flame retardant, in fireworks and in antimony salts, which are used in the rubber, chemical and textile industries, as well as medicine and glassmaking.
The U.S. was 83 percent import reliant in 2016.

Barium

A heavy metal contained in barite. It's used as a heavy additive in oil well drilling; in the paper and rubber industries; as a filler or extender in cloth, ink and plastics products; in radiography ("barium milkshake"); as a deoxidizer for copper; a sparkplug in alloys; and in making expensive white pigments.

Bauxite

Rock composed of hydrated aluminum oxides.
In the U.S., it is primarily converted to alumina. See "aluminum." The U.S. was more than 75 percent import reliant on bauxite in 2016.

Beryllium

Used in the nuclear industry and to make light, but strong alloys used by the aircraft industry. Beryllium salts are used in fluorescent lamps, X-ray tubes and as a deoxidizer in bronze metallurgy. It is used in computers, telecommunication and electronics products, aerospace and defense applications, appliances, automotive and consumer electronics, and medical applications.
The U.S. was 10 percent import reliant in 2016.

Chromite

The U.S. consumes about 5 percent of world chromite ore production in various forms of imported materials, such as chromite ore, chromite chemicals, chromium ferroalloys, chromium metal and stainless steel. It's used as an alloy in stainless and heat resisting steel products. It's also used in chemical and metallurgical industries (chrome fixtures, etc.). Superalloys require chromium. It is produced in South Africa, Kazakhstan and Russia. The U.S. was 58 percent import reliant for chromium in 2016.

Clays

It's used in floor and wall tile as an absorbent, in sanitation, mud drilling, foundry sand bonding, in iron pelletizing, brick, light weight aggregate and cement. Ball clay is used in floor and wall tile. Bentonite is used for drilling mud, pet waste absorbent, iron ore pelletizing and foundry sand bond. Kaolin is used for paper coating and filling, refractory products, fiberglass, paint, rubber and catalyst manufacture. Common clay is used in brick, light aggregate and cement. The U.S. was not import reliant in 2016.

Cobalt

It's used primarily in superalloys for aircraft gas turbine engines, cemented carbides for cutting tools and wear-resistant applications, chemicals (paint dryers, catalysts, magnetic coatings) and

permanent magnets. The U.S. has cobalt resources in Minnesota, Alaska, California, Idaho, Missouri, Montana and Oregon. Cobalt production comes principally from Congo, China, Canada, Russia, Australia and Zambia. The U.S. was 74 percent import reliant in 2016.

Copper

It's used in building construction; electric and electronic products (cables and wires, switches, plumbing, heating); transportation equipment; roofing; chemical and pharmaceutical machinery; and alloys (brass, bronze and beryllium alloyed with copper are particularly vibration resistant); alloy castings; electroplated protective coatings; and undercoats for nickel, chromium, zinc, etc. More recently, copper is being used in medical equipment due to its anti-microbial properties. The United States has copper mines in Arizona, New Mexico, Utah, Nevada, Montana and Michigan. Leading producers are Chile, China, Peru, U.S., Congo and Australia. The U.S. was 34 percent import reliant in 2016.

Feldspar

A rock-forming mineral, it's industrially important in glass and ceramic industries; patter and enamelware; soaps; bond for abrasive wheels; cements; insulating compositions; fertilizer; tarred roofing materials; and as a sizing, or filler, in textiles and paper. In pottery and glass, feldspar functions as a flux. End uses for feldspar in the U.S. include glass (60 percent) and pottery and other uses (40 percent). The U.S. was 10 percent import reliant in 2016.

Fluorite (fluorspar)

It's used in production of hydrofluoric acid, which is used in the pottery, ceramics, optical, electroplating and plastics industries; in the metallurgical treatment of bauxite; as a flux in open hearth steel furnaces and in metal smelting; in carbon electrodes; emery wheels; electric arc welders; toothpaste; and paint pigment. It is a key ingredient in the processing of aluminum and uranium. The U.S. was 100 percent import reliant in 2016.

Gallium

Gallium is used in integrated circuits, light-emitting diodes (LEDs), photodetectors and solar cells. It has a new use in chemotherapy for some types of cancer. Integrated circuits are used in defense applications, high performance computers and telecommunications. Optoelectronic devices were used in areas such as aerospace, consumer goods, industrial equipment, medical equipment and telecommunications. Leading sources are China, Germany, UK and Ukraine. The U.S. was 100 percent import reliant in 2016.

Gold

Gold is used in jewelry and arts; dentistry and medicine; medallions and coins; ingots as a store of value; scientific and electronic instruments; and as an electrolyte in the electroplating industry. It is mined in Alaska and several western states. Leading producers are China, Australia, Russia, U.S. and Canada. The U.S. was not import reliant in 2016.

Gypsum

Processed and used as prefabricated wallboard or an industrial or building plaster; used in cement manufacturing; agriculture and other uses.
The U.S. was 12 percent import reliant in 2016.

Halite (sodium chloride salt)

It's used in human and animal diet, both a seasoning and a preservative. It's also used to prepare sodium hydroxide, soda ash, caustic soda, hydrochloric acid, chlorine, metallic

sodium, ceramic glazes, metallurgy, curing of hides, mineral waters, soap manufacturing, home water softeners, highway de-icing, photography and in scientific equipment for optical parts. Single crystals used for spectroscopy, ultraviolet and infrared transmission. The U.S. was 23 percent import reliant for salt in 2016.

Indium

Indium tin oxide is used for electrical conductivity purposes in flat panel devices most commonly in liquid crystal displays (LCDs). It is also used in solders, alloys, compounds, electrical components, semiconductors and research. Indium ore is not recovered from ores in the U.S. China is the leading producer. It is also produced in Korea, Japan, Canada, France and Belgium. The U.S. was 100 percent import reliant in 2016.

Iron Ore

Used to manufacture steels of various types. It's used in powdered iron, metallurgy products, magnets, high-frequency cores, auto parts, catalysts. Radioactive iron (iron 59) is used in medicine and in biochemical and metallurgical research. Iron blue is used in paints, printing inks, plastics, cosmetics and paper dyeing. Black iron oxide is used as pigment, polishing compounds, metallurgy, medicine and magnetic inks. Most U.S. production is in Michigan and Minnesota. Australia, China, Brazil and Russia are the major producers. The U.S. was not import reliant in 2016.

Lead

It's used in lead-acid batteries, tanks, solders and seals or bearings. It's also used in electrical and electronic applications (TV tubes and glass); construction, communications and protective coatings; ballast or weights; ceramics or crystal glass; X-ray and gamma radiation shielding; soundproofing material and ammunition. Industrial type batteries are used as a source of uninteruptible power equipment for computer and telecommunications networks and mobile power. Lead is mined mainly in Missouri, but also in Alaska, Idaho and Washington. The U.S. was 30 percent import reliant in 2016.

Lithium

Compounds are used in ceramics and glass; batteries; lubricating greases; air treatment; primary aluminum production; lubricants and greases; rocket propellants; vitamin A synthesis; silver solder; batteries; and medicine. Lithium ion batteries have become a substitute for nickel-cadmium batteries in hand held/portable electronic devices. There is one brine operation in Nevada. Australia, Chile, Argentina and China are major producers. The U.S. was more than 50 percent reliant for lithium in 2016.

Manganese

Ore is essential to iron and steel production. It's also used in the making of manganese ferroalloys. Construction, machinery and transportation end uses account for most U.S. consumption of manganese. Manganese ore has not been produced in the U.S. since 1970. Major producers are South Africa, China, Australia, Gabon and Brazil. The U.S. was 100 percent import reliant in 2016.

Mica

Mica commonly occurs as flakes, scales or shreds. Ground mica is used in paints, joint cement, dusting agents, oil well-drilling muds and plastics, roofing, rubber and welding rods. Sheet mica is fabricated into parts for electronic and electronic equipment. China and Russia are leading producers. The U.S. was 100 percent import reliant in 2016.

Molybdenum

It's used in alloy steels to make automotive parts, construction equipment, gas transmission pipes, stainless steels, tool steels, cast irons, super alloys and chemicals and lubricants. As a pure metal, molybdenum is used because of its high melting temperature (4,730 F) as filament supports in light bulbs, metalworking dies and furnace parts. Major producers are China, Chile, U.S. and Peru. The U.S. was not import reliant in 2016.

Nickel

Vital as an alloy to stainless steel, it plays a key role in the chemical and aerospace industries. End uses are transportation, fabricated metal products, electrical equipment, petroleum and chemical industries, household appliances and industrial machinery. Major producers are the Philippines, Canada, Russia, Australia and New Caledonia. The U.S. was 25 percent import reliant in 2016.

Perlite

Expanded perlite is used in building construction products like roof insulation boards and as fillers. It's also used for horticulture aggregate and filter aids. It's produced in New Mexico and other western states and processed in more than 20 states. Leading producers are Turkey, Greece, U.S., Japan and Hungary. The U.S. was 19 percent import reliant in 2016.

Platinum Group Metals (PGMs)

PGMs includes platinum, palladium, rhodium, iridium, osmium and ruthenium. They commonly occur together in nature and are among the scarcest of the metallic elements. Platinum is used principally in catalysts for the control of automobile and industrial plant emissions, jewelry, catalysts to produce acids, organic chemicals and pharmaceuticals. PGMs are found in bushings for making glass fibers used in fiber-reinforced plastic and other advanced materials, electrical contacts, capacitors, conductive and resistive films used in electronic circuits and dental alloys used for making crowns and bridges. South Africa, Russia, U.S., Zimbabwe and Canada are major producers. The U.S. was more than 45 percent import reliant for most PGMs in 2016.

Phosphate Rock

It's used to produce phosphoric acid for ammoniated phosphate fertilizers, feed additives for livestock, elemental phosphorus, and a variety of phosphate chemicals for industrial and home consumption. U.S. production occurs in Florida, North Carolina, Idaho and Utah. The U.S. is a major producer. It was 3 percent import reliant in 2016.

Potash

It's a carbonate of potassium. It's used as a fertilizer, in medicine, in the chemical industry. It also can produce decorative color effects on brass, bronze and nickel. The leading producers are Canada, Russia and Belarus. The U.S. was 90 percent import reliant in 2016.

Pyrite

It's used in the manufacture of sulfur, sulfuric acid and sulfur dioxide. Pellets of pressed pyrite dust are used to recover iron, gold, copper, cobalt and nickel. It's also used to make inexpensive jewelry.

Quartz (Silica)

As a crystal, quartz is used as a semiprecious gemstone. Crystalline varieties include amethyst, citrine, rose quartz, smoky quartz, etc. Cryptocrystalline forms include agate, jasper, onyx, etc. Because of its piezoelectric properties, quartz is used for pressure gauges, oscillators, resonators and wave stabilizes. Because of its ability to rotate the plane of polarization of light

and its transparency in ultraviolet rays, it's used in heat-ray lamps, prism and spectrographic lenses. It's also used in manufacturing glass, paints, abrasives, refractory materials and precision instruments.

Rare Earth Elements (Rare Earth Elements (lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium ytterbium and lutetium)

They are used mainly in petroleum fluid cracking catalysts, metallurgical additives and alloys, glass polishing and ceramics, permanent magnets and phosphors. It is estimated that 40 pounds of rare earths are used in a hybrid car for rechargeable battery, permanent magnet motor and regenerative braking systems. The U.S. no longer produces rare earth (bastnasite). More than 80 percent of global production is in China. The U.S. was import reliant for 100 percent of its rare earth metals in 2016.

Silica

Aluminum and aluminum alloy producers and the chemical industry are major users of silicon metal. Silica is also used in manufacture of computer chips, glass and refractory materials, ceramics, abrasives, water filtration systems, component of hydraulic cements, filler in cosmetics, pharmaceutical, paper, insecticides, anti-caking agents in foods, flatting agents in paints, thermal insulators, and photovoltaic cells.

China is the leading producer. The U.S. was 38 percent reliant on silicon metal in 2016.

Silver

It's used in coins and medals, electrical and electronic devices, industrial applications, jewelry, silverware and photography. The physical properties of silver include ductility, electronics conductivity, malleability and reflectivity. It's used in lining vats and other equipment for chemical reaction vessels, water distillation, in the manufacture of ethylene, mirrors, silver plating, table cutlery, dental, medical and scientific equipment, bearing metal, magnet windings, brazing alloys and solder. It's also used in catalytic converters, cell phone covers, electronics, circuit boards, bandages for wound care and batteries. Silver is produced in the U.S. at more than 30 base and precious metal mines primarily in Alaska and Nevada. The leading global producers include
Mexico, Peru, China, Chile and Australia. The U.S. was 67 percent reliant in 2016.

Sodium Carbonate (soda ash or trona)

Used in glass container manufacture; in fiberglass and specialty glass; also used in production of flat glass; in liquid detergents; in medicine; as a food additive; photography; cleaning and boiler compounds; pH control of water. Most U.S. production comes from Wyoming. The U.S. is a major producer and was not import reliant in 2016.

Sulfur

It's used in the manufacture of sulfuric acid, fertilizers, petroleum refining and metal mining. Elemental sulphur and byproduct sulfuric acid were produced in more than 100 operations in 27 states. The U.S., China, Russia and Canada are major producers. The U.S. was 9 percent import reliant in 2016.

Tantalum

Tantalum is a refractory metal with unique electrical, chemical and physical properties used to produce electronic components, including tantalum capacitors (found in auto electronics, pagers, personal computers and portable telephones). High-purity tantalum metals can be found in products ranging from weapon

systems to superconductors, high-speed tools, catalysts, sutures and body implants, electronic circuitry and thin-film components. It's used in optical glass and electroplating devices. Leading producers are Congo, Rwanda, Brazil and China. The U.S. was 100 percent reliant in 2016.

Titanium

Titanium mineral concentrates are used primarily by titanium dioxide pigment producers. A small amount is used in welding rod coatings and for manufacturing carbides, chemicals and metals.
It is produced in Florida, Georgia and Virginia.
Leading producing countries are South Africa, China, Australia, Mozembique and Canada. The U.S. was 91 percent reliant in 2016.

Titanium and titanium dioxide are used in aerospace applications (i.e., jet engines, airframes and space and missile applications). It is also used in armor, chemical processing, marine, medical, power generation, sporting goods and other non-aerospace applications. Titanium sponge metal was produced in three operations in Nevada and Utah. The leading global producers are China, Japan, Russia, Kazakhstan and Ukraine.

Tungsten

More than half of the tungsten consumed in the U.S. was used in cemented carbide parts for cutting and wear-resistant materials - primarily in the construction, metalworking, mining, and oil- and gas-drilling industries. The remaining tungsten was consumed to make tungsten heavy alloys for applications requiring high density, including electrodes, filaments, wires, and other components for electrical, electronic, heating, lighting, and welding applications. It can also be found in steels, superalloys, wear-resistant alloys and chemicals for various applications. China is by far the leading producer. Vietnam, Russia, Bolivia, Austria and Spain also produce tungsten. The U.S. produces very little. It was more than 25 percent import reliant in 2016.

Uranium

Nearly 20 percent of U.S. electricity is produced using uranium in nuclear generation. It is also used for nuclear medicine, atomic dating, powering nuclear submarines and other uses in the U.S. defense system. The U.S. received about 80 percent of its uranium from other countries in 2016.

Vanadium

Vanadium's metallurgical use is primarily as an alloying agent for iron and steel - accounting for about 94 percent of domestic vanadium consumption. Of the other uses for vanadium, the major non-metallurgical use is in catalysts for the production of maleic anhydride and sulfuric acid. China, Russia and South Africa are large producers. The U.S. was 100 percent reliant in 2016.

Zeolites

Zeolites are used in animal feed, cat litter, cement, aquaculture (fish hatcheries for removing ammonia from the water), water softener and purification, catalysts, odor control and for removing radioactive ions from nuclear plant effluent. The U.S. was not import reliant in 2016.

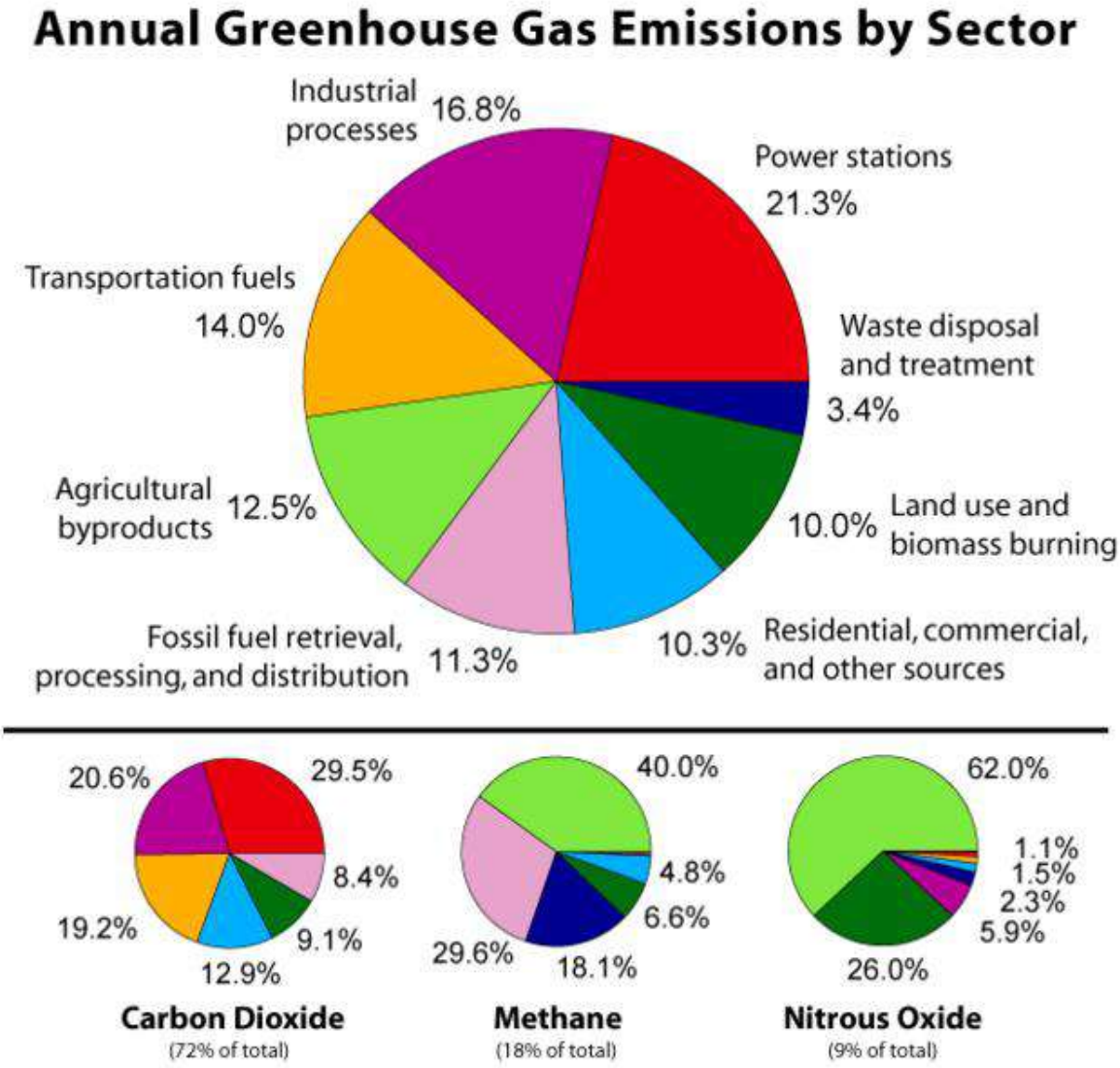
Zinc

Of the total zinc consumed in the U.S., most was used in galvanizing. Other primary uses included brass, bronze and zinc-based alloys. Zinc compounds and dust were used principally by the agriculture, chemical, paint, and rubber industries.

Major co-products of zinc mining and smelting, in order of decreasing tonnage, were lead, sulfuric acid, cadmium, silver, gold and germanium. Zinc is used as protective coating on steel, as die casting, as an alloying metal with copper to make brass and as chemical compounds in rubber and paints. It's also used as sheet zinc and for galvanizing iron; electroplating; metal spraying; automotive parts; electrical fuses; anodes; dry cell batteries; nutrition; chemicals; roof gutter; engravers' plates; cable wrappings; organ pipes; and pennies. Zinc oxide is used in medicine, paints, vulcanized rubber and sun block. Zinc dust can be used for primers, paints, precipitation of noble metals and removal of impurities from solutions in zinc electrowinning. U.S. production is in five states and 12 mines. Leading producers are China, Australia, Peru, the U.S. and India. The U.S. was 82 percent import reliant in 2016.

On Environment

The first World climate conference was held in 1979. Natural climate change conditions such as ice age and global warming from volcanic activity and increasing world biomass are a part of the natural history of the planet. The current approaches to address global warming is part of an effort to address human activities contributing to global warming that has significantly increased since the late 18th century from increasing population, mining, agriculture, livestock farming, clearing of forests, industrial revolution, manufacturing and the post wars explosive increase in human population.



About 50% of the greenhouse effect is due to water vapour, 25% due to clouds, 20% to CO_2, with other gases accounting for the remainder. Since the water cycle quickly manifests, rising levels of water vapour will pour down as rain. Hence the other greenhouse gases are the more important static considerations. Carbon dioxide is the major constituent by component in greenhouse gases, mostly produced from Power stations. The other components of methane and nitrous oxide are mostly formed from Agriculture, agricultural products and livestock farming. Fluorinated gases constitute a small portion of greenhouse gas emissions. SF6 has an atmospheric lifetime of ~ 3200 years.

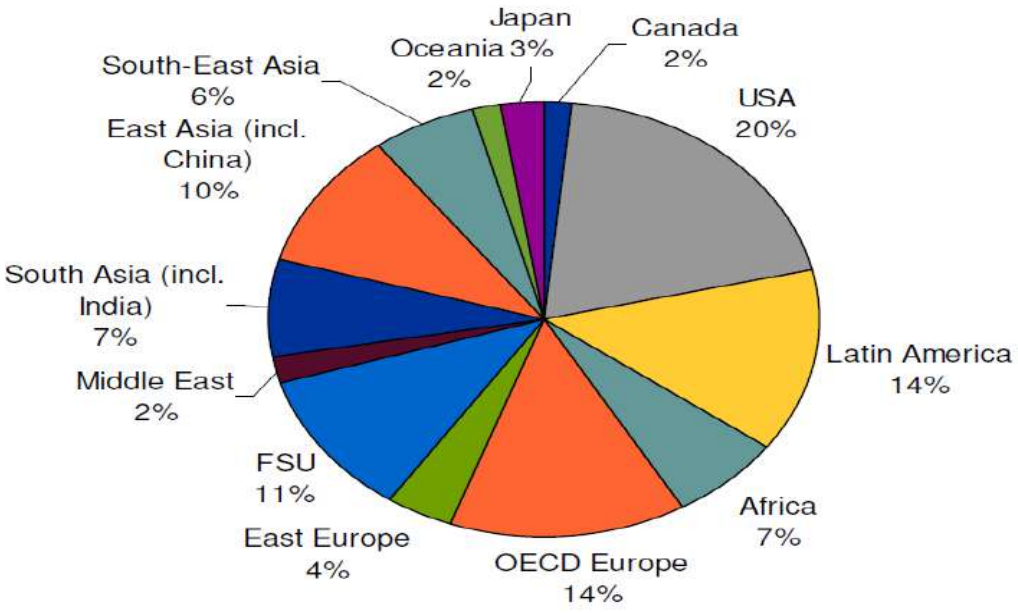
Greenhouse gas	Global-warming potential
Carbon dioxide	1
Methane	21
Nitrous oxide	310
Perfluorocarbons	6 500–9 200
Hydrofluorocarbons	140–11 700
Sulphur hexafluoride	23 900

Source: Adapted from UNFCCC 2010, Global warming potentials, http://unfccc.int/ghg_data/items/3825.php [accessed 26 November 2010]

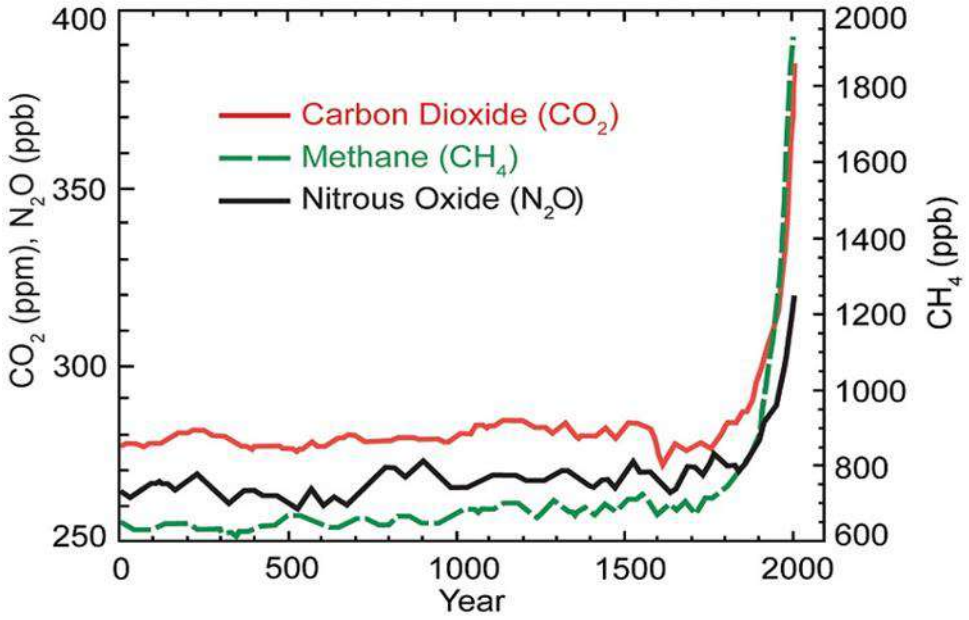
Perfluorocarbons are powerful greenhouse gases that were introduced as alternatives to ozone depleting substances. PFCs replace chlorofluorocarbons (CFCs) in manufacturing semiconductors. They are also used as solvents in the electronics industry for etching, refrigerants of some specialized refrigeration systems and as blood substitutes.

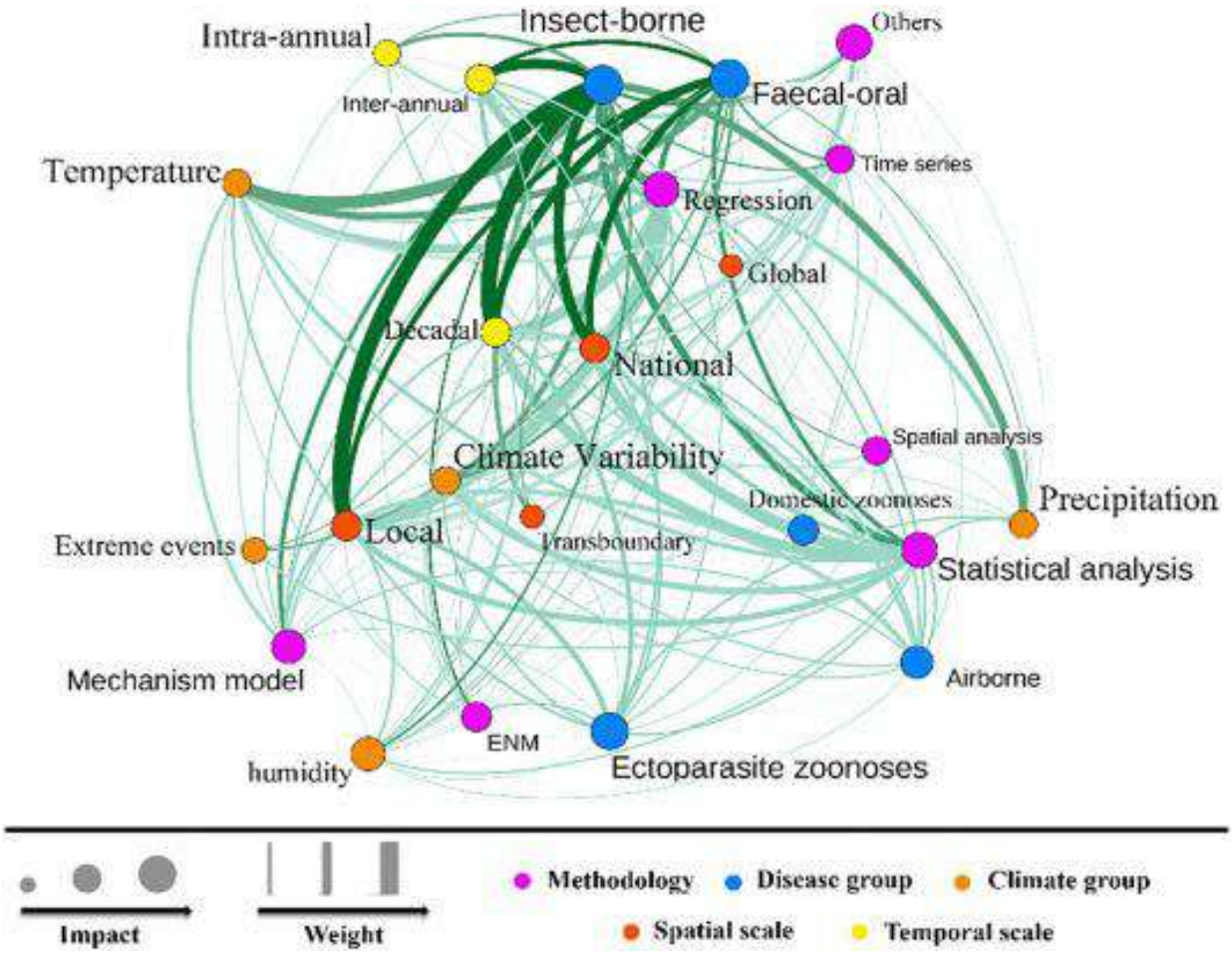
Hydrofluorocarbons (HFCs) are greenhouse gases (GHGs) commonly used by federal agencies in a wide variety of applications, including refrigeration, air-conditioning (AC), building insulation, fire extinguishing systems, and aerosols

SF6 is mainly used in switchgears of power stations and wind turbines; alternatives to this are being explored.



The sample **pie chart shows the relative regional / national contributions** to the global temperature increase in 2000 caused by emissions of CO_2, CH_4, and N_2O beginning in 1890.

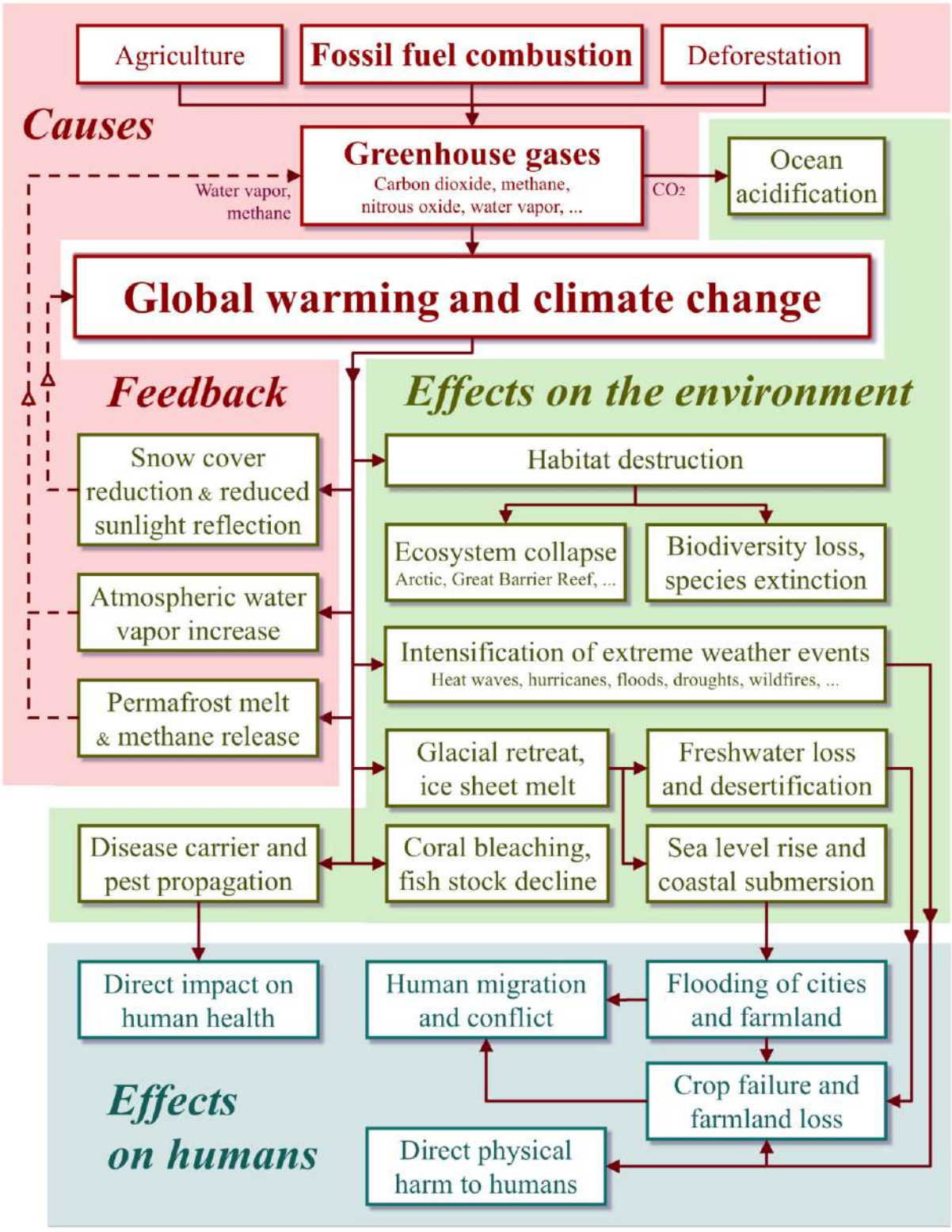


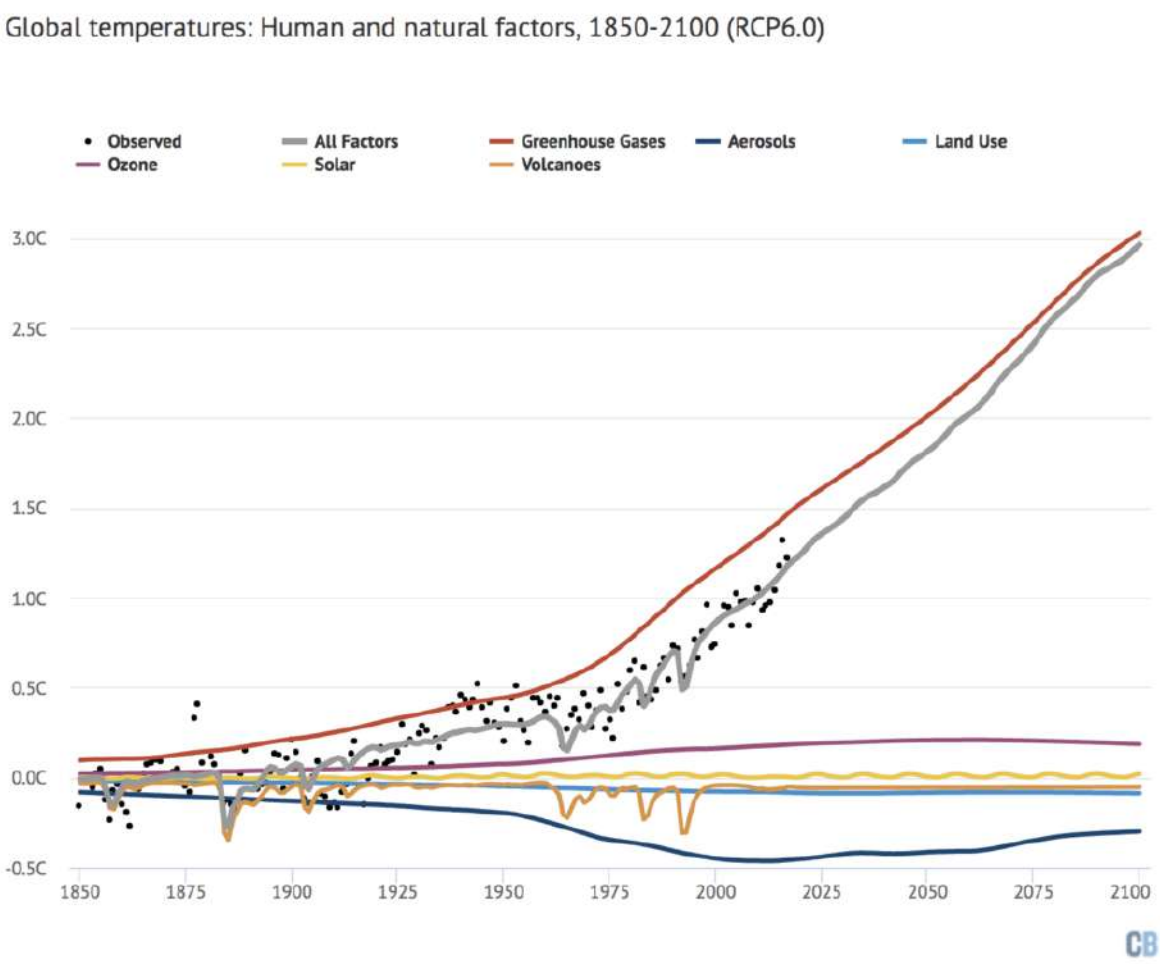


Various natural events cascade as a consequence of climate change.

Global warming and climate change

Causes and effects





Greenhouse Gas	Lifetime (Years)	100-Year GWP
Carbon Dioxide (CO_2)	hundreds	1
Methane (CH_4)	12	25
Nitrous Oxide (N_2O)	114	298
Hydrofluorocarbon-23 (CHF_3)	264	14,800
Sulphur hexafluoride (SF_6)	3,200	22,800
PFC-14 (CF_4)	50,000	7,390

Higher global temperatures result in ice melts and thawing of permafrost (permanently frozen ground in high altitudes and the earth's poles). Permafrost thawing releases methane gas. GRACE satellite imaging showed melting of glaciers in antartica as much as the everest each year. Each degree Celsius of temperature rise is estimated to increase sea levels by 2.3m.

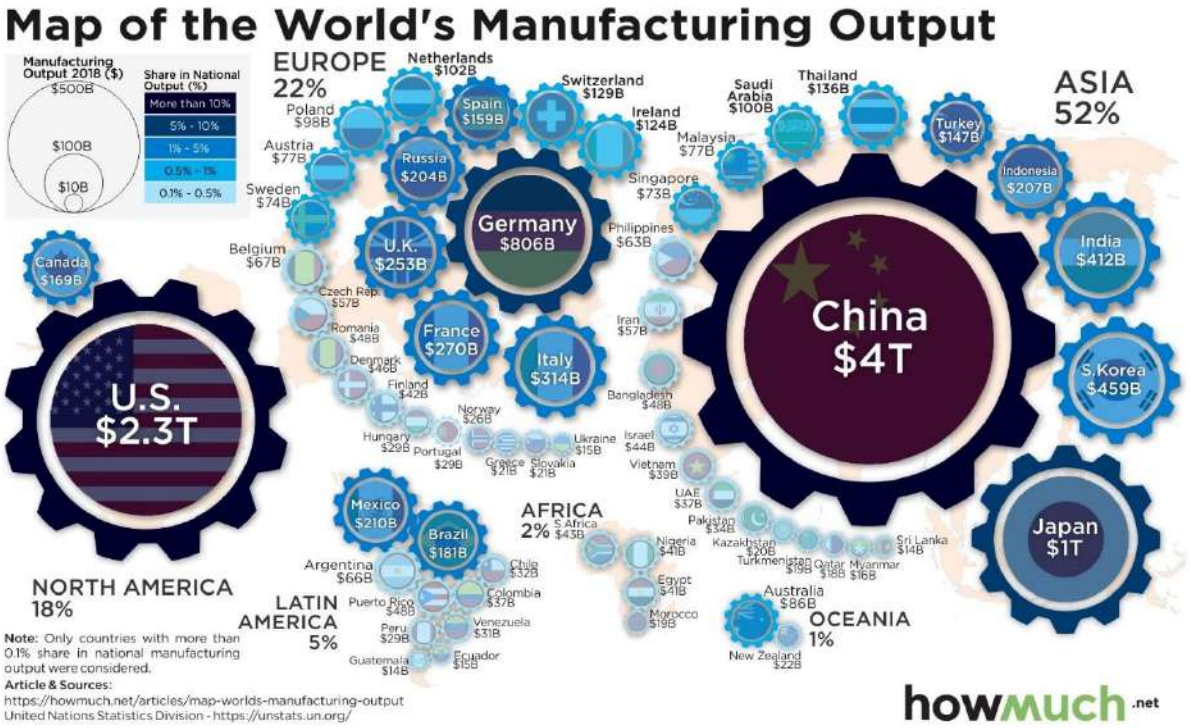
On products

Stone was man's first tool dating back to 3 million years ago. The earliest record of tools and ingredients for making paints dates back 100,000 years in Blombos cave in South Africa. The generally agreed reason for mass production was to meet increasing needs of a growing population. The Neolithic age or late stone age around 12,000BC known as the cradle of human civilization; changed man's hunter-gatherer status to an agricultural one. The times then changed to the use of bronze and Iron in its respective ages.

The first city by Archaeological listing was Jericho in West Bank in 7000BC; a time recorded in history as smelting of copper in the nearby Timna Valley. The domestication of horse mainly found in the Eurasian Steppes (with the Carpathian mountain in the west to Manchuria in the east) and the invention of the potter's wheel, some claim in Mesopotamia, dates to about 4000BC. By 2000BC the horse and the spoked wheel were brought in a technological interface to develop a horse chariot. The water mill was used in the Persian empire by 350BC, mainly for grinding grains. By 1000AD, Bilbays in Egypt was one of the major grain processing factories in the world. In a way, the water mills and windmills of central Asia and the Islamic world were the earliest known factories. By this time, assembly line fitting of parts was used in ship building by the Venice Arsenal capable of building one ship a day. Next major developments had to wait for the British Industrial Revolution of the 1700's with silk, brass utensils, wool and cotton mills using water power. Around the world, the 20th century came with a barrage of industrial inventions such as computers, CAD, robotics, machine learning, assembly line management, 3D printing and IT systems that have led to modern day factories and industries.

In summary, the last 300 years of a 100,000 years history in product development is bursting through consumer markets around the world; vying for purchase. Technological collaborations and product lines can be developed in as less as a year now. Compare this to 2000 years for tying a horse to a cart! From the World Bank National Accounts data, in the last 40 years alone, there has been a declining trend in manufacturing sector globally and better returns from service industry sector. In addition, there is improved productivity despite reduced labour employment due to automation, data management and better machines. The global manufacturing output from its peak days in USA has decreased from 40% of their national GDP to about 15% now. Most western Europe countries have less than 5% of their GDP from manufacturing now. However, China has shown increasing manufacturing revenue as part of GDP at nearly 30%.

There are about 50 million registered chemicals in the American Chemical Society database which are used in various ways including in the manufacture of products. There are 350 million products on amazon and its market sellers in a B2C platform. A wild estimate of 1 billion products for human consumption may not be an underestimate; clearly since many products are still sold outside of amazon. This is excluding the range of products for B2B consumption in mutual needs of manufacturing and non-personal consumption such as Engineering, construction, Mining, warfare etc. There can be no comprehensive catalogue of all existing products in the world currently or that which were ever made to be sold. Each product industry, such as healthcare or automotive industry is developing their industry catalogues. This is currently one of the biggest challenges of the manufacturing world – categorising and cataloguing manufactured products.


Map of the World's Manufacturing Output
Manufacturing Output 2018 ($)
$500B
$100B
$10B
Share in National Output (%)
More than 10%
5% - 10%
1% - 5%
0.5% - 1%
0.1% - 0.5%
EUROPE
22%
Netherlands $102B
Switzerland $129B
Poland $98B
Spain $159B
Ireland $124B
Austria $77B
Russia $204B
Sweden $74B
Germany $806B
Belgium $67B
U.K. $253B
Canada $169B
Czech Rep. $57B
Romania $48B
France $270B
Italy $314B
Denmark $46B
Finland $42B
Norway $26B
Hungary $29B
Portugal $29B
Greece $21B
Slovakia $21B
Ukraine $15B
U.S. $2.3T
NORTH AMERICA
18%
Mexico $210B
Brazil $181B
Argentina $66B
Chile $32B
Puerto Rico $48B
Colombia $37B
Peru $29B
Venezuela $31B
Guatemala $14B
Ecuador $15B
LATIN AMERICA
5%
AFRICA
2%
S. Africa $43B
Nigeria $41B
Egypt $41B
Morocco $19B
ASIA
52%
Saudi Arabia $100B
Thailand $136B
Malaysia $77B
Turkey $147B
Indonesia $207B
Singapore $73B
Philippines $63B
India $412B
Iran $57B
China $4T
S. Korea $459B
Bangladesh $48B
Israel $44B
Vietnam $39B
UAE $37B
Pakistan $34B
Kazakhstan $20B
Turkmenistan $19B
Qatar $18B
Myanmar $16B
Sri Lanka $14B
Japan $1T
Australia $86B
New Zealand $22B
OCEANIA
1%
Note: Only countries with more than 0.1% share in national manufacturing output were considered.
Article & Sources:
https://howmuch.net/articles/map-worlds-manufacturing-output
United Nations Statistics Division - https://unstats.un.org/
howmuch.net

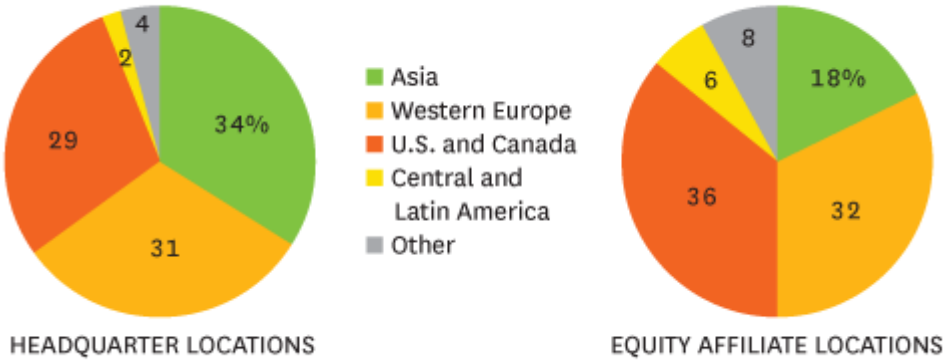
On economy

The Egyptians and the Akkadians about 2500BC were the earliest Empire builders known in history. In a top 100 list of empires by land size in Wikipedia, the lowest in rank is 0.4% of global land by the Sumers in 2400BC to the 26% global land held by British colonies of early 20th century. The world GDP estimated in 1AD was 182 Billion dollars, barely edged towards 0.5 trillion by 1500 at the beginning of colonisation, 1 Trillion dollars in 1800 at the early beginnings of Industrial Revolution, 9 trillion dollars at the end of world war II, the nominal global GDP has now increased to 87 trillion dollars in 2020. The world average GDP per capita has increased from $300 in 1800 to $11,000 in 2020.

The colonial period started from Columbus landings in Americas (Italian sailor under Spanish sponsorship) and Vasco da Gama's (Portuguese) sailing sponsored by Portuguese King around the African cape to east Asia in the beginning of 1500's as the trans Mediterranean route was controlled by the Ottoman Turks. Ferdinand Magellan (Portuguese sailor sponsored by Spanish King) with his fleet circum-navigated the world down South America to reach Phillipines and back via the African cape already found by Vasco Da Gama. Thomas cook (British) made it to Oceania in late 18th century via his voyages of exploration through Newfoundland (Canada), Hawai and Oceania. Portugal, Spain, France, Britain, Netherlands, Belgium, Germany and Russia were involved in colonisation. Although there were conquests and rule inside Europe between kingdoms, this is not referred to within colonisation. The wars over colonies began as early as 1689 and ended with World War II.

Trade by companies & Religious missions was the antecedent method in this period, however, historically noted as the forebearers and enforcers of colonisation with the backing of Royalty; who sponsored the initial explorations. The first foreign company, British East India Company was founded in 1600 and soon followed by Dutch east India company in 1601. The Dutch East India company is now acknowledged as the first Multinational corporation in the world. It is seen in below picture that nearly 70% of equity affiliate locations are in Western Europe and North America.

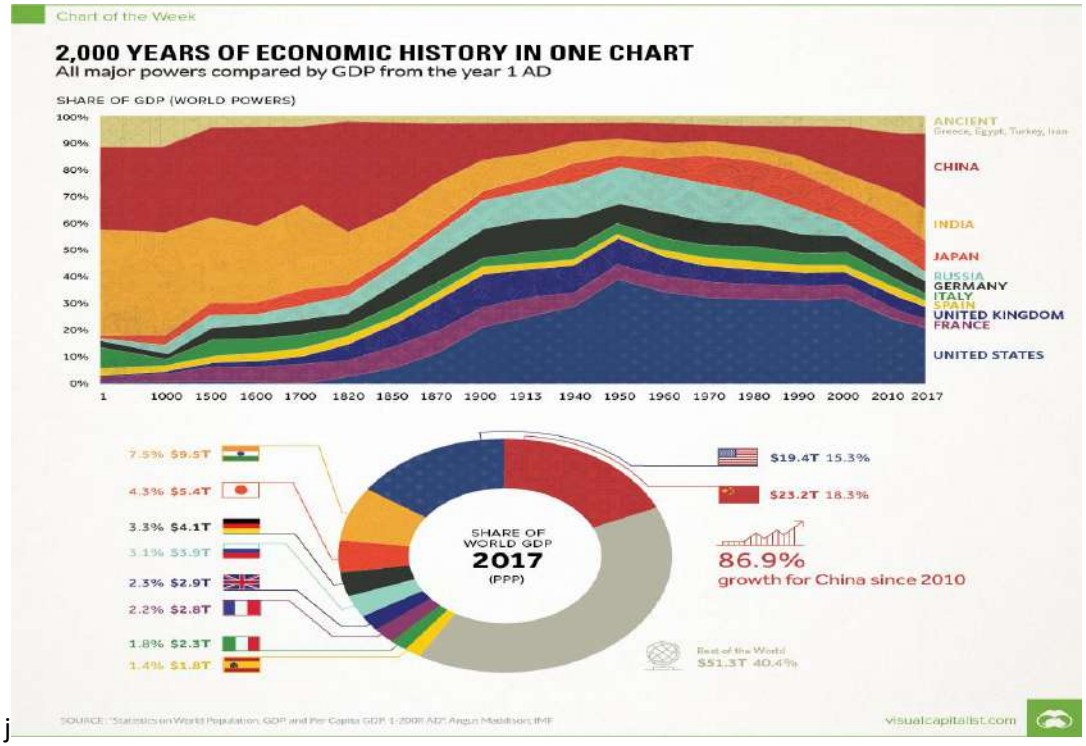
HEADQUARTER AND EQUITY AFFILIATE LOCATIONS OF THE LARGEST MULTINATIONALS



SOURCE PANKAJ GHEMAWAT AND NICCOLÒ PISANI HBR.ORG

The global colonial period witnessed an increase in Global GDP per annum from 0.5 trillion dollars in 1500 to 10 trillion dollars in 1950. WWI saw 10% loss of GDP per annum (Global GDP at the time was 4.5 trillion dollars) and WWII lost 40% per annum (Global GDP 7.8 trillion dollars). The estimate comes ~ 15 trillion dollars over 9 years of world at war in the 20th century. Western Europe/Americas on the west and Japan in the east were at the forefront of selling goods within domestic and international markets after the world wars, through multinational companies. It is estimated that there are nearly 100,000 MNC's in the world now (research pending).

Productivity per hour of work has increased 4 folds since World War II. Urbanisation is associated with higher GDP per capita. In developed countries since 1800, average weekly wages have increased 20 folds and spliced consumer price index has increased 60 folds (1/3 fold every year); implying average price goes up 3 folds to income per annum. Also, 60% of the world's GDP is accounted for by 10 countries.



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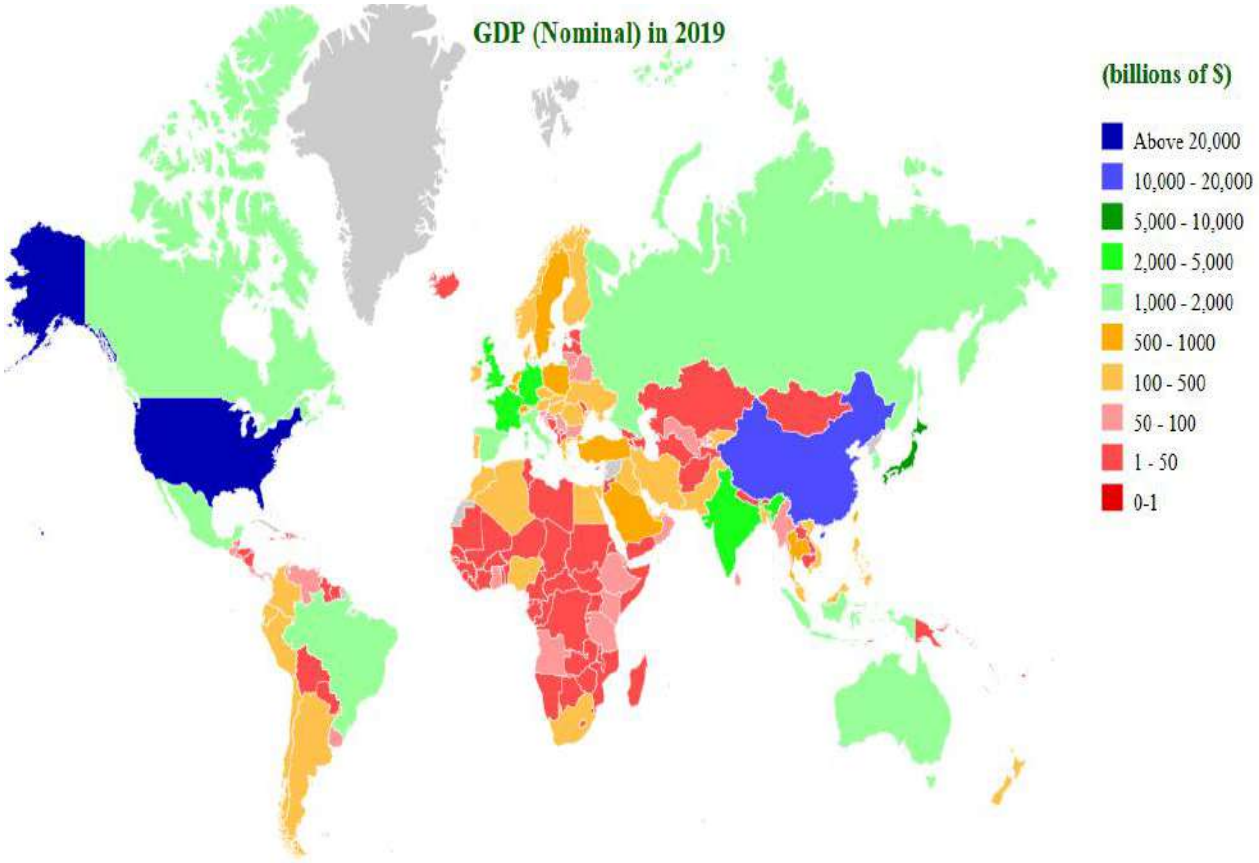
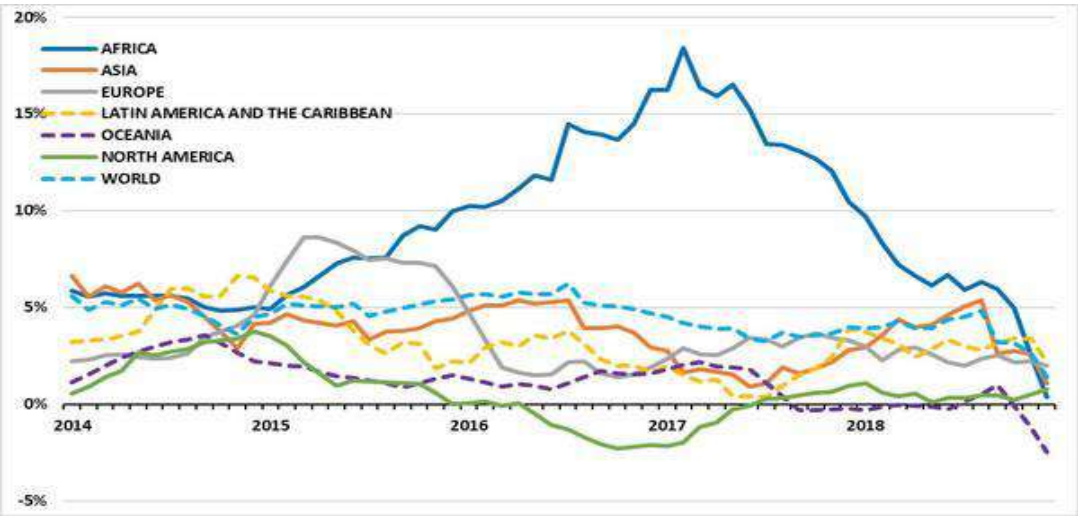
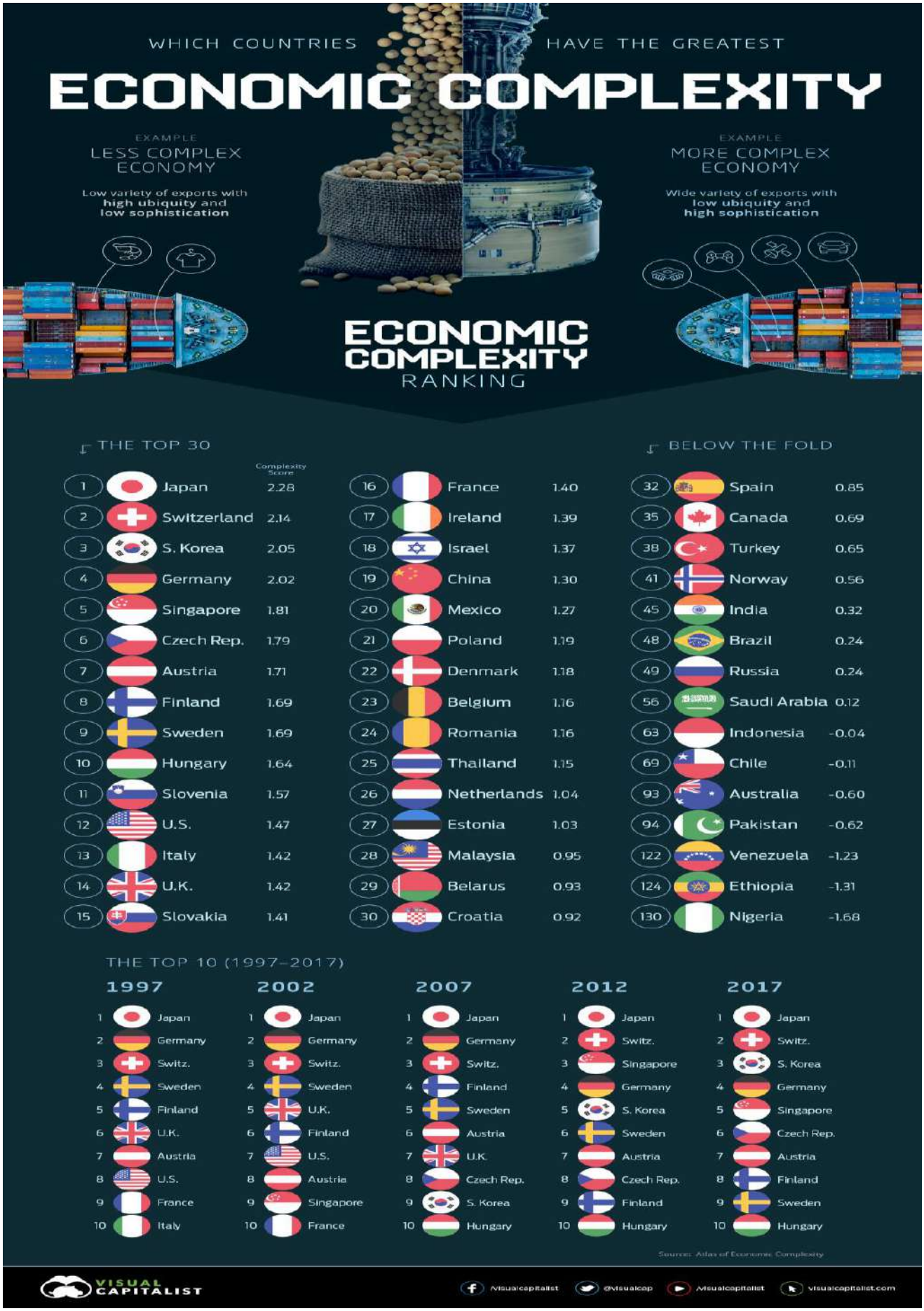




Inflation, a general increase in prices and fall in the purchasing value of money is another factor with spliced consumer index that determines the value of money in relative time.

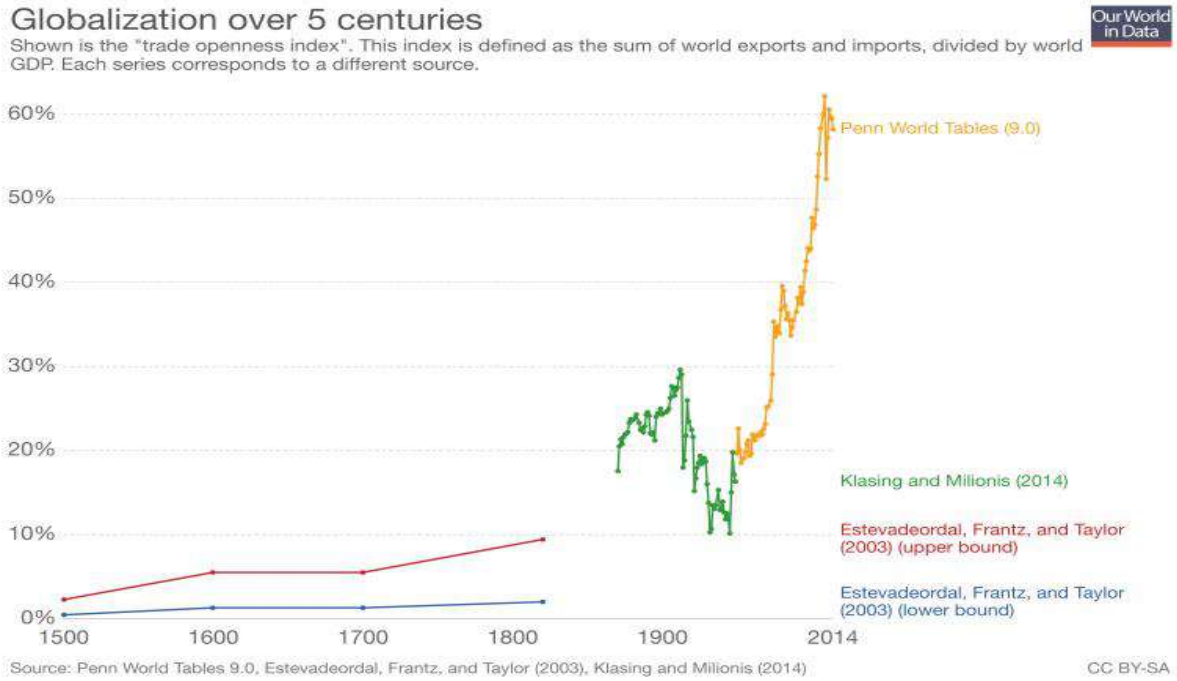

WHICH COUNTRIES HAVE THE GREATEST
ECONOMIC COMPLEXITY
EXAMPLE
LESS COMPLEX ECONOMY
Low variety of exports with high ubiquity and low sophistication
EXAMPLE
MORE COMPLEX ECONOMY
Wide variety of exports with low ubiquity and high sophistication
ECONOMIC COMPLEXITY RANKING
THE TOP 30
Complexity Score
1 Japan 2.28
2 Switzerland 2.14
3 S. Korea 2.05
4 Germany 2.02
5 Singapore 1.81
6 Czech Rep. 1.79
7 Austria 1.71
8 Finland 1.69
9 Sweden 1.69
10 Hungary 1.64
11 Slovenia 1.57
12 U.S. 1.47
13 Italy 1.42
14 U.K. 1.42
15 Slovakia 1.41
16 France 1.40
17 Ireland 1.39
18 Israel 1.37
19 China 1.30
20 Mexico 1.27
21 Poland 1.19
22 Denmark 1.18
23 Belgium 1.16
24 Romania 1.16
25 Thailand 1.15
26 Netherlands 1.04
27 Estonia 1.03
28 Malaysia 0.95
29 Belarus 0.93
30 Croatia 0.92
BELOW THE FOLD
32 Spain 0.85
35 Canada 0.69
38 Turkey 0.65
41 Norway 0.56
45 India 0.32
48 Brazil 0.24
49 Russia 0.24
56 Saudi Arabia 0.12
63 Indonesia -0.04
69 Chile -0.11
93 Australia -0.60
94 Pakistan -0.62
122 Venezuela -1.23
124 Ethiopia -1.31
130 Nigeria -1.68
THE TOP 10 (1997–2017)
1997
1 Japan
2 Germany
3 Switz.
4 Sweden
5 Finland
6 U.K.
7 Austria
8 U.S.
9 France
10 Italy
2002
1 Japan
2 Germany
3 Switz.
4 Sweden
5 U.K.
6 Finland
7 U.S.
8 Austria
9 Singapore
10 France
2007
1 Japan
2 Germany
3 Switz.
4 Finland
5 Sweden
6 Austria
7 U.K.
8 Czech Rep.
9 S. Korea
10 Hungary
2012
1 Japan
2 Switz.
3 Singapore
4 Germany
5 S. Korea
6 Sweden
7 Austria
8 Czech Rep.
9 Finland
10 Hungary
2017
1 Japan
2 Switz.
3 S. Korea
4 Germany
5 Singapore
6 Czech Rep.
7 Austria
8 Finland
9 Sweden
10 Hungary
Sources: Atlas of Economic Complexity
VISUAL CAPITALIST
/visualcapitalist
@visualcap
/visualcapitalist
visualcapitalist.com

On Labour

Labour is human effort, at one end to support their own need, to the other end of supporting a nation's economy. Labour is a loose term for physical effort; however, mental effort to deliver required goals also constitute labour.

Some mammals, insects and arthropods are the only class of Animals that store food for later use. Most animals can be said to be hunter gatherers when they need it. This was the case with humans until cave dwelling and agriculture came along. Civilisations, empires, companies and Governments built the scale of industry to new heights. Variety of consumer products (edible and other) and increasing population were other drivers. The birth of companies and the Industrial Revolution scaled up production and changed methods drastically. In a global economy and relative regional governance methods with various inter-government and global negotiating agencies, stand the current practices of labour.

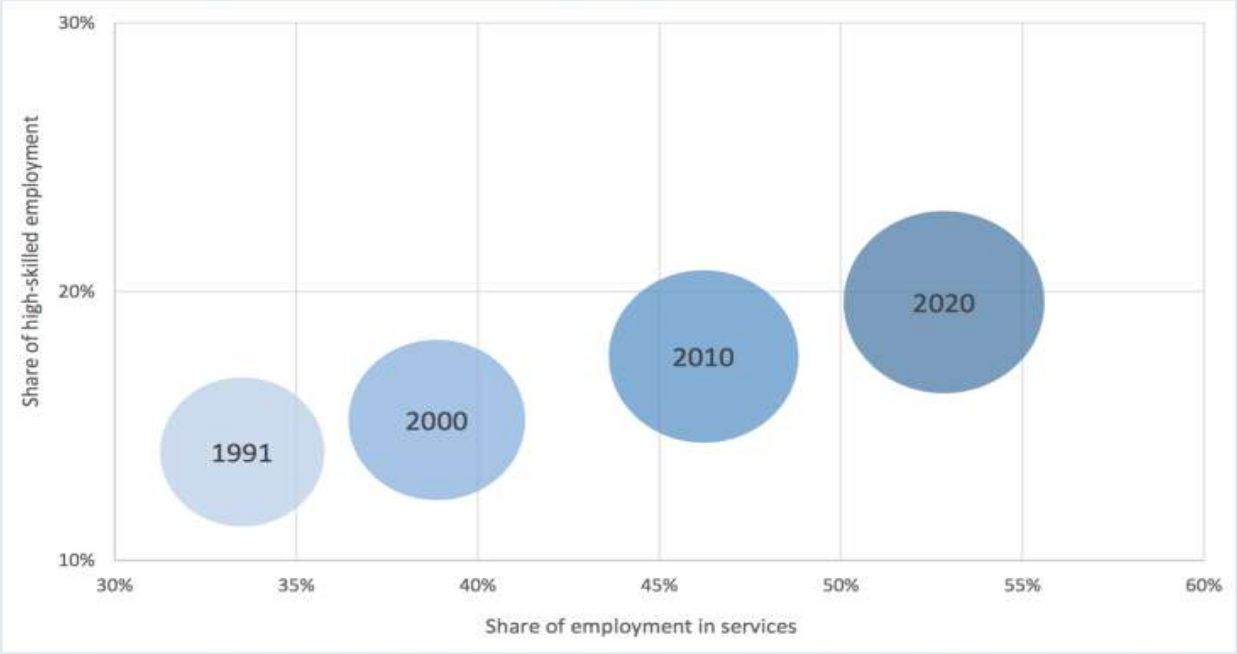
In prehistoric times since dwelling began; the old, children and women were domicile. The adult and young were foraging and hunting. As civilisations began, there was a social hierarchy. Complex societies have complex hierarchies. Slavery was widely practised in various forms (ethnic, religious, caste, serfdom, vanquished and the punished) around the world from 10,000 BC until late 20th century. The division of power/governance divided the benefits of labour and riches of a region; followed by increasing representation from various influential groups until it finally reached the common population. Marx and Engels called this the class struggle. Many factors go into good governance of a region and ultimately benefit the society. Thomas Hobbes (England), Machiavelli (Italy), Chanakya (India ~300BC) advocated for a powerful state, if required, at the expense of other interests. Confucianism (400 BC China) and Manusmriti (200 BC India) advocate reasonable balance between the rulers and the population. Group and Social uprisings in history brought in representations in parliament and suffrage. Communism of the 20th century advocates for equal sovereignty. Population have had to adapt constantly to changing governance and technologies for livelihoods, offsetting their cultural inheritance. Unions were formed to negotiate interests with employers and national bodies and make representations; however, Unions have had unrest with governments. More automation and newer technologies posing a constant challenge to livelihood; there in developing the need for continuous professional development.



The three-sector model of labour economy is divided into primary (raw materials), Secondary (processing the raw materials) and tertiary (administering the economy). A quaternary sector of knowledge is suggested by some.

51.4% of the total global income was earned by working. Consequently, 48.6% of income went to capital owners. The top 10% earns 48.9%, the bottom 50% earns 6.4% (ILO 2017)

Share of global employment in services and/or high-skilled employment (1991-2020)

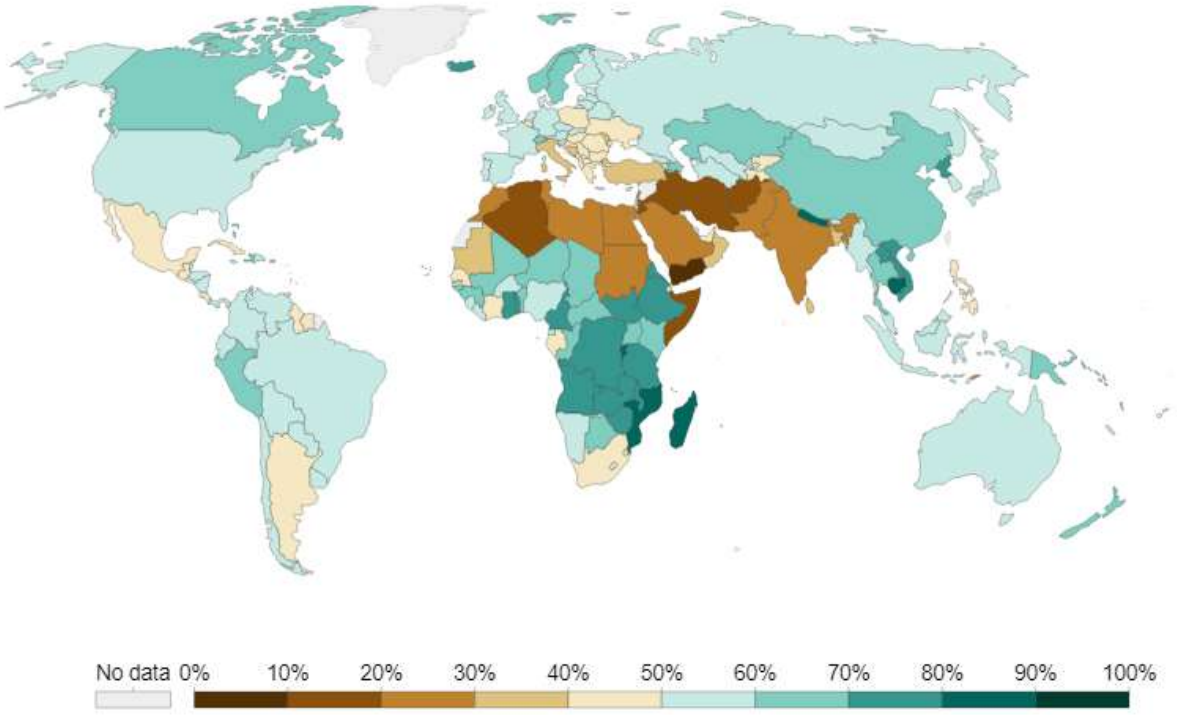


Source: ILOSTAT, ILO Estimates and Projections, November 2017. Note: The bubbles are sized proportionately according to the size of employment. In all figures included in this brief, services refer to sections G to U of the ISIC Rev.4 and G to Q of the ISIC Rev.3, and high skill level refers to categories 1 to 3 of the ISCO-08 or ISCO-88.

Female labor force participation rates, 2017

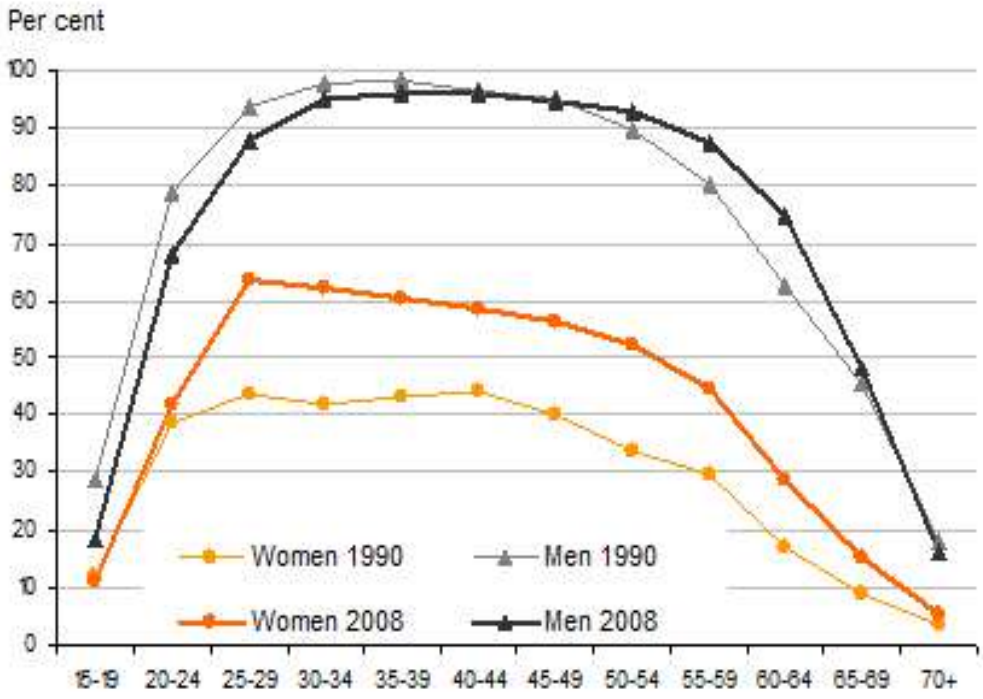
Labor force participation rate is the proportion of the population ages 15 and older that is economically active.

Our World in Data

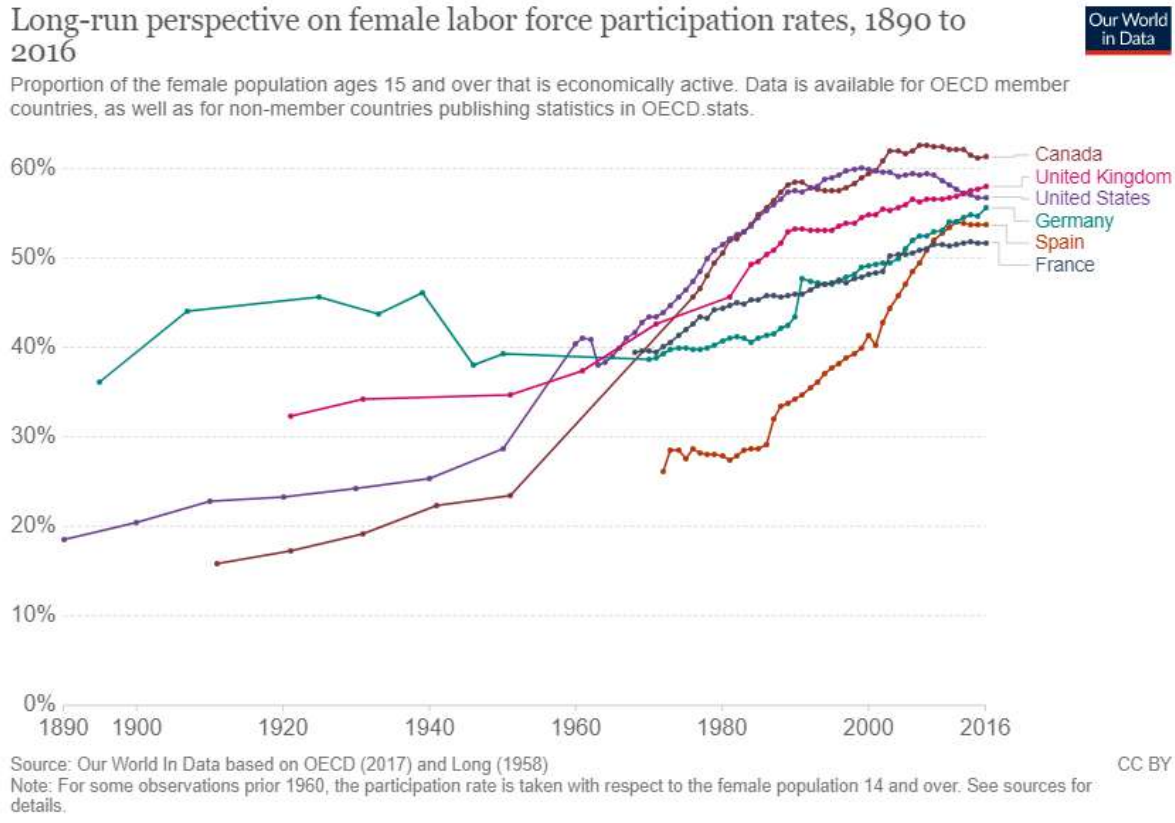


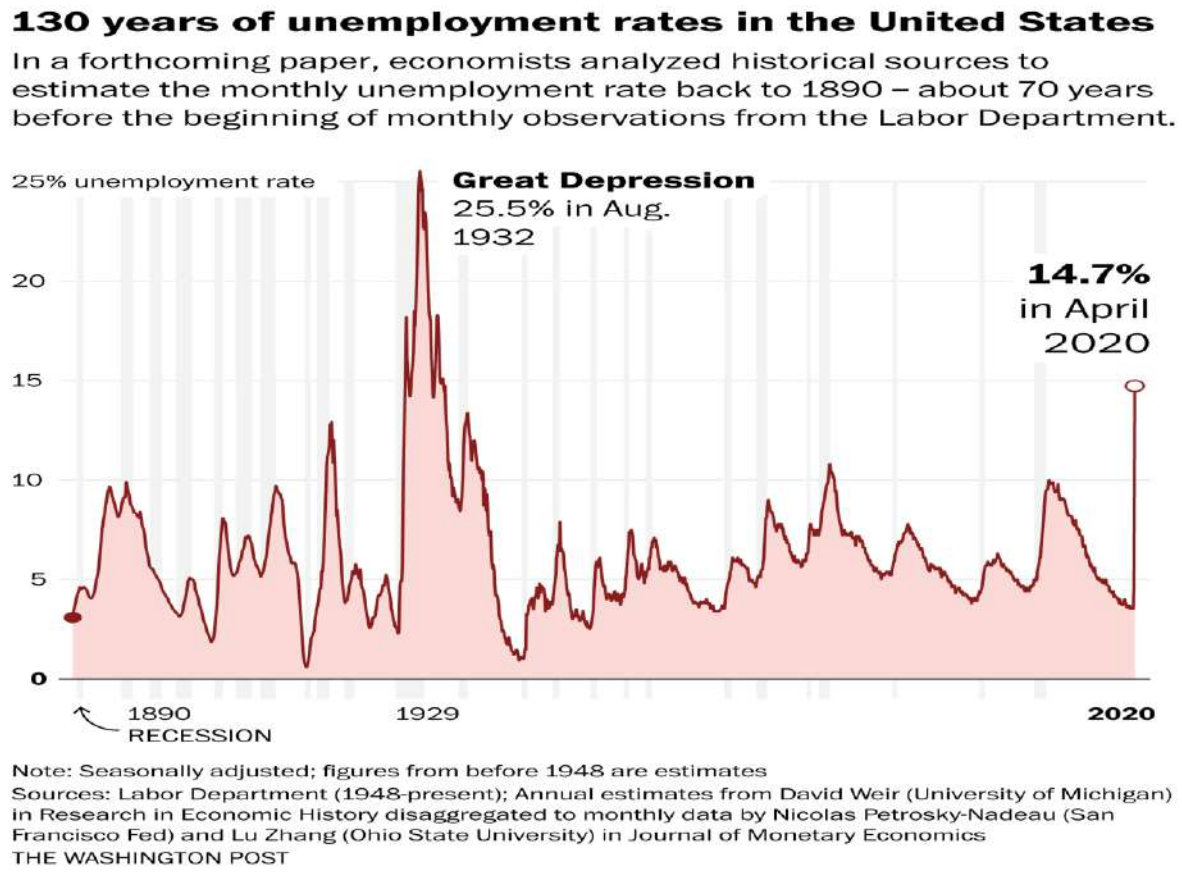
Source: World Bank
Note: All figures correspond to 'modeled ILO estimates' (see source for details).

OurWorldInData.org/female-labor-supply • CC BY

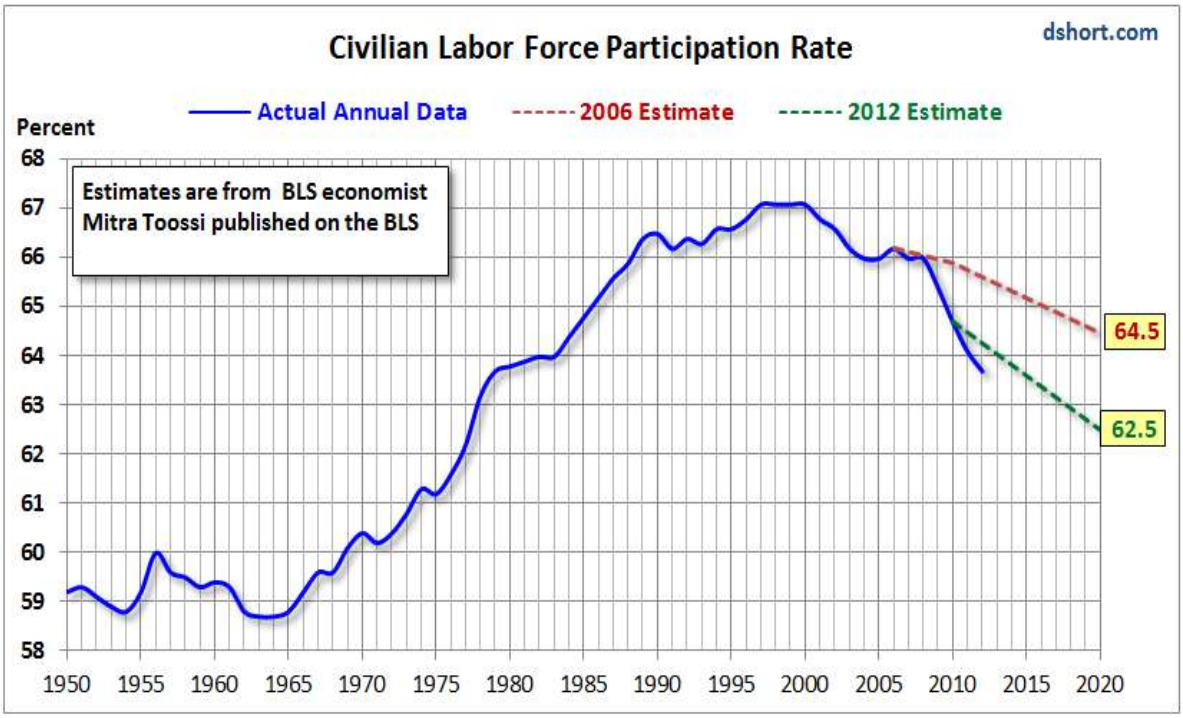


Global trend in labour by gender and age (UN)



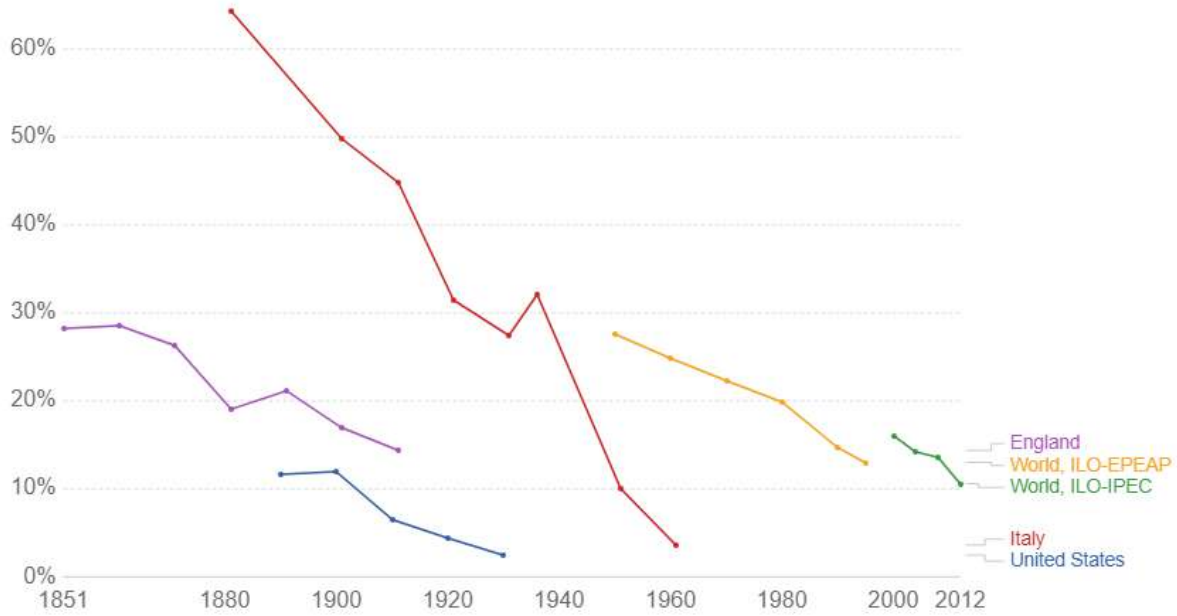


An example country to demonstrate unemployment trends and labour force participation rates over long periods



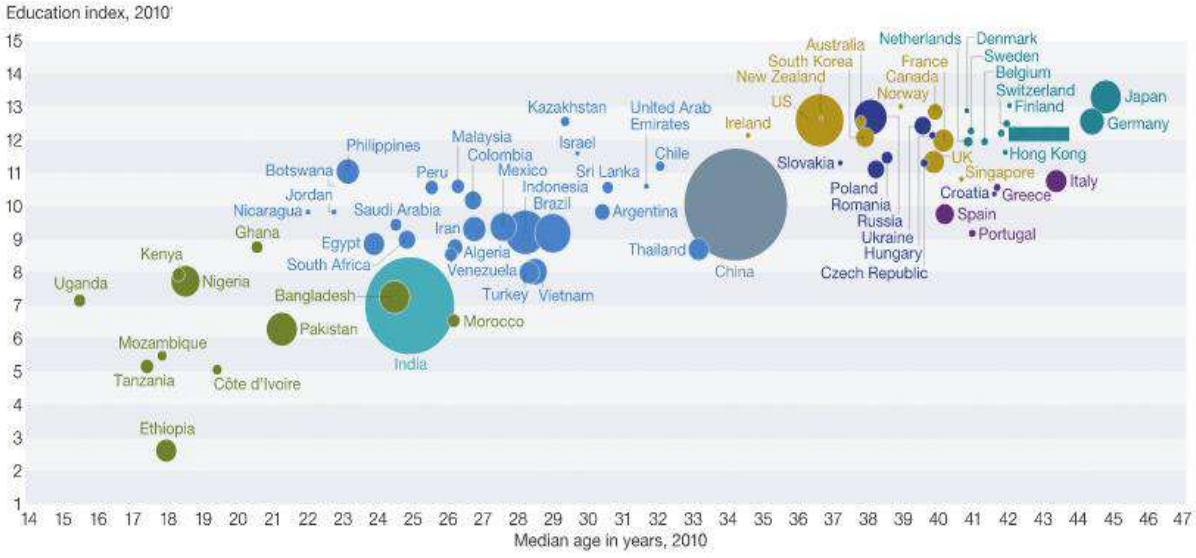
Various measures of child labor incidence

The series World ILO-EPEAP, as well as the series for England and Italy, cover working children aged 10-14. The series for the US covers working children aged 10-13. The series World ILO-IPEC covers children aged 5-17.



Source: England: Cunningham, H. and Viazzo, P.P. (1996); Italy: Tonioli and Vecchi (2007); US: Long (1958); World (1950-1995): International Labor Organisation Programme on Estimates and Projections on the Elimination of of Child Labor (ILO-EPEAP). Basu, 1999; World (2000-2012): International Labor Organisation Programme on the Elimination of Child Labor (ILO-IPEC). ILO, 2013.
OurWorldInData.org/child-labor/ • CC BY

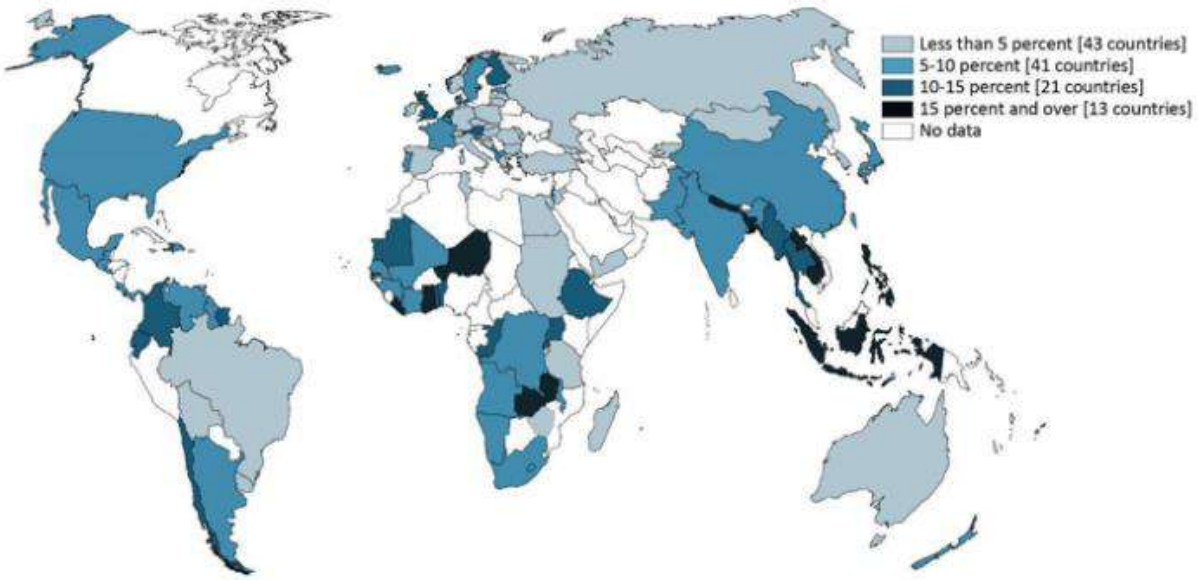
Global labor markets fall into eight clusters, each distinctly positioned in terms of age profile and educational attainment.



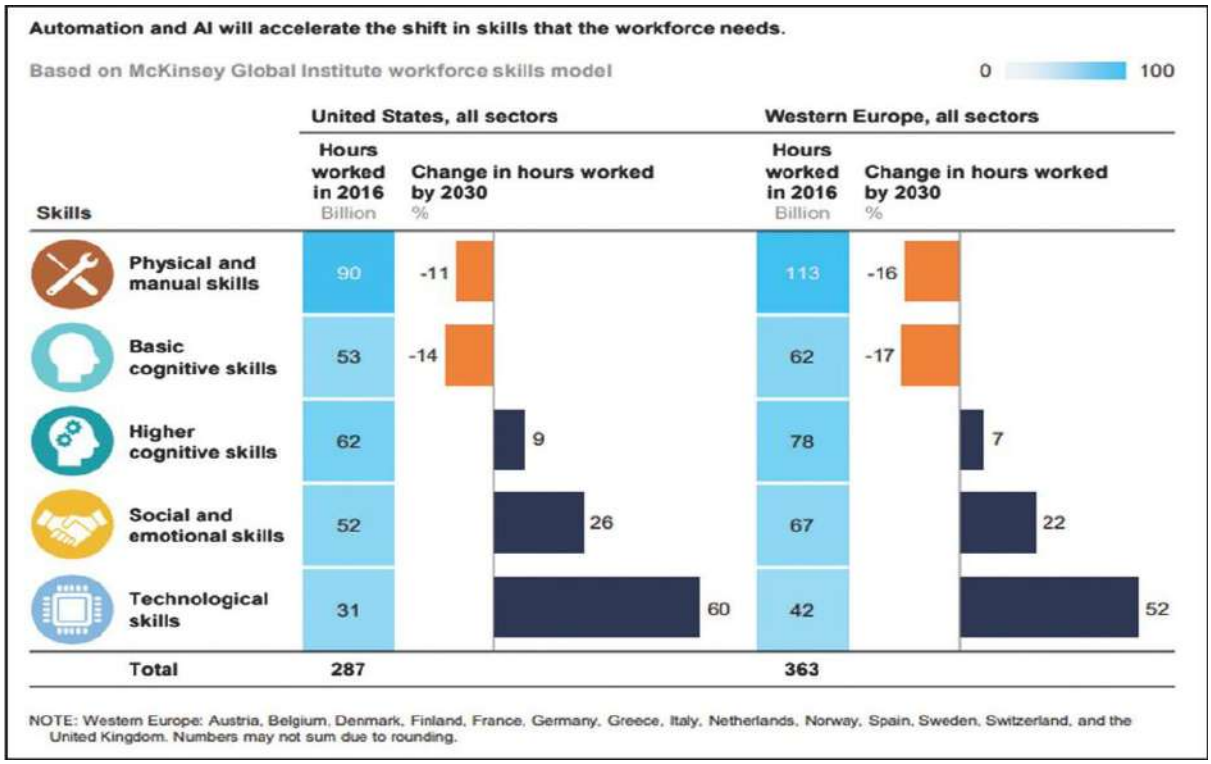
View slideshow

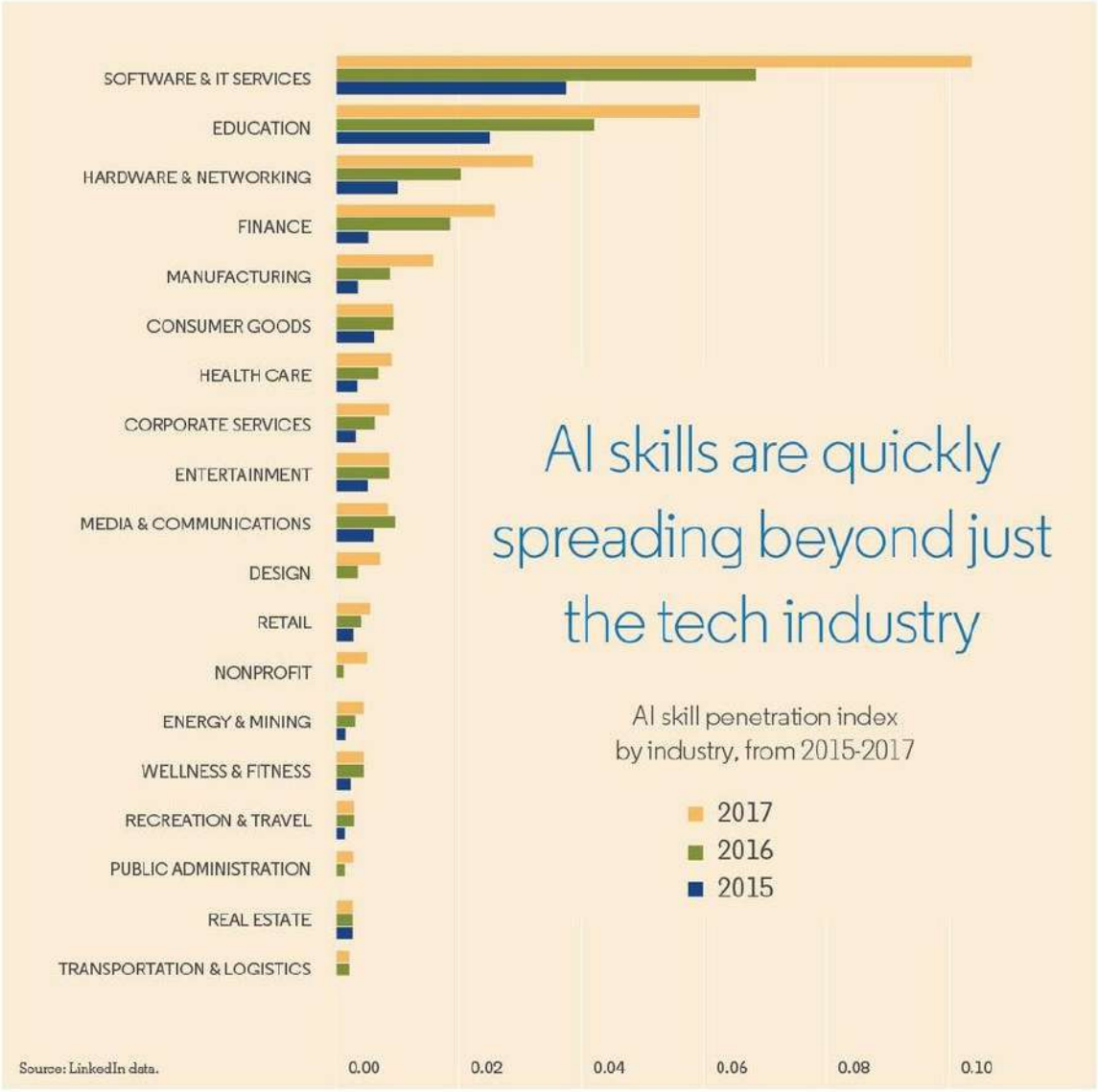
McKinsey labour projections for 2020 include:

- 13% shortage of tertiary labourers
- 15% shortage of secondary labourers
- 11% excess of primary labourers



Working from home estimates of potential engagement



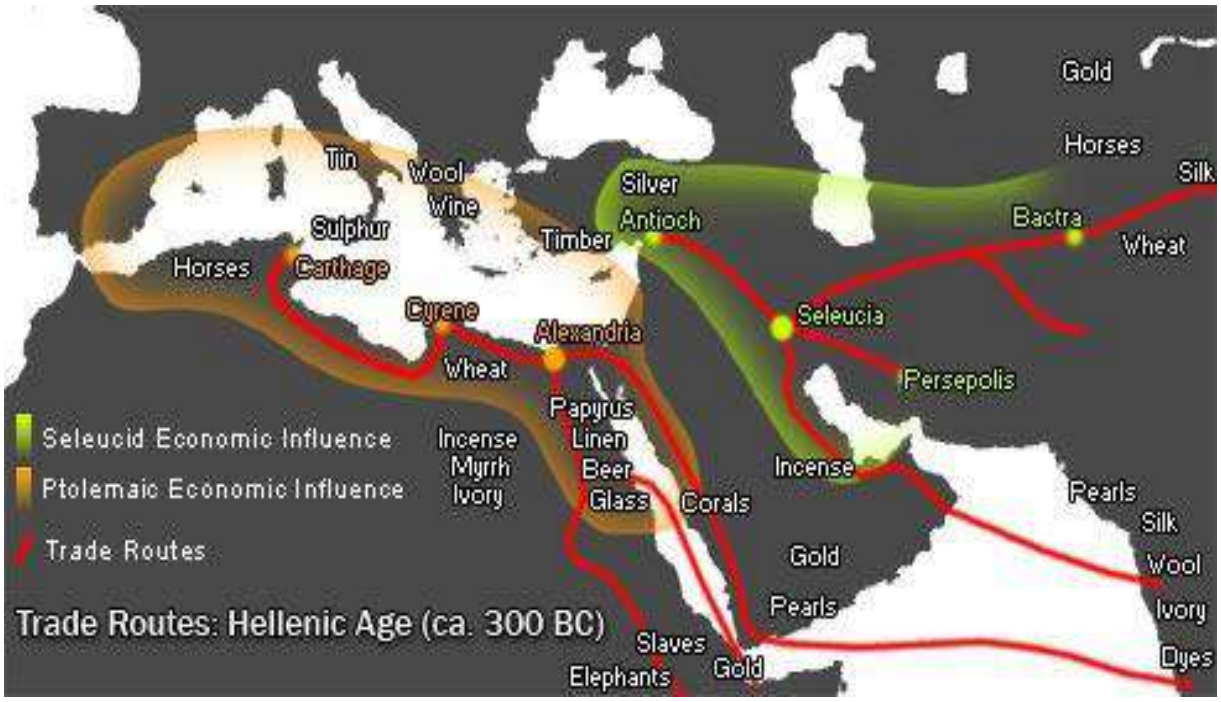


Note: The penetration index looks at how many of the AI skills appear among top 30 skills for each occupation in each industry. It computes the mean % of AI skills across occupations within each industry in year 2015, 2016 and 2017. By comparing the index across years, it gives us the time trend of industry-level AI skills penetration.

Changing climate of work

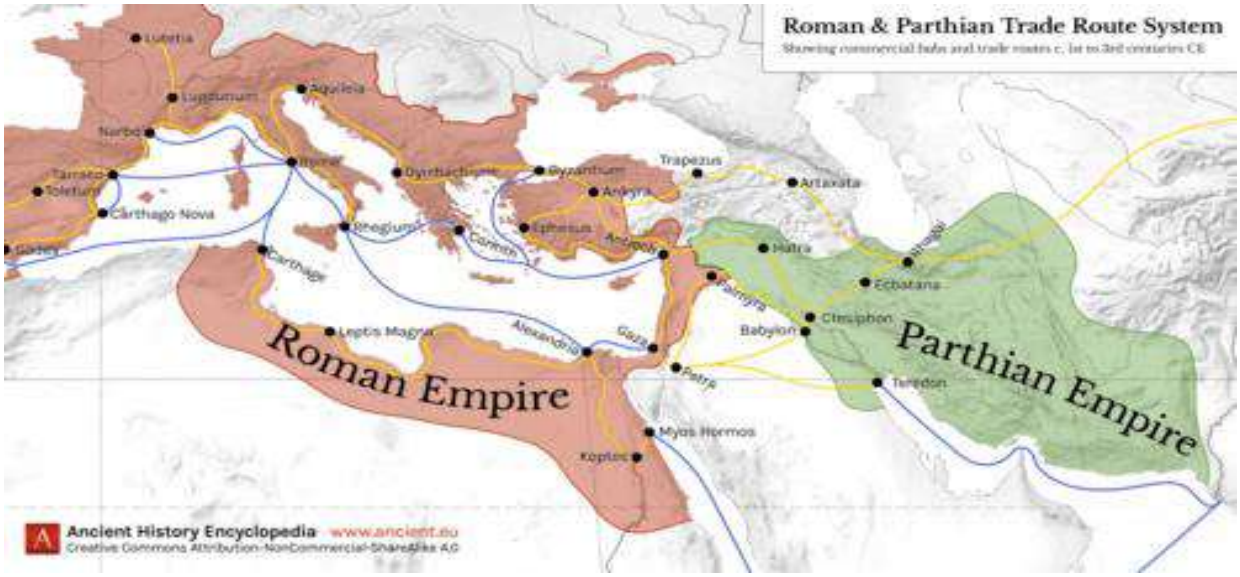
On trade

Barter of goods was known as a form of early exchange. There is some opinion that language developed in homo sapiens about 100,000 years ago, which was an integral part of long distance commerce. Trade in obsidian and flint rocks used in carving tools was known even in stone age. Obsidian rock trade was known within New Guinea by 12,000 BC. There was also a 900mile trade route around the mediterranean mainly to trade obsidian rocks by 10,000BC. The Hanseatic merchants of northern coastal Europe were involved in trade. Lapis Lazuli was traded up to Babylon from the mountains of Afghanistan. By 3000BC there were trade routes between mesopotamia and Indus valley people. The lebanese Phoenician traders sailed across the mediterranean to Britain for tin trade that was available in abundance in Britain. Use of metal for currency was known since 2000BC in Babylon, first of iron, but was only standardised and certified by ruling bodies in 700BC likely origin in Turkey. Silver began to be used in coins by 600BC. Specific silver content in coins used by the Greeks became the europian practice and the Hellenistic trade routes were primarily in silver trade. Specific trade routes deveopled as kingdoms (early economies of scale) traded with each other. Spices were traded from asia to Europe by the Hellenistic tarde routes. The Greeks and the Romans had their reverred Gods of Trade. Pax Romana in first 2 centuries of AD allowed safe trading.



Hellenistic routes around 300BC

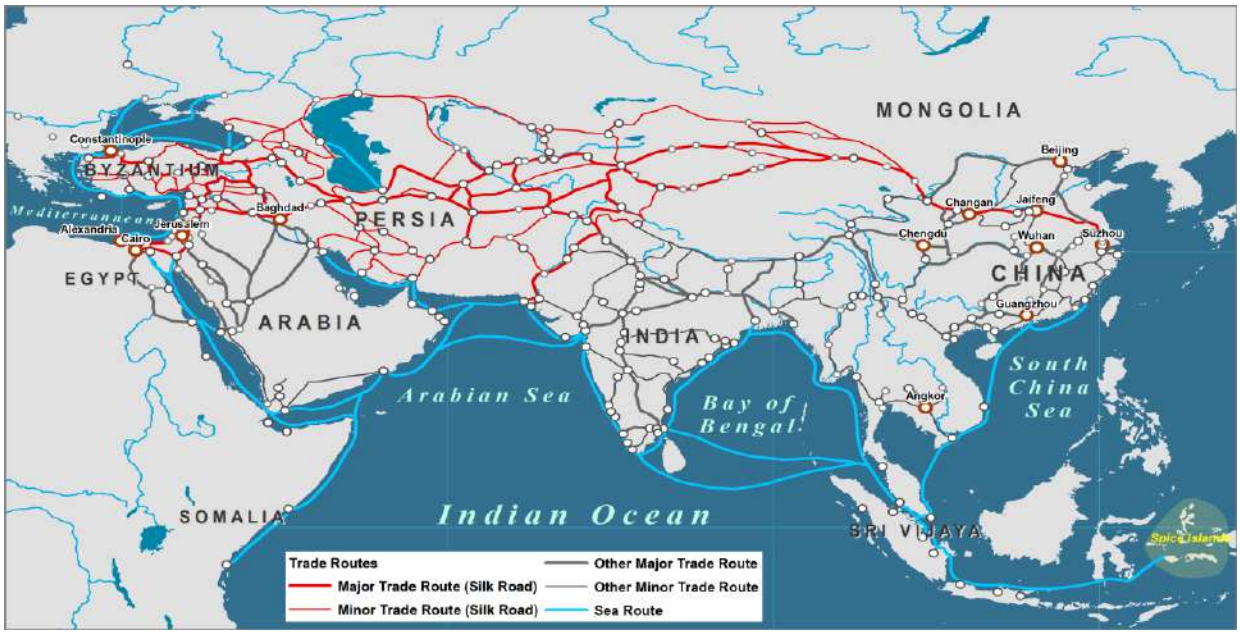
Gold coins were introduced in about 90BC by the Romans. There were several problems with metal currency and it is postulated that debasement (percentage content of precious metal in coins) in metal currencies was one of the reasons for the downfall of the Roman Empire.



Roman and Parthian trade routes 300 AD

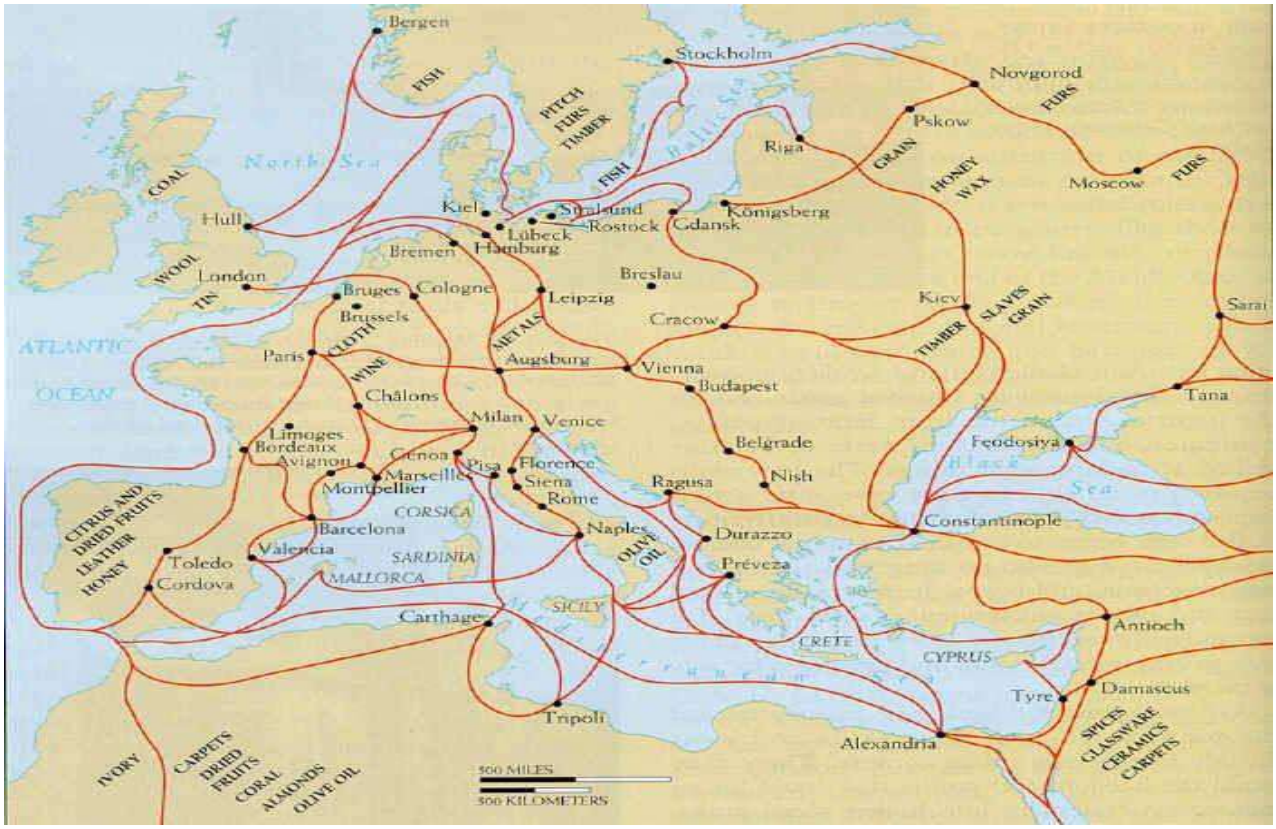
The fall of the Western Roman Empire caused a failure of trade routes to Europe but the Asian/Egyptian trade routes flourished. Grains, cotton, minerals and beasts of burden from Africa; tea, spices, pottery, gold and diamonds and silk from asia were the main commodities. Iron and silver coins were the exchange units.

However, the Chinese in eastern asia were using paper currencies since 1000BC.

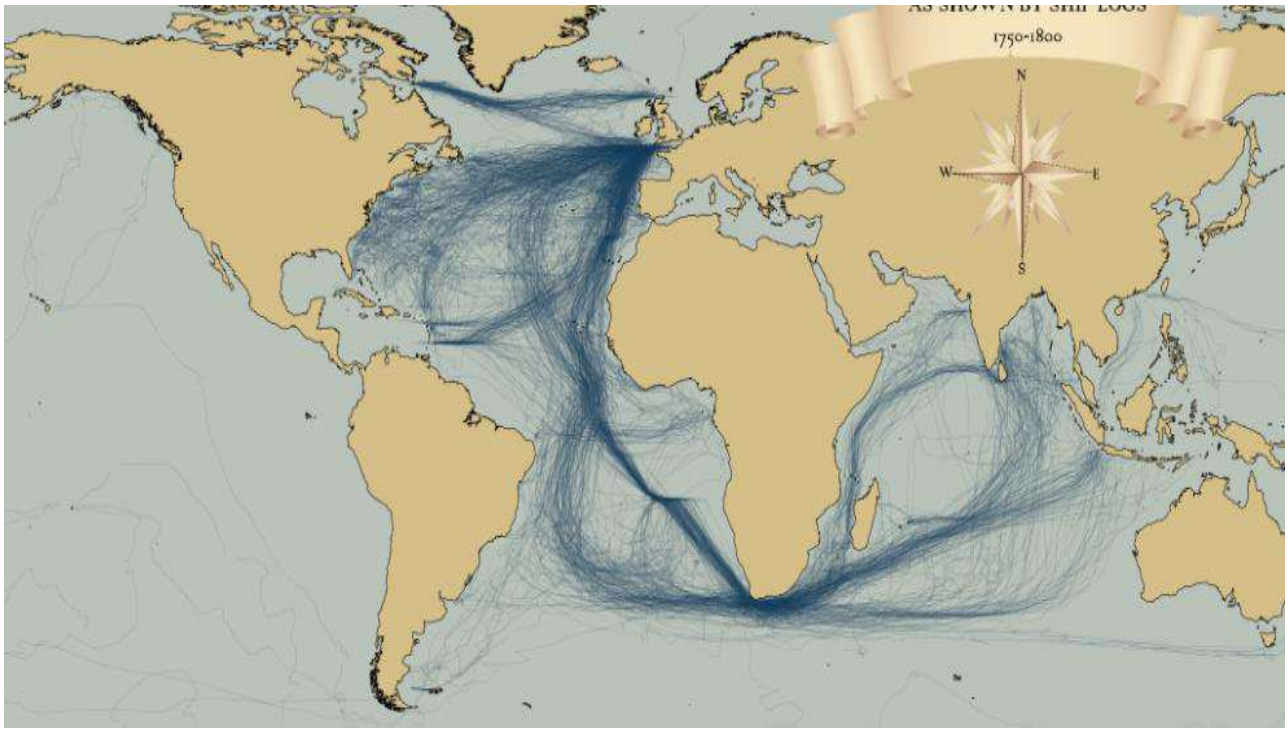


Silk Road and Indian Ocean/Arab sea route BC/AD junction

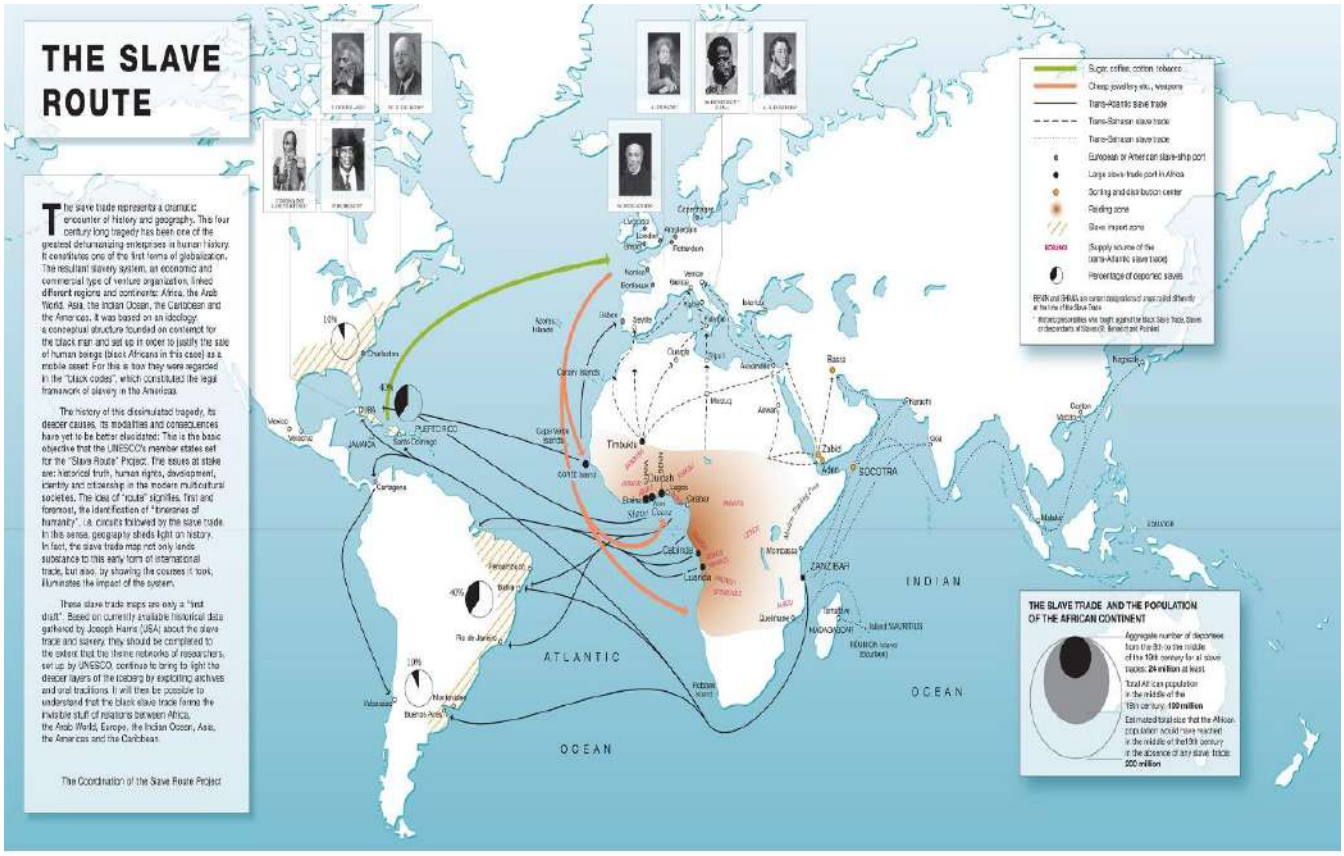
Large scale use of paper money started in France in early 18th century. The history of coins and paper currency tells a story of how debasement, valuation and devaluation with rulers making changes in certain circumstances and markets responding to the changes sets in motion an important aspect of economics.

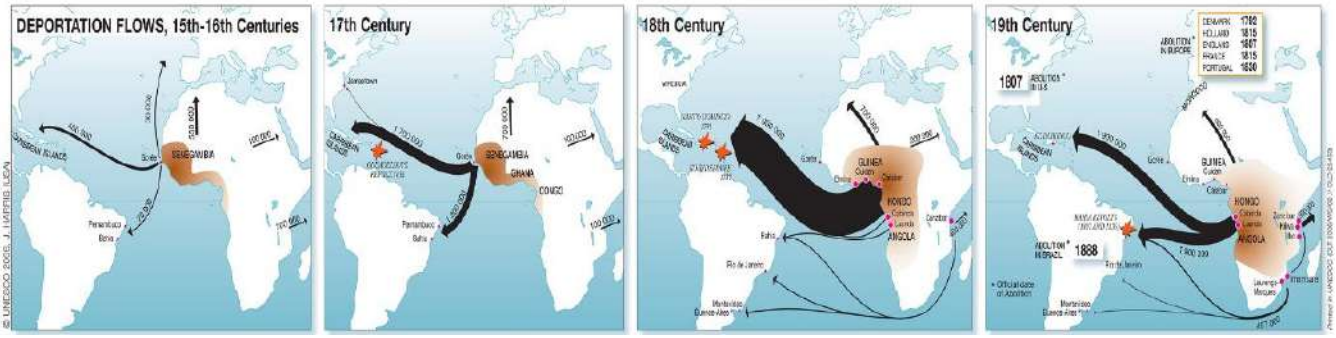


Medieval trade routes 500-1500AD

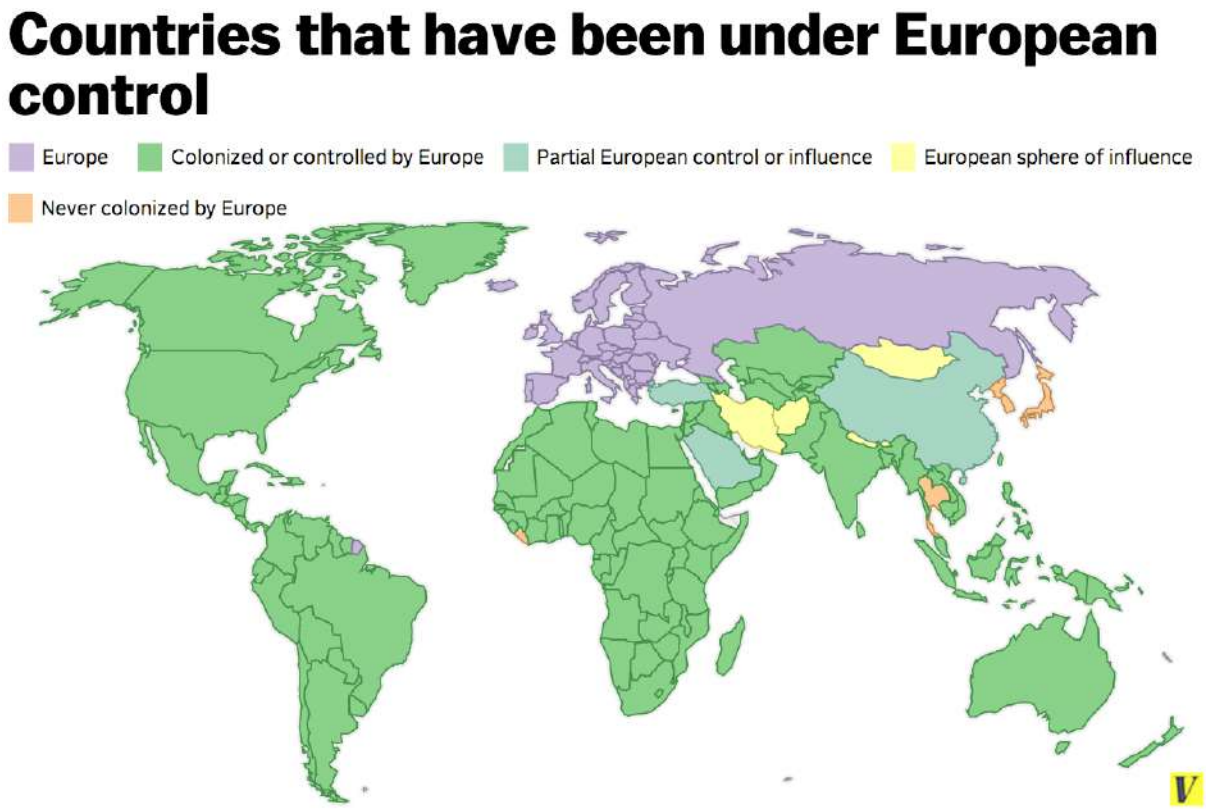


Portuguese, Spanish, Dutch and British trade routes 18th century





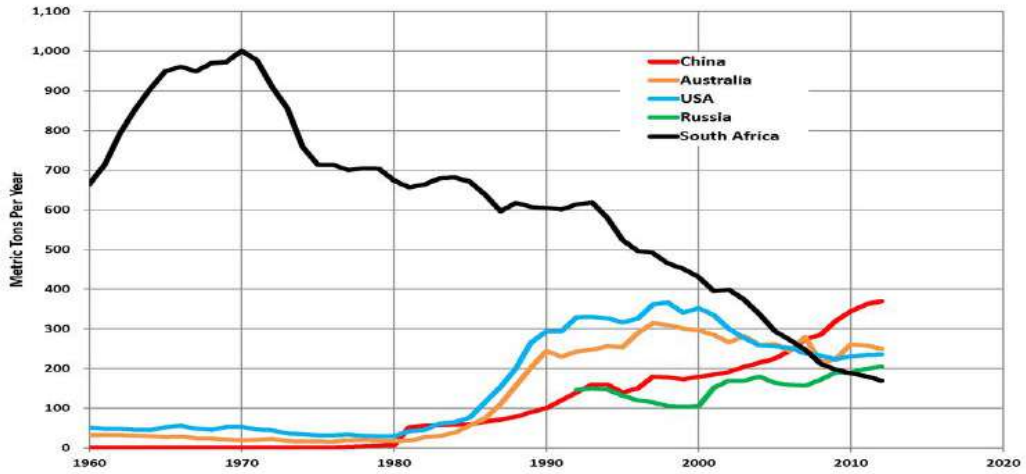
Slave trade route between 15th and 19th century of an estimated 25% of African population in that time; selected slaves were the fitter ones.



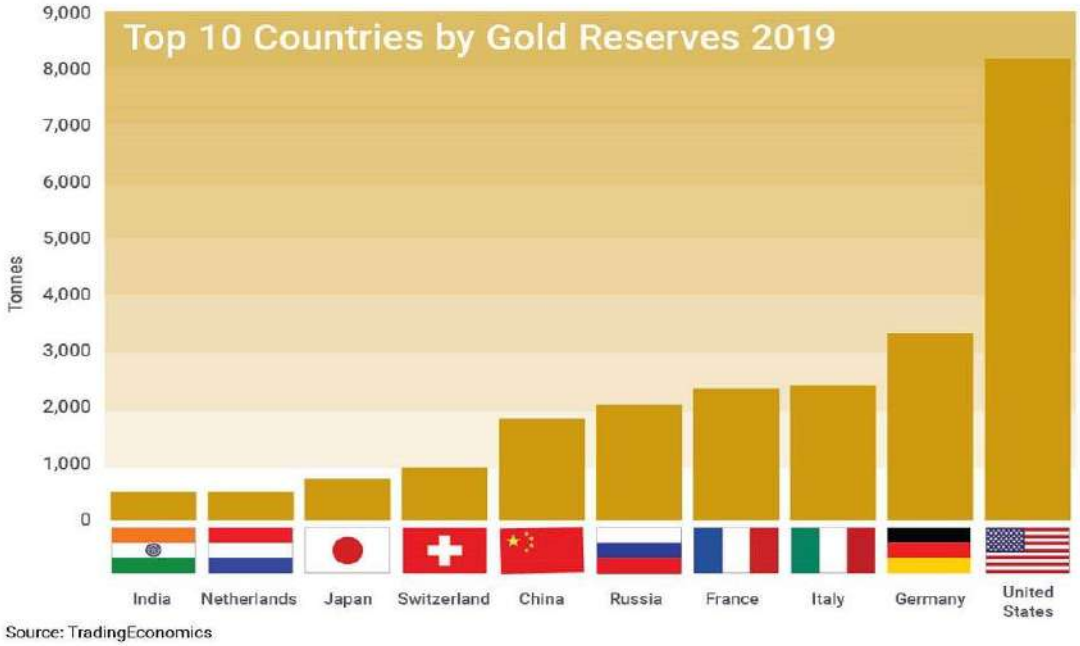
In the 450 years of colonial influence, the above picture suggests the extent

A country's bullion reserve can be exchanged for capital by the ruling state.

The gold rush of the 1850's changed the mixed bullion reserve to one based predominantly on Gold. The gold to silver bullion prices and reserves changed in favour of Gold. The below pictures show global gold status. The current gold mining reserves are between 10,000 tonnes in Australia to 1000 tonnes in Papua new guinea among the top ten gold mining reserve countries.

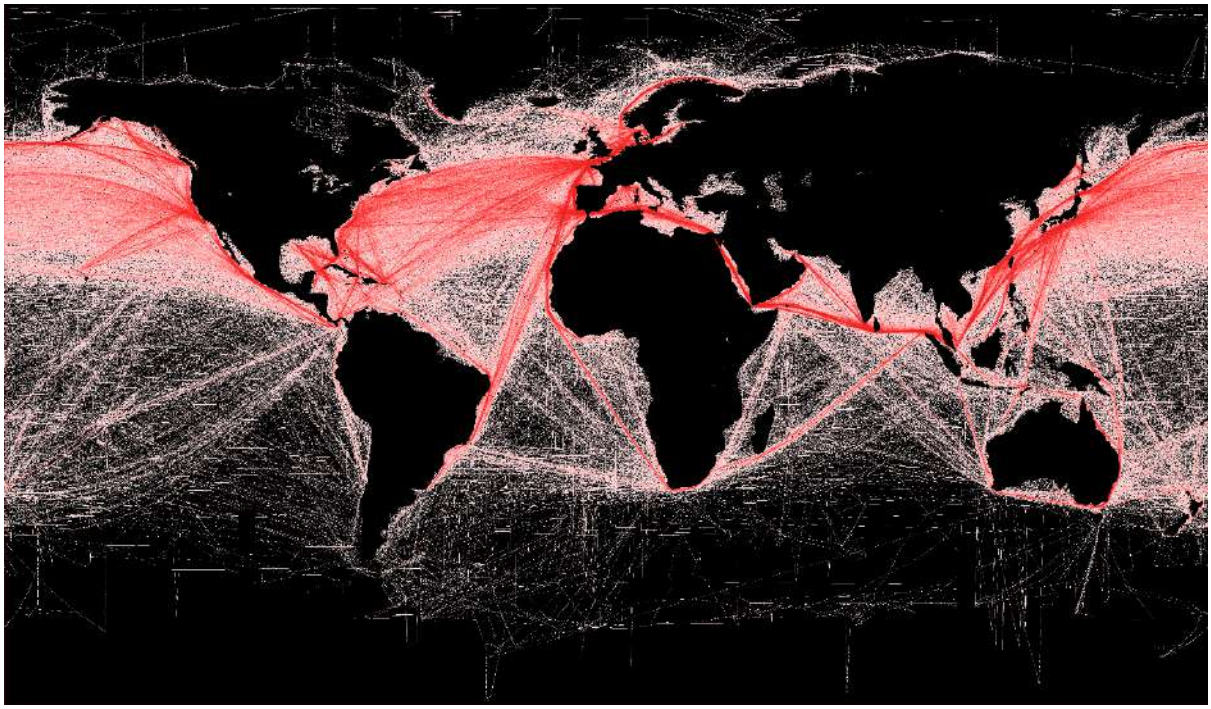

Metric Tons Per Year
China
Australia
USA
Russia
South Africa


Mine Production, metric tons
1912: 705
1940: 1,310
1970: 1,480
2001: 2,600
2014: 2,860

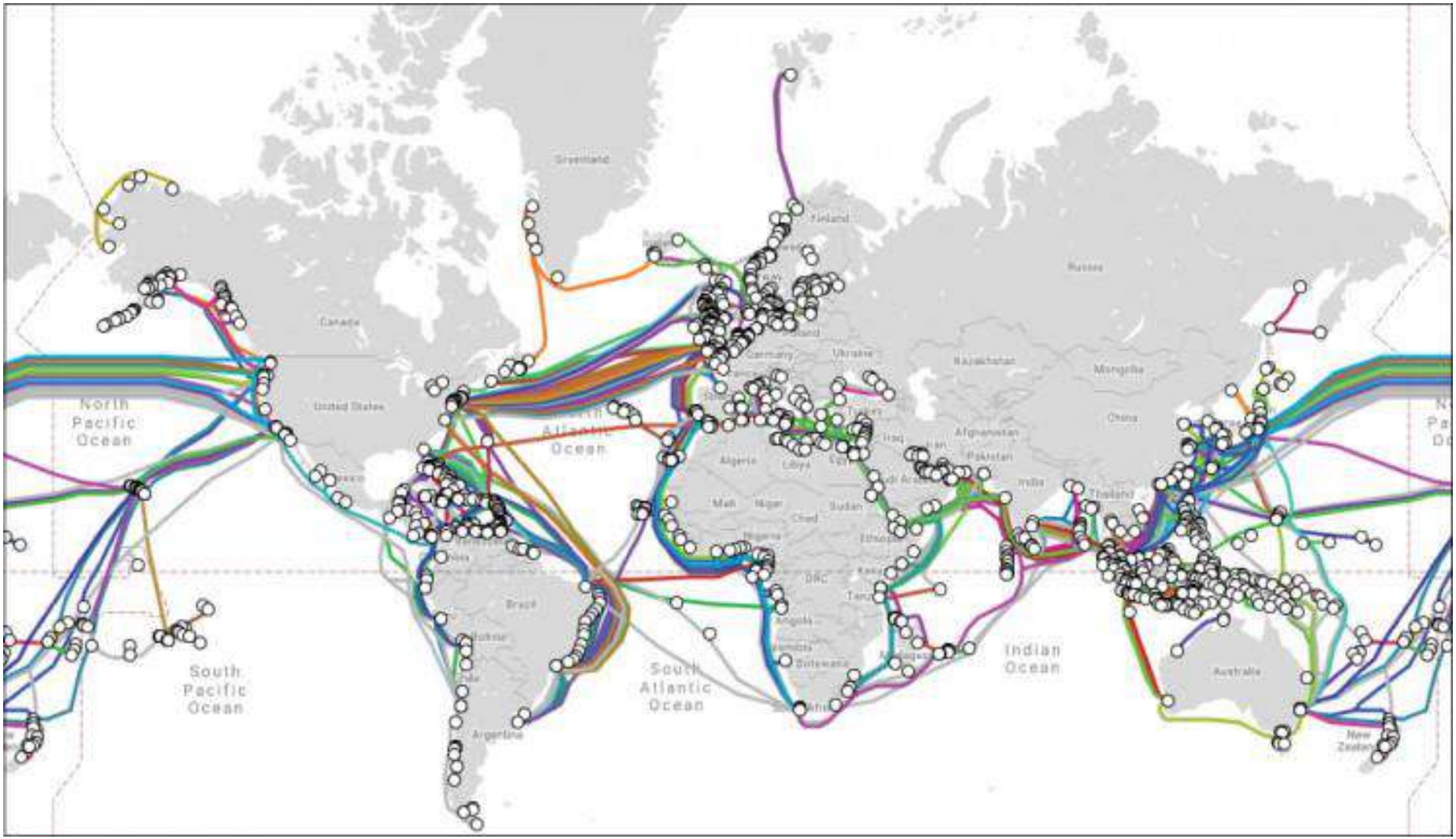

Top 10 Countries by Gold Reserves 2019
Tonnes
India
Netherlands
Japan
Switzerland
China
Russia
France
Italy
Germany
United States
Source: TradingEconomics

In recent times, freight transport by sea and air has become both dense and accessible; thus, the chosen modes of long-distance freight transport. However, for shorter distances, extensive networks of national and international train and road networks exist. The global trade is now 50% of overall global GDP per annum. The number of flights per year in 2020 for travel and transport was estimated by Statistica as 40 million. There are about 53,000 global merchant ships travelling per year with less than 1% passenger liners. These air and sea transports exclude private charters and military use. However, the bulk of freight transport is by the sea route.

Global air route travel & trade in recent times (only 1-2% of global freight movement is by air)

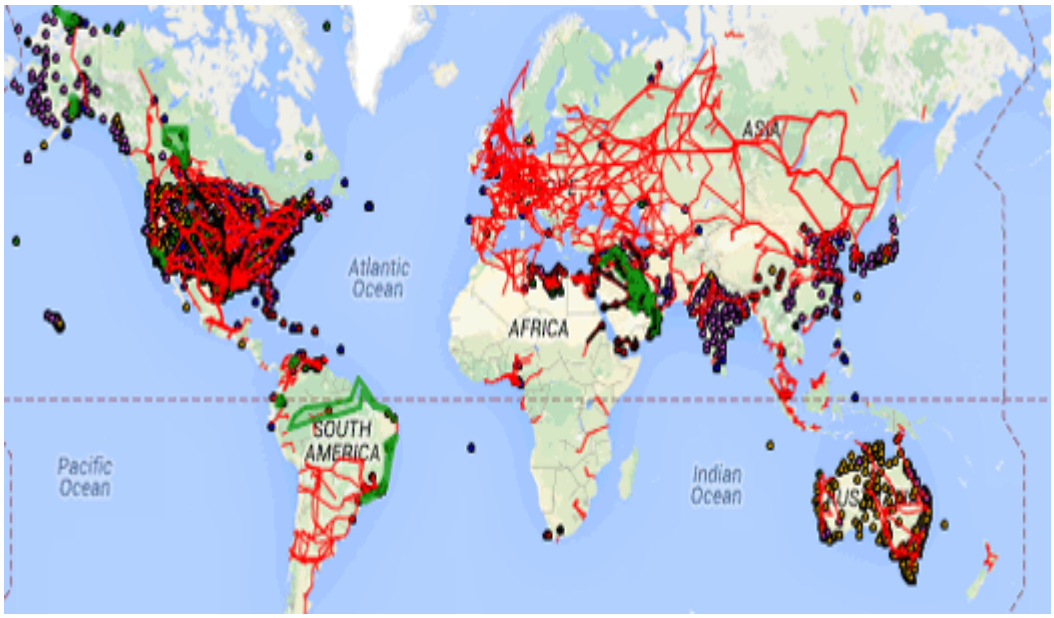


Global sea trade routes in recent times



The global undersea cables for all modes of communication currently existent in the world

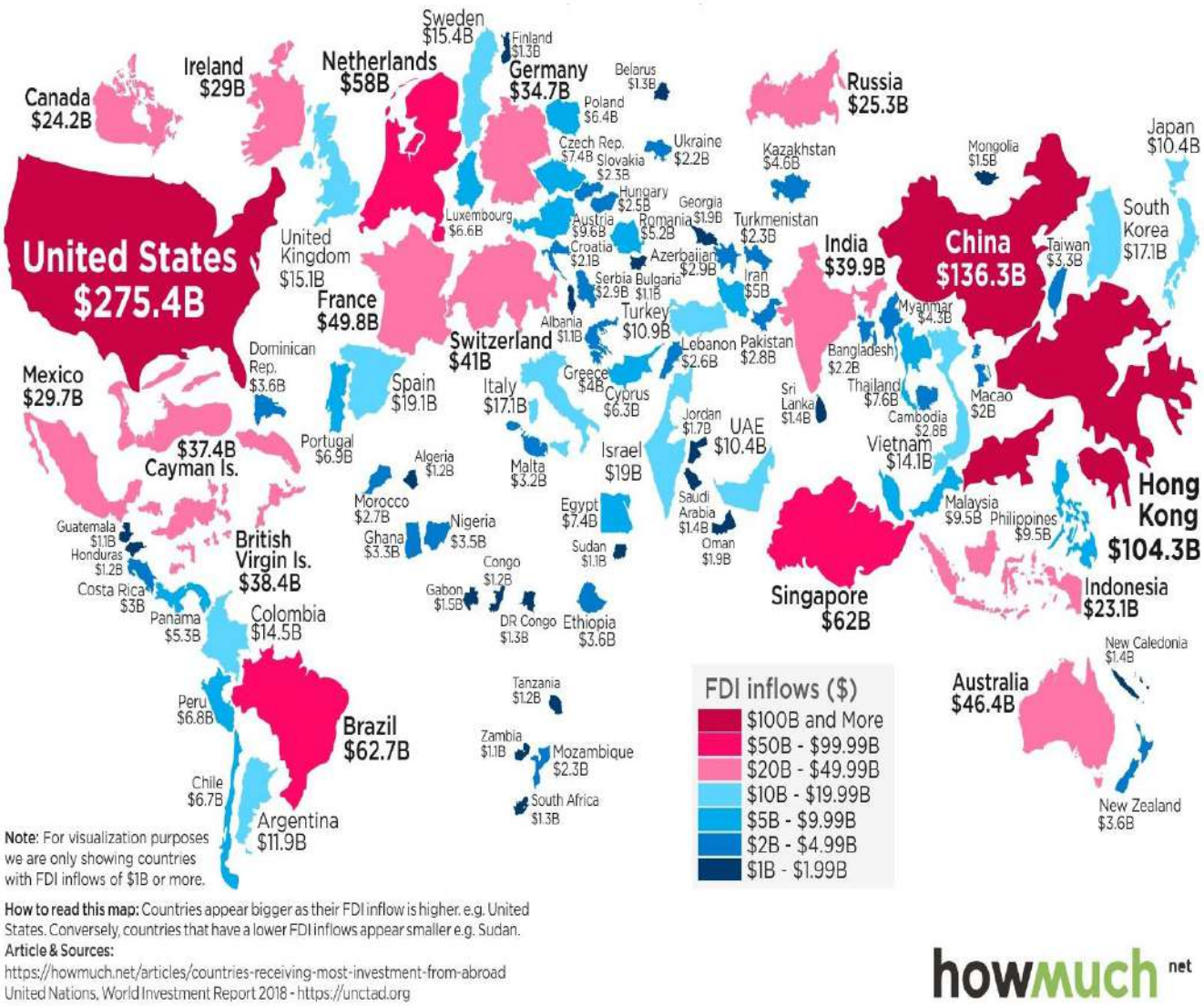
Oil and natural gas have their own production sites and distribution by pipelines in addition to sea transport of crude and refined petroleum products in large volumes.



green – major production zones
red dots – refineries
purple dots – health and safety issues reported
red lines – pipelines for transporting oil (nearly 2.5 million miles throughout the world)

Trade until 1600 was by real value of a product as found in a market. The Amsterdam Stock exchange was founded in 1602 when it changed the market prices to a speculative trading mode on the market. London and New York Stock exchange were founded in early 19th century and Hong Kong Stock Exchange in late 19th century. Currently, an average of 100% of global GDP is traded as stocks by market capitalisation. However, the trading in stock markets by different countries currently range from 1% to 625% of their GDP (Hong Kong) as per World Federation of exchanges database, World Bank. This ratio is known as the Buffett indicator.

The World Bank was set up towards the end of World War II and provides loans to poorer countries not able to obtain commercial loans. The International Monetary Fund was started in 1945 for global cooperation in trade and economic stability (mainly deals with international payment system and balance of payments). The Organisation for Economic Cooperation and Development was extended to world-wide status in 1961. They monitor the FDI flows between countries. The LSE changed from open-outcry to electronic and had some deregulations introduced in 1986 which allowed retail banking investments in Stock exchange. Some exchanges now operate on the electronic call out system. Establishment of WTO in 1995 led to the reduction of tariff and non-tariff barriers for participating countries. Regional banks and financial systems were set up in due course (for ex: asia).



FDI Inflows by country

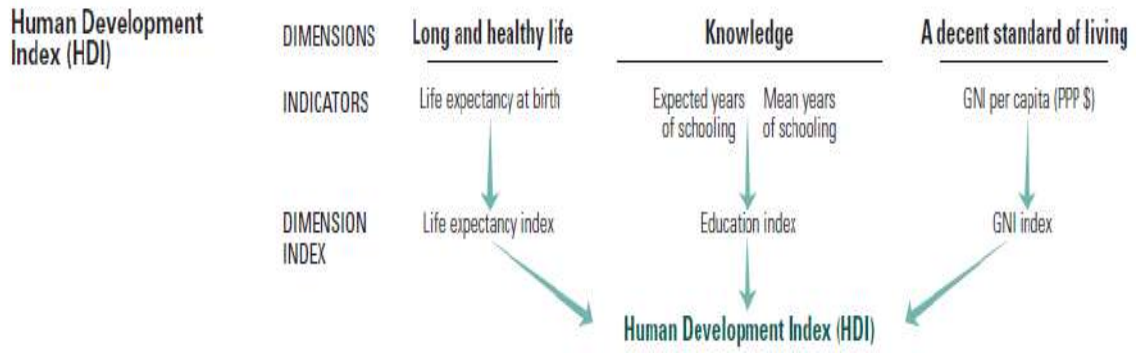
On Earning

An individual's wealth and its relative value in his country and to the world can be visualised; some examples are given here. There are several such measures to make a composite impression.

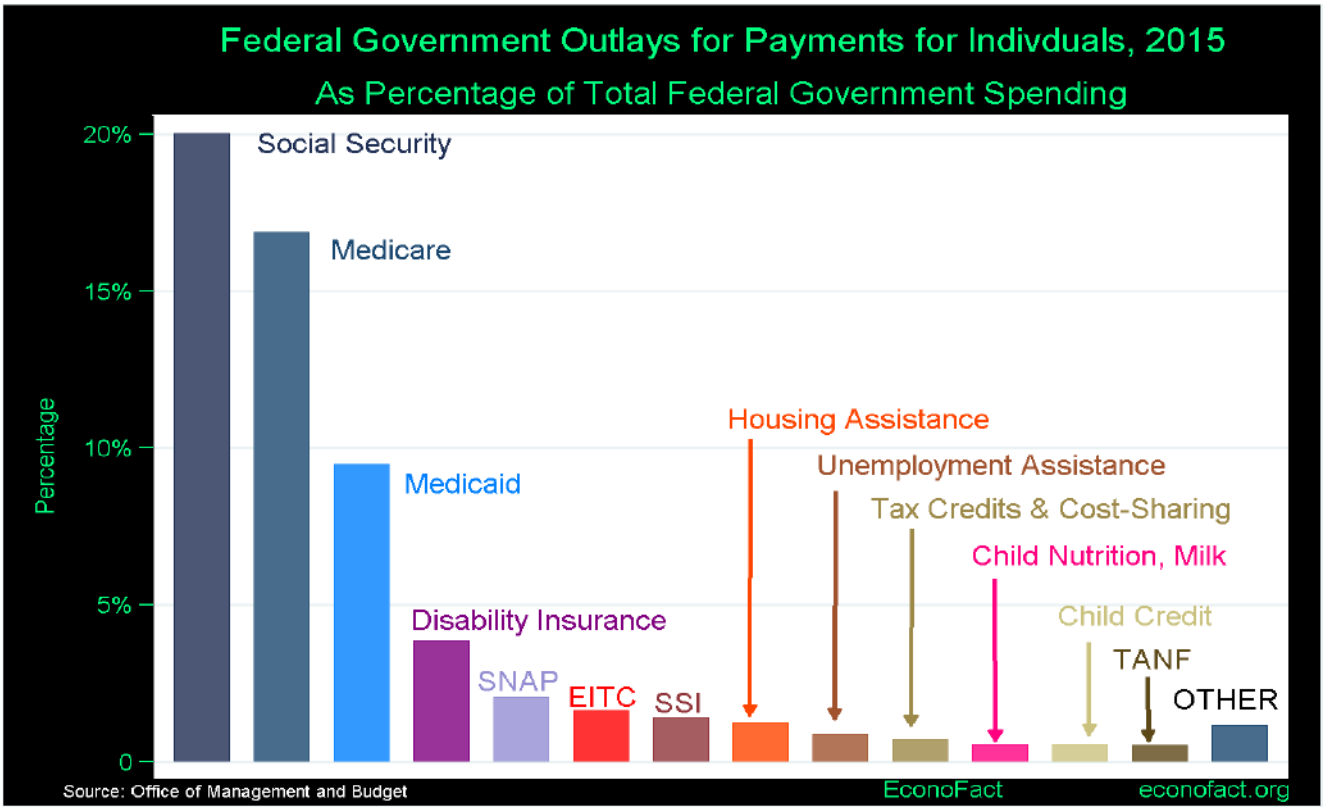
Term	Definition	Example Country USA	Example country India
GDP Nominal	Estimates the size of the economy & its growth rate	22 Trillion dollars	3.2 trillion dollars
GDP Nominal Rank	Relative to other countries	1	5
GDP (PPP)	Compares economic productivity and cost of living; purchasing power parity	20.5 Trillion dollars	11.3 trillion dollars
GDP (PPP) Rank	Relative to other countries	2	3
GDP per capita	GDP with respect to its population	$65,000	$2,340
GDP per capita rank	Relative to other countries	13	139
GDP (PPP) per capita	GDP (PPP) with respect to its population	$62,800	$9,000
GDP (PPP) per capita rank	Relative to other countries	13	118
GNI (PPP) per capita	Measure of a country's income; purchasing power parity of the income	$65,000	$2,130
GNI (PPP) per capita Rank	Relative to other countries	10	128
HDI	Links life expectancy, education and GDP	0.92	0.642
HDI rank	Relative to other countries	15	129
Inequality adjusted HDI	Once HDI is adjusted for inequality in a country	0.797	0.538
Inequality adjusted HDI rank	Relative to other countries	28	94

There are countries with very high, high, medium and low HDI. Percent of population living below a country's specific national poverty line is another way to observe poverty in a country. The World Bank's category of <$1.90 per day for extreme poverty is applicable to 10% of the world's population, <$5.50 per day applies to 46% of the world's population, <$10 per day applies to 71% of the world's

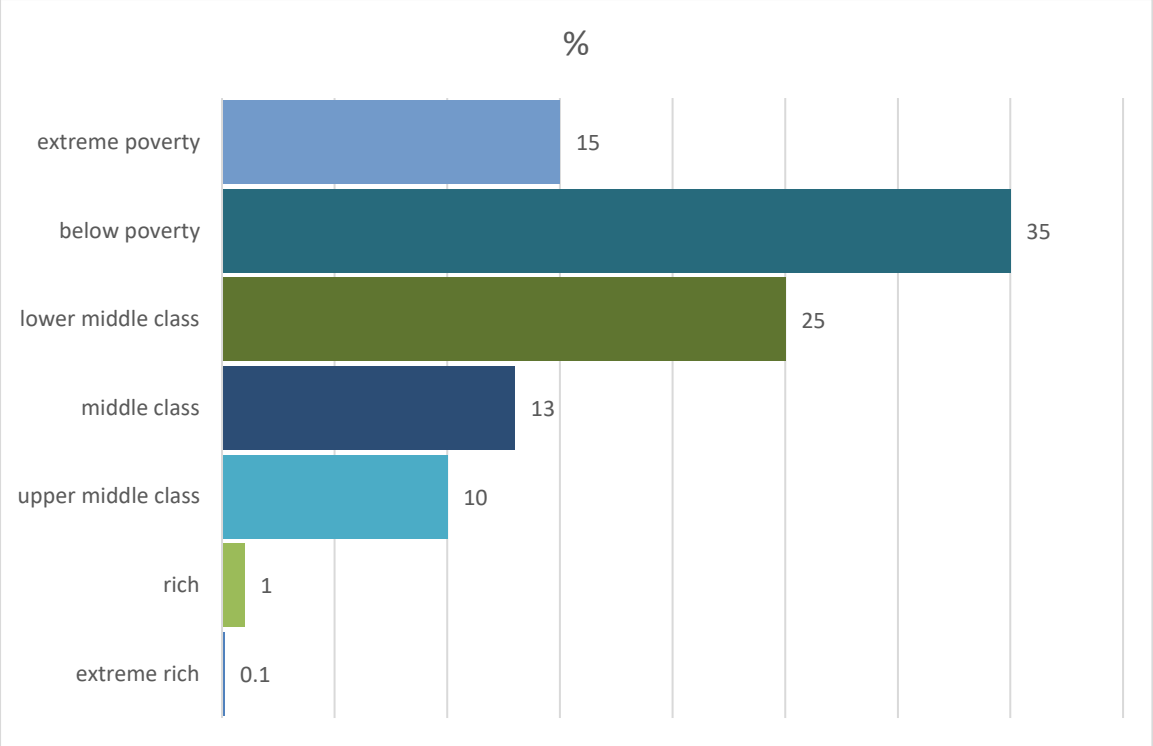
population, $10,000 - $100,000 per annum is the middle class which is 20%, credit Suisse report in 2018 stated that a net asset of $900,000 per head is the top 1% of the world earning population.



A middle-class earner in one country may be one in poverty relative to another country and an upper middle-class earner relative to another country. Using American dollar as the international benchmark, an American in America needs to continue to earn >$100,000 per annum per head as upper middle class; this is 9% of Americans. On the other hand, for a family of 2, earning <$26,000 per annum is below poverty in America. 13% of Americans are living below poverty line.



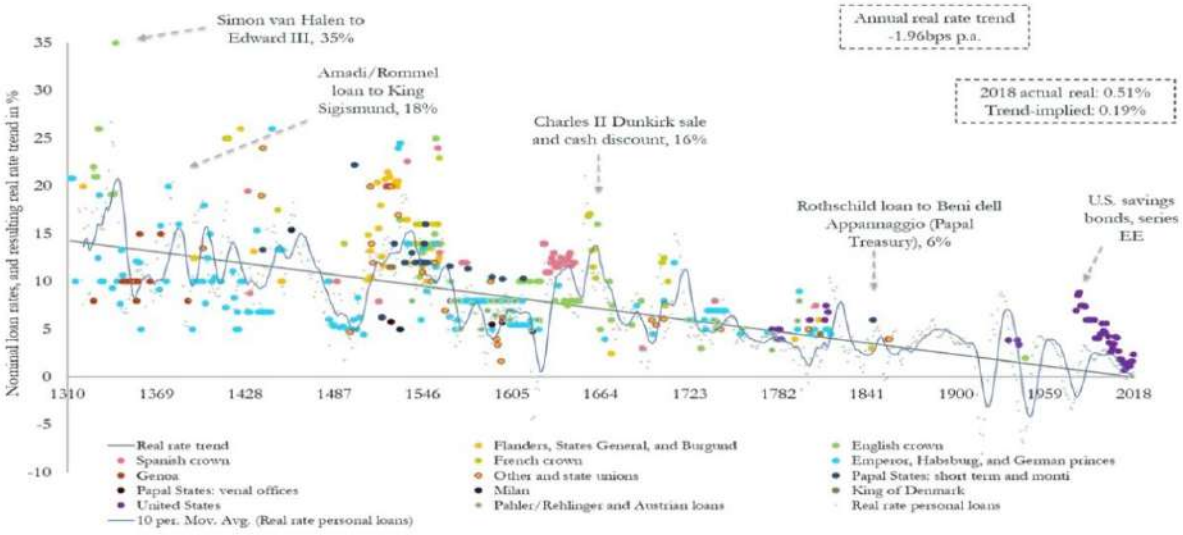
This picture gives an illustration of different financial support mechanisms in USA



This would generally be the layers of any country's population. Depending upon the Human Development index of the nation, the percentage of the population in each layer may vary and in some very high HDI nations, extreme poverty may be eradicated and below poverty supported by social support measures from a part of the general taxation.

Wealth excess or deprivation can also be seen as a relative concept. The idea of equality between individuals reduces perception of wealthiness or lack of it. However, the common meaning of equality is being equal in status, rights or opportunities.

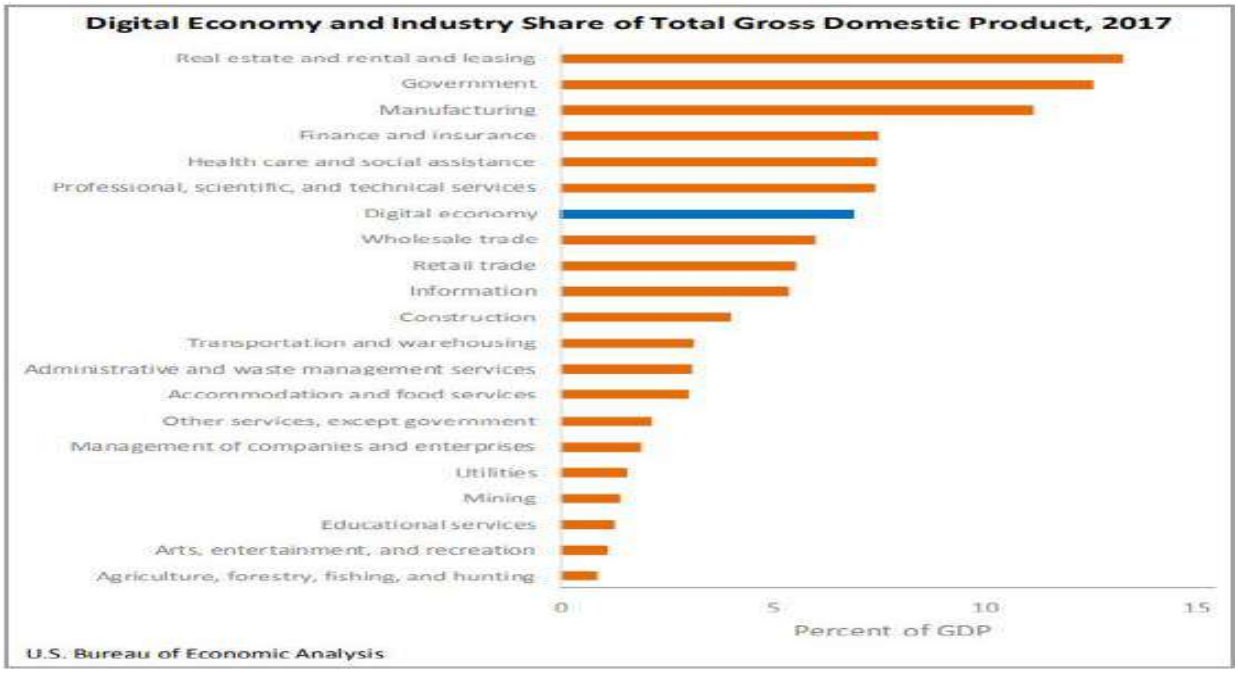
For earning individuals, bank interest rates were a profitable way to save. Currently the least bank interest rates are in the developed world. For example, it is 0% in western Europe and in fact, Denmark and Switzerland are charging about 0.5% to the savings account holders. In developing countries, banks still offer an interest to their customers for their savings. The current highest in the world is about 10%.



If one were to observe the Global GDP by sector, it gives an idea of global trends in investments and revenues.

Sector	1995 Global GDP %	2018 Global GDP %
Industry	32	26
Services	54	61
Agriculture, fishing and forestry	7.6	4.1

If a country's GDP by sector needs to be understood, it can be understood by the example of USA GDP 2017 as below

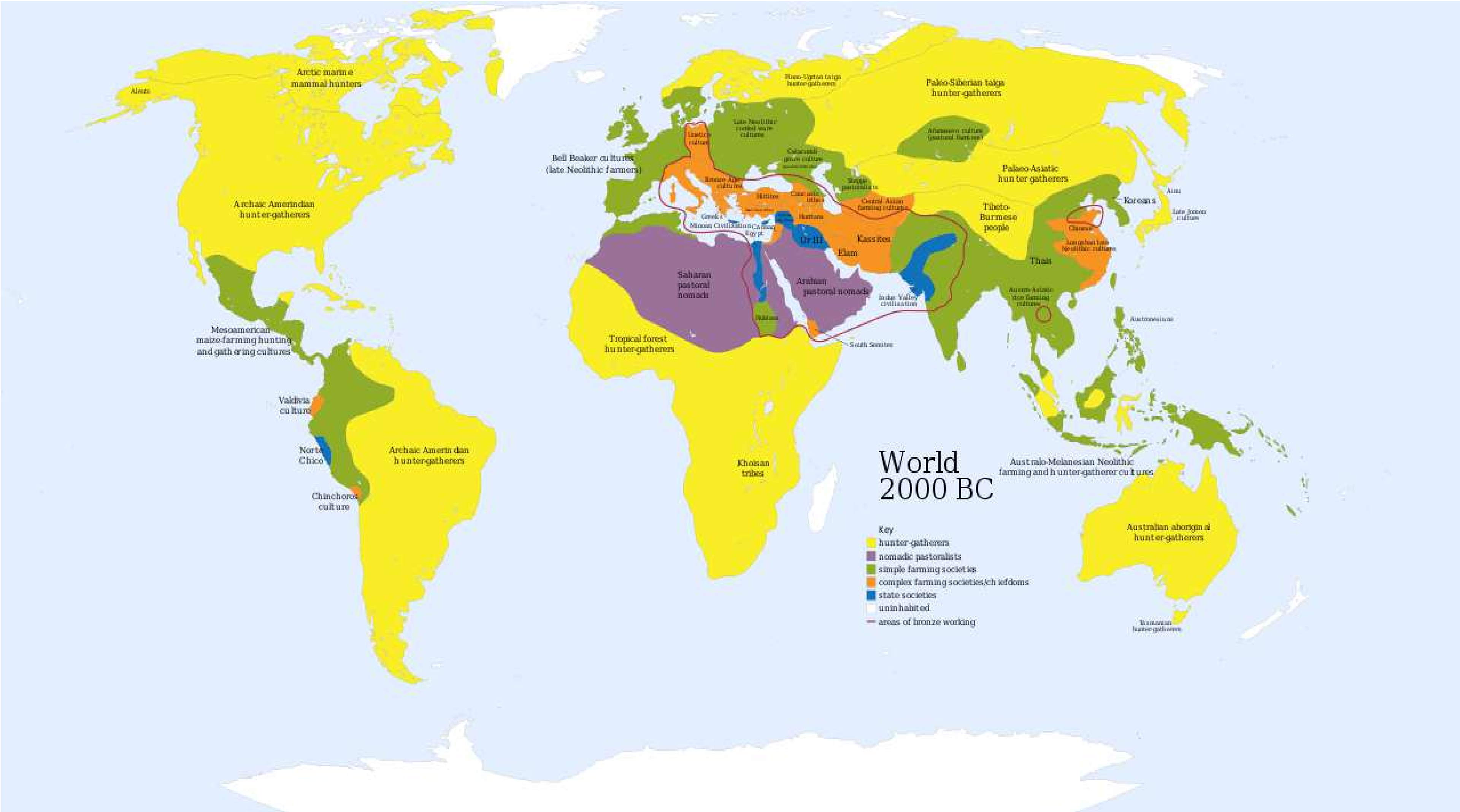


An average 40% of ones' lifetime is spent on receiving education until higher secondary Education. The upper 10% of professional earners have usually completed one/two post-graduation/research. For this group, educational time formal and informal can go up to 70% of their lifetime until education is completed. An example estimate of the total cost of education from nursery to post graduation on an average private fee structure in the USA is about $500,000 per person. Such a candidate also needs to maintain licences, memberships and ongoing education for his/her entire career adding another average $300,000 in his lifetime. This rough estimate includes subsistence and allowances necessary to pursue educational and career goals. It may not be wrong to say that to be a millionaire, one has to spend a million in the USA.

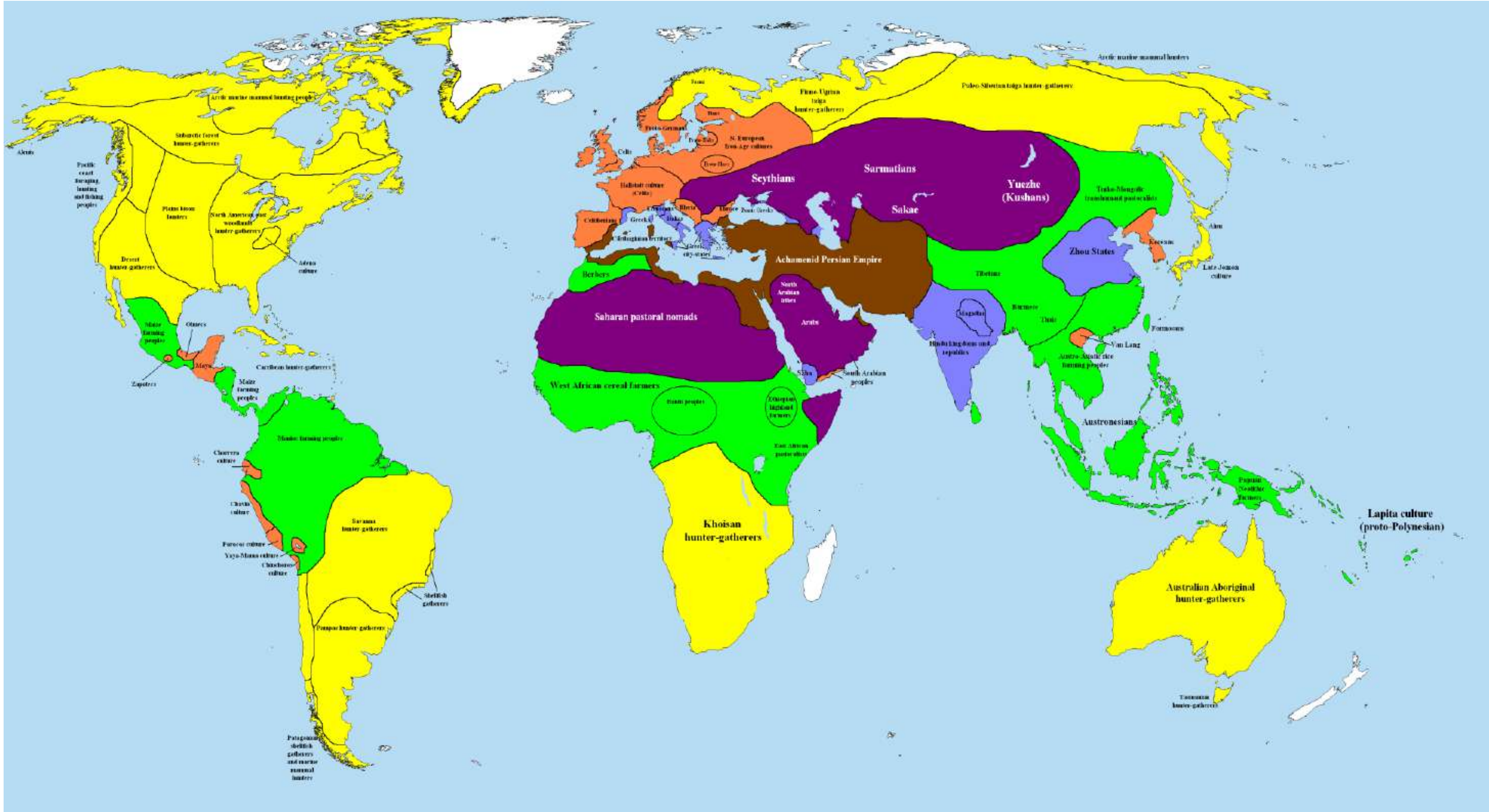
Purchasing power parity conversion factor takes into account the cost of living in a country. An example of India is 20 folds currently. The conversion factor is different for different countries and changes with time. This means 1$ if used in in India can buy 20 times what it can buy in USA currently; however, MNC products are equivalent in PPP.

An individual's earning and what it can afford in its country fits somewhere along this spectrum: Global, country, sector, education, skills and seniority/promotion and purchasing parity.

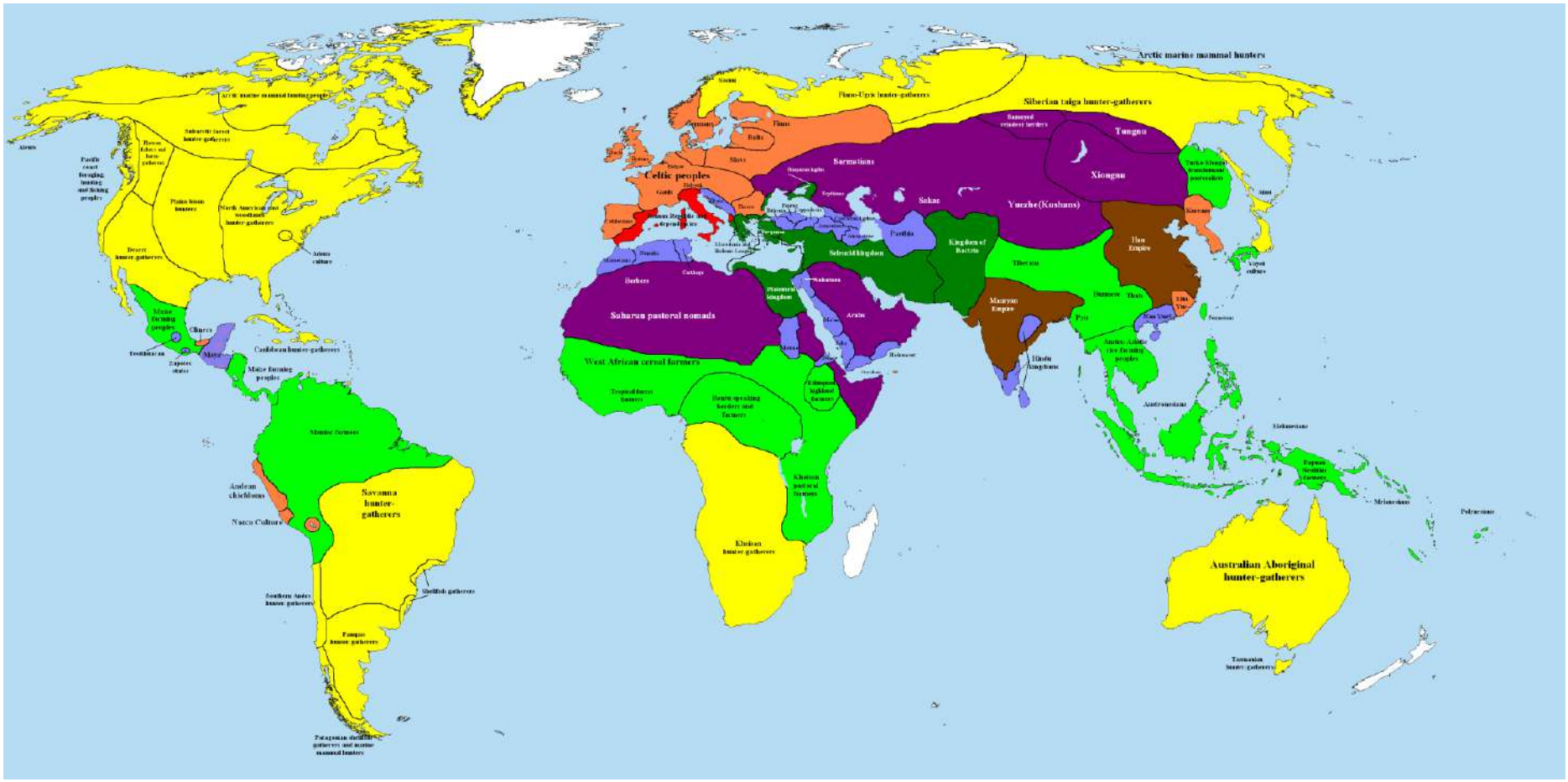
On War



Aleuts
Arctic marine mammal hunters
Archaic Amerindian hunter-gatherers
Bell Beaker cultures (late Neolithic farmers)
Mesoamerican maize-farming hunting and gathering cultures
Valdivia culture
Norte Chico
Chinchoros culture
Archaic Amerindian hunter-gatherers
Paleo-Siberian taiga hunter-gatherers
Palaeo-Asiatic hunter gatherers
Hittites
Hurrians
Greeks
Minoan Civilization
Egypt
Ur III
Kassites
Elam
Saharan pastoral nomads
Arabian pastoral nomads
Indus Valley civilization
South Semites
Tibeto-Burmese people
Koreans
Thais
Tropical forest hunter-gatherers
Khoisan tribes
World 2000 BC
Australo-Melanesian Neolithic farming and hunter-gatherer cultures
Australian aboriginal hunter-gatherers
Key
hunter-gatherers
nomadic pastoralists
simple farming societies
complex farming societies/chiefdoms
state societies
uninhabited
areas of bronze working

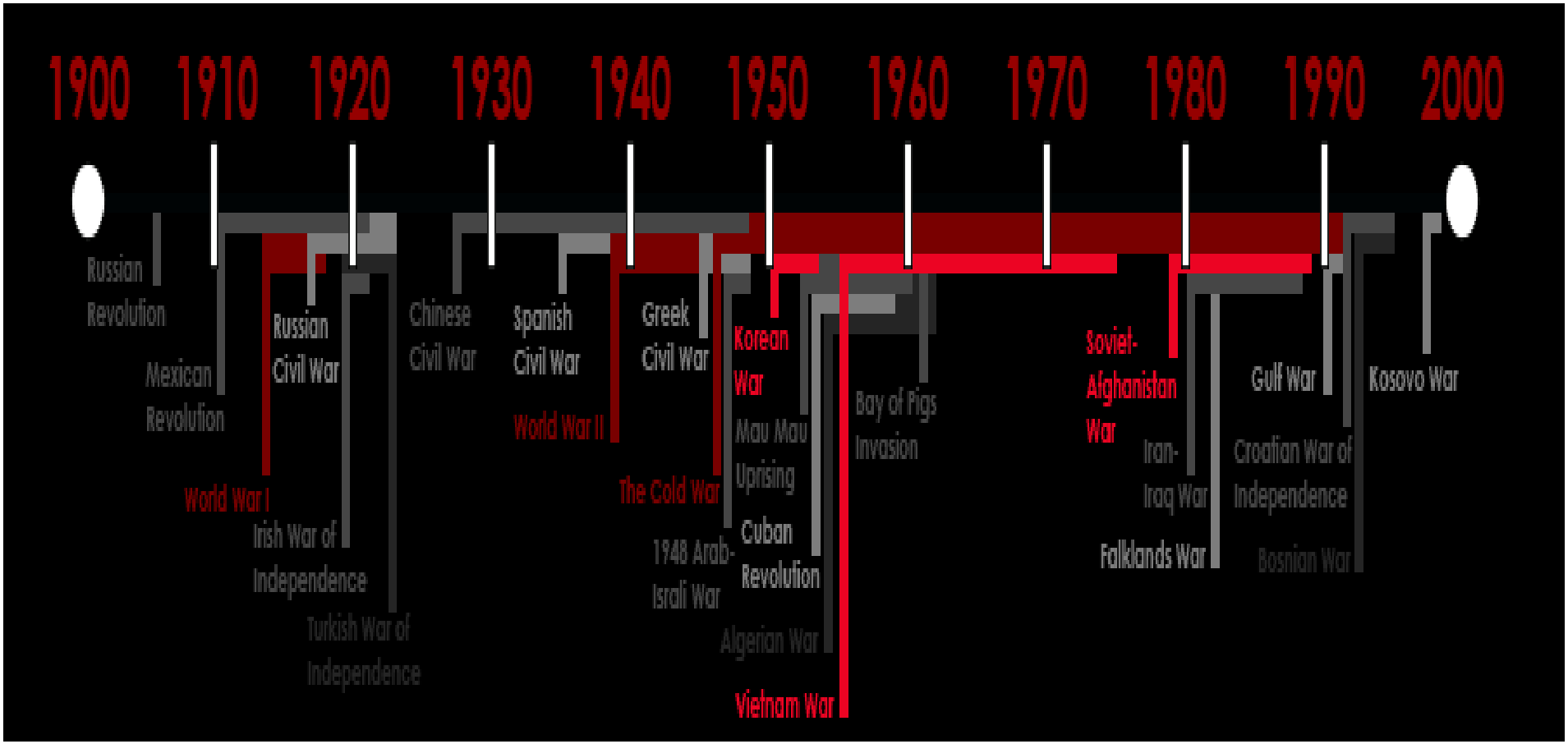

Scythians
Sarmatians
Yuezhe
(Kushans)
Sakae
Achaemenid Persian Empire
Saharan pastoral nomads
West African cereal farmers
Khoisan
hunter-gatherers
Zhou States
Austronesians
Lapita culture
(proto-Polynesian)
Australian Aboriginal
hunter-gatherers
Berbers

World 500BC

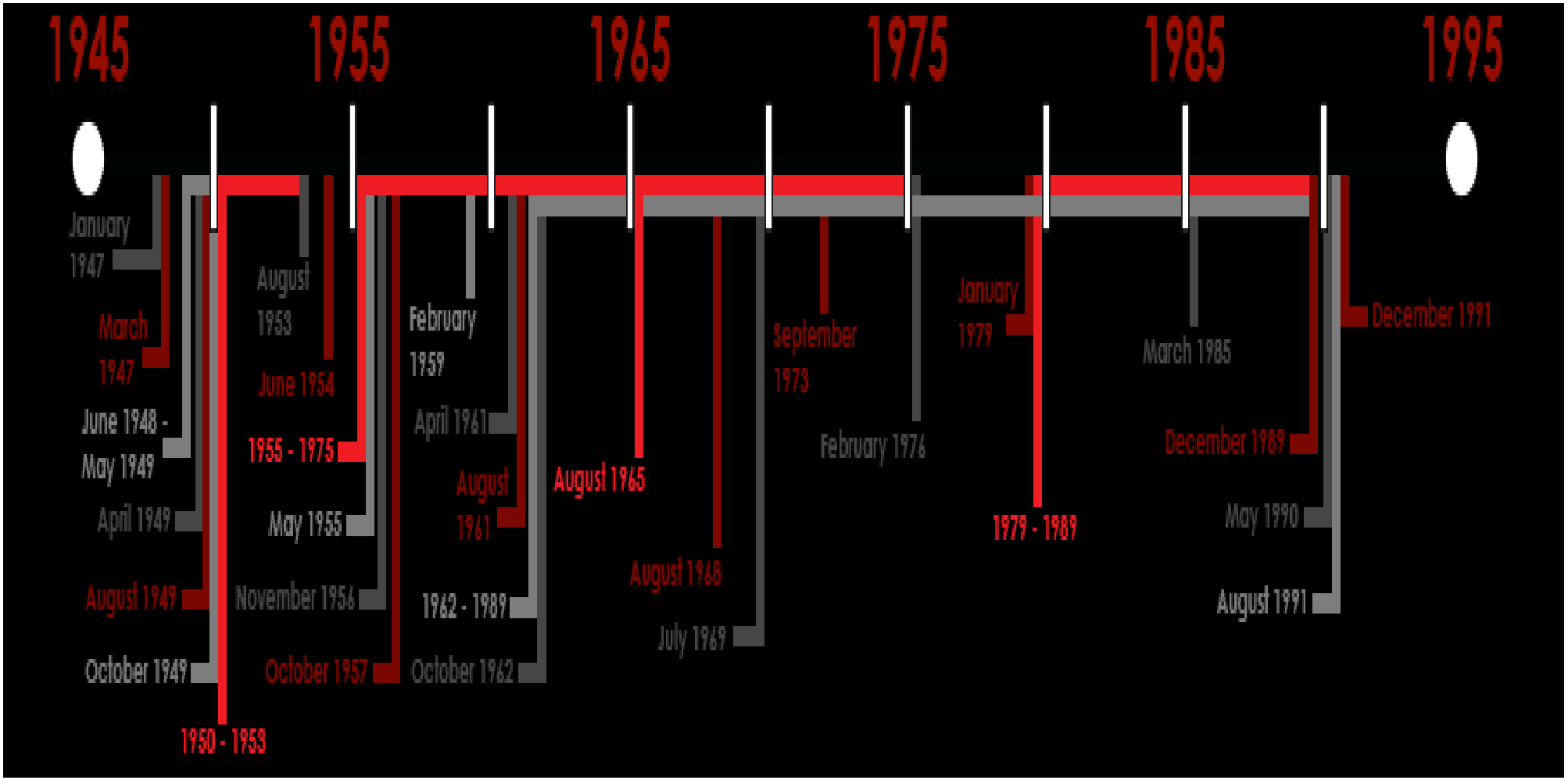

Arctic marine mammal hunters
Siberian taiga hunter-gatherers
Tungusi
Xiongnu
Yuezhe (Kushans)
Sakae
Sarmatians
Celtic peoples
Suharan pastoral nomads
West African cereal farmers
Kingdom of Bactria
Han Empire
Mauryan Empire
Seleucid kingdom
Parthia
Caribbean hunter-gatherers
Andean chiefdoms
Nazca Culture
Savanna hunter-gatherers
Australian Aboriginal hunter-gatherers

World 200 BC

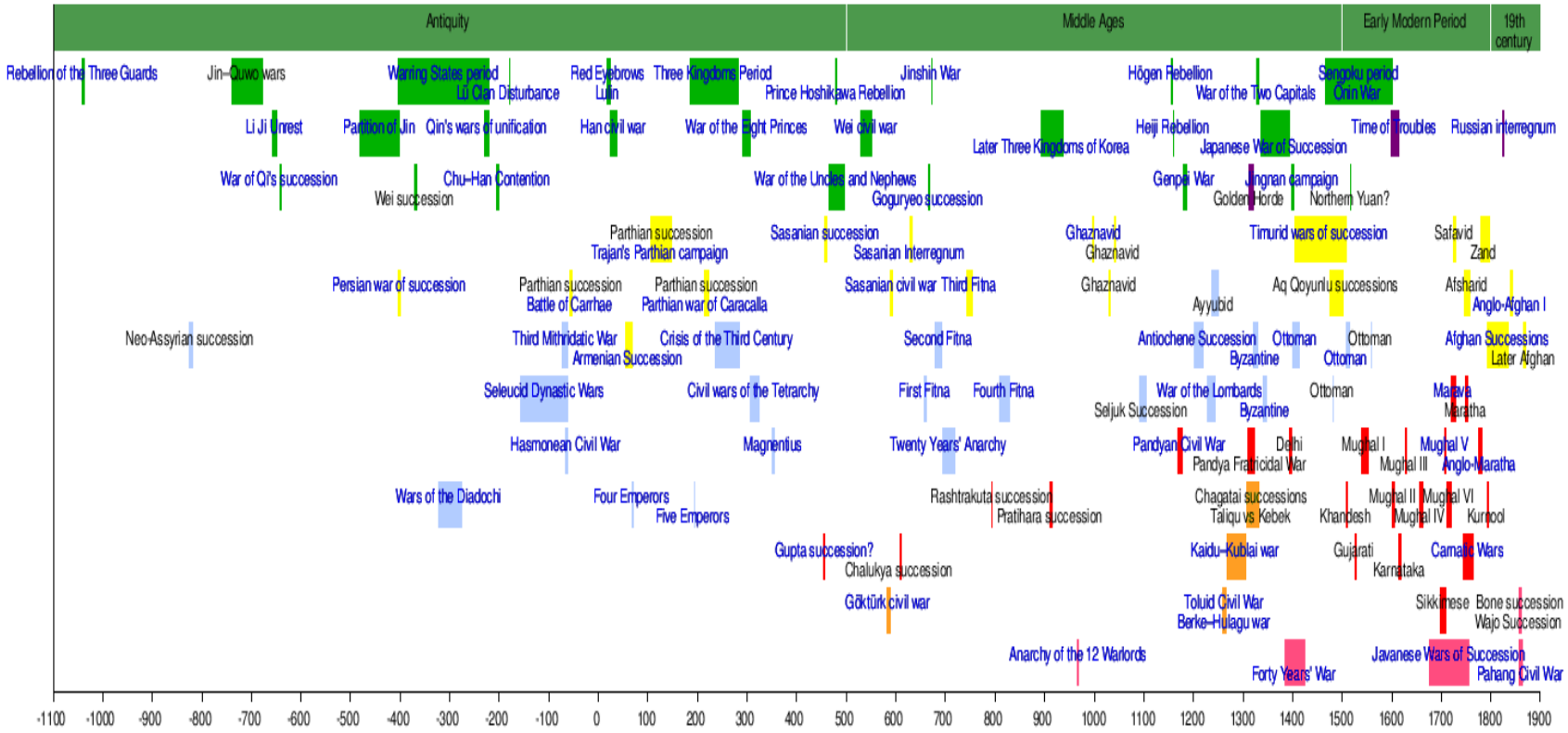
In the last 2000 years, war has resulted in an estimated 0.5billion deaths (>80% casualties are civilians) [National Geographic July 2020].



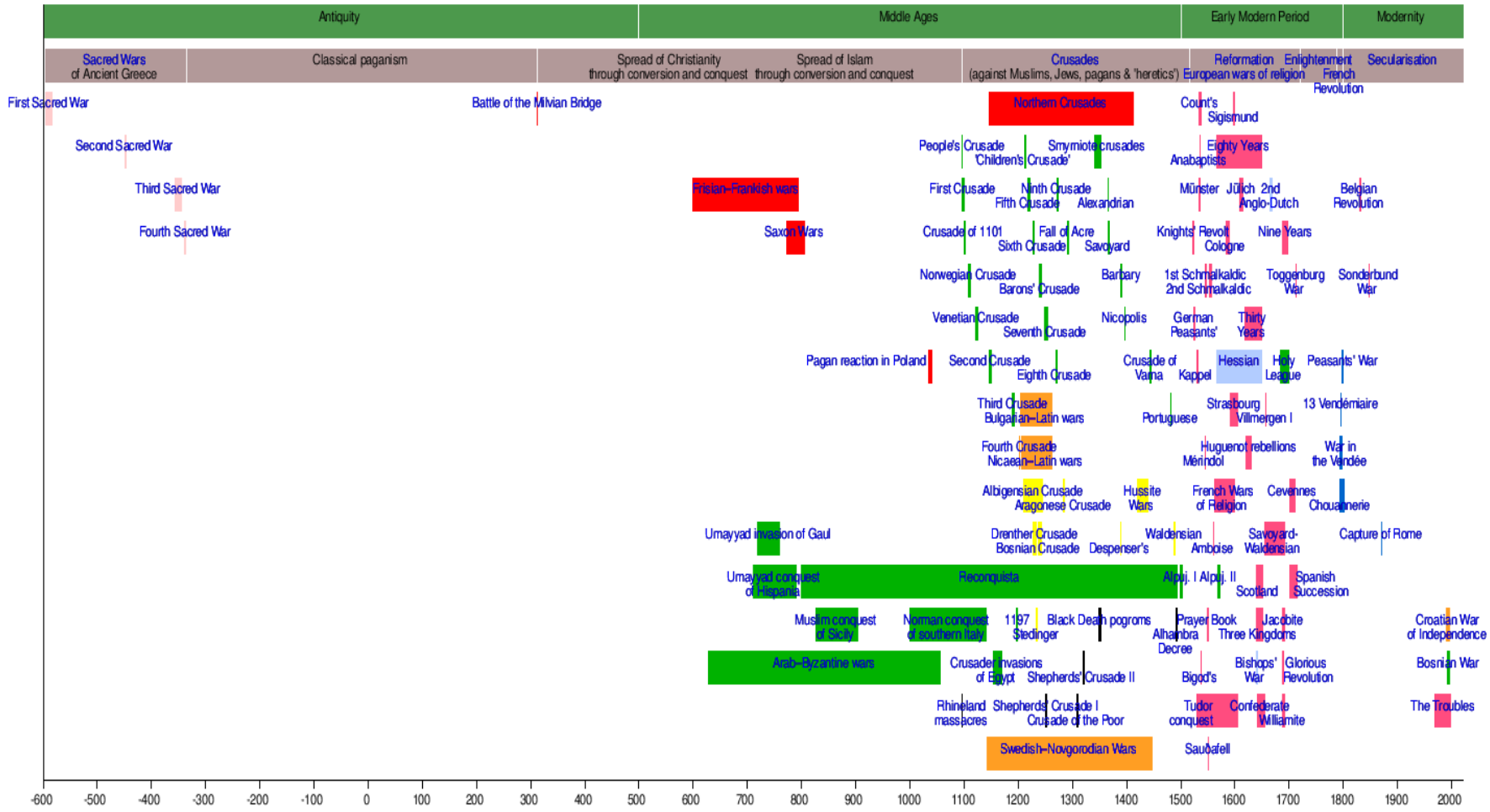
Wars of the 20th century



Cold War – the era of proxy wars and sponsored coups



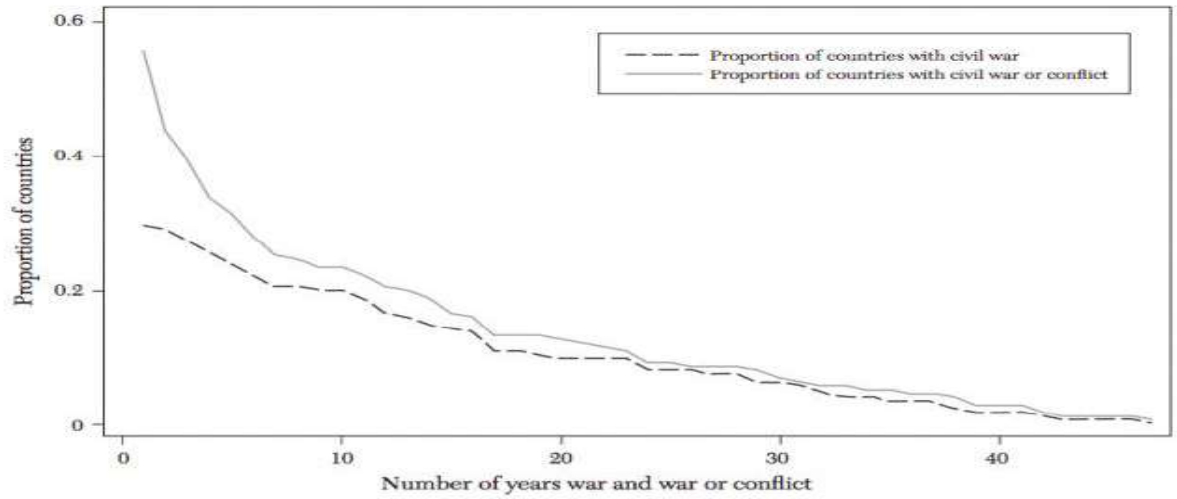
- Central Asia
- East Asia
- North Asia
- Persia & Afghanistan
- South Asia
- Southeast Asia
- West Asia



Religious wars over the millenia

- Inter-pagan conflict
- Christian–pagan conflict
- Christian–'heretic' conflict
- Christian–Islamic conflict
- Catholic–Orthodox conflict
- Catholic–Protestant conflict
- Inter-Protestant conflict
- Anti-Jewish pogrom
- Christian–secularist conflict

There have been several civil wars within kingdoms/empires/nations over the course of history all over the world. These would include wars of succession. They are still ongoing. There is a constant ebb of civil violence superimposed by regional or world conflicts. There is no war free time on the globe. 19th century Europe and America witnessed acts of terror against the state in Britain, Russia, Italy and America. It was the beginning of terrorism. In 1930 Israel, there was a Zealot similar uprising of Israelites against Palestinians in retaliation. This is the modern version of the term terrorism. However, Western Europe has achieved its most stable point with the absence of war deaths since end of world war II and North America has had no war on its soil since 1890.

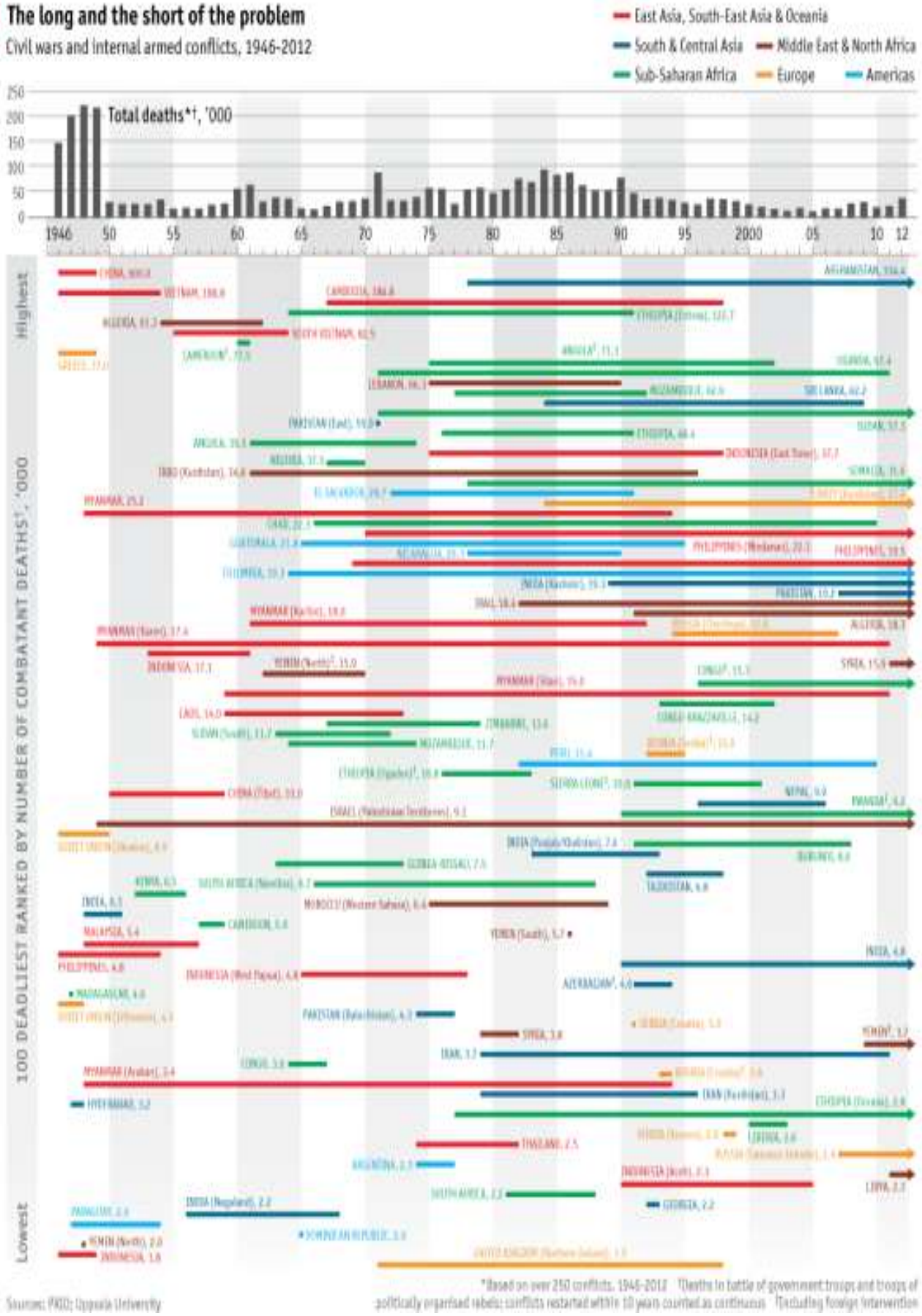


Civil wars across countries between 1960 – 2006

Comparative data

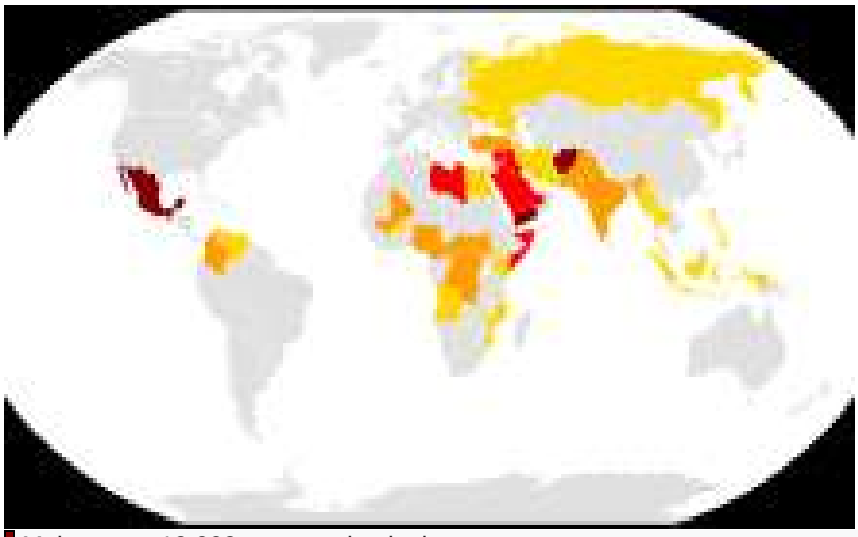
The long and the short of the problem

Civil wars and internal armed conflicts, 1946-2012



*Based on over 250 conflicts, 1946-2012 †Deaths in battle of government troops and troops of politically organised rebels; conflicts restarted within 10 years counted as continuous ‡Excluding foreign intervention

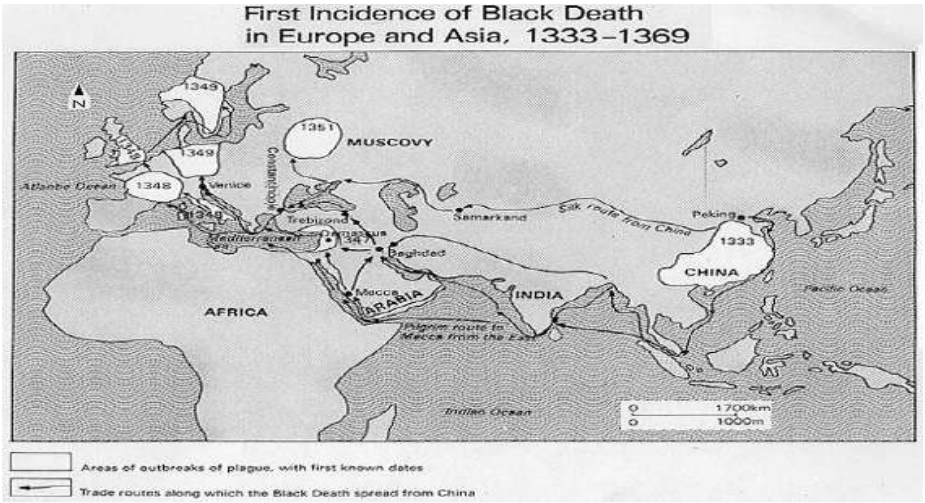
Sources: PRIO; Uppsala University



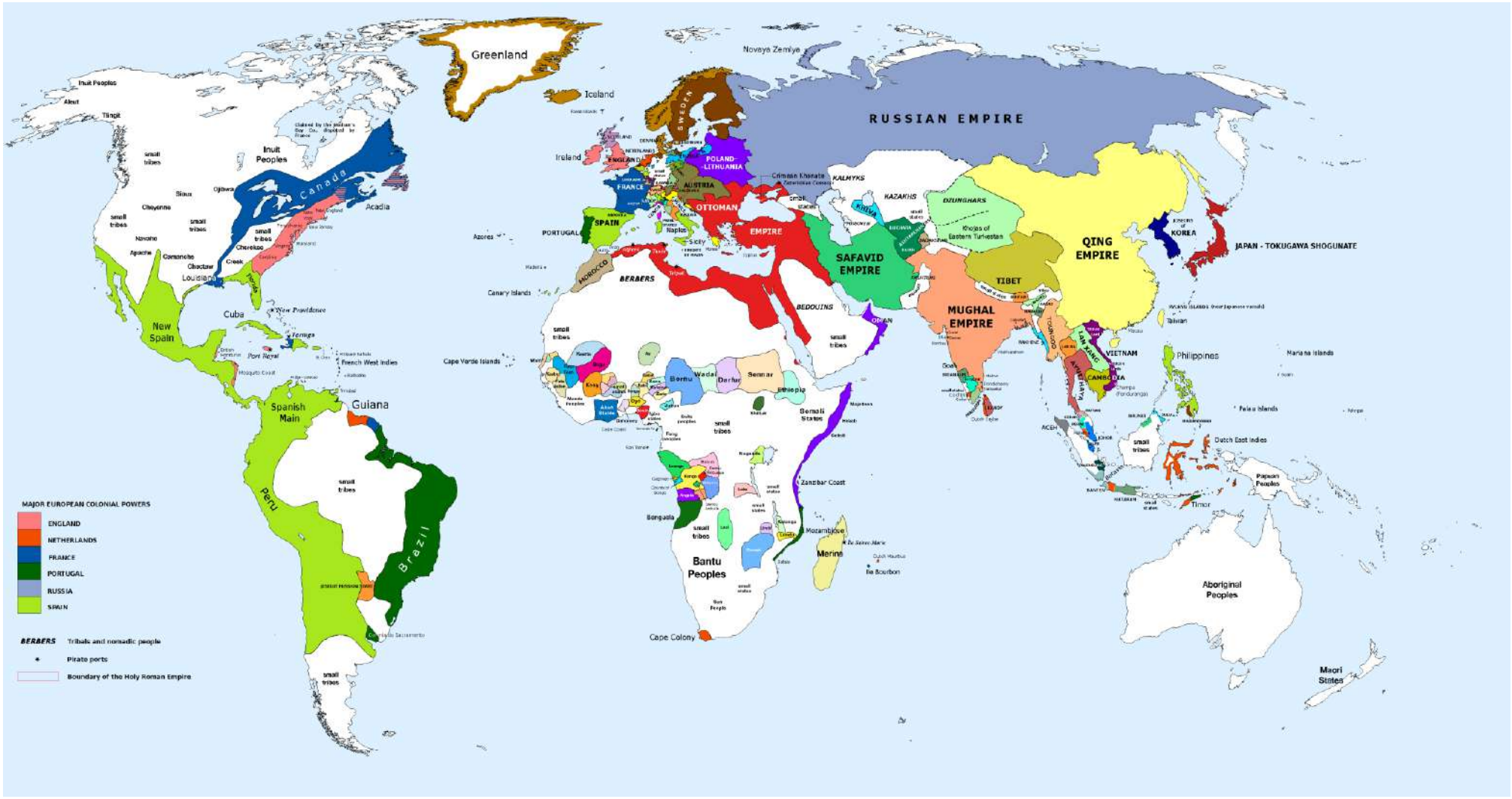
Major wars, 10,000 or more deaths in current or past year
Wars, 1,000–9,999 deaths in current or past year
Minor conflicts, 100–999 deaths in current or past year
Skirmishes and clashes, fewer than 100 deaths in current or past year

In 15th, 16th and 17th century Europe, the social, political, and economic lives of the vast majority of European men and women (Portugal, Spain, France, Netherlands and England) were dramatically changed by the end of feudalism and the origin of mercantilism. The reality of the commoners at this transitional time was:

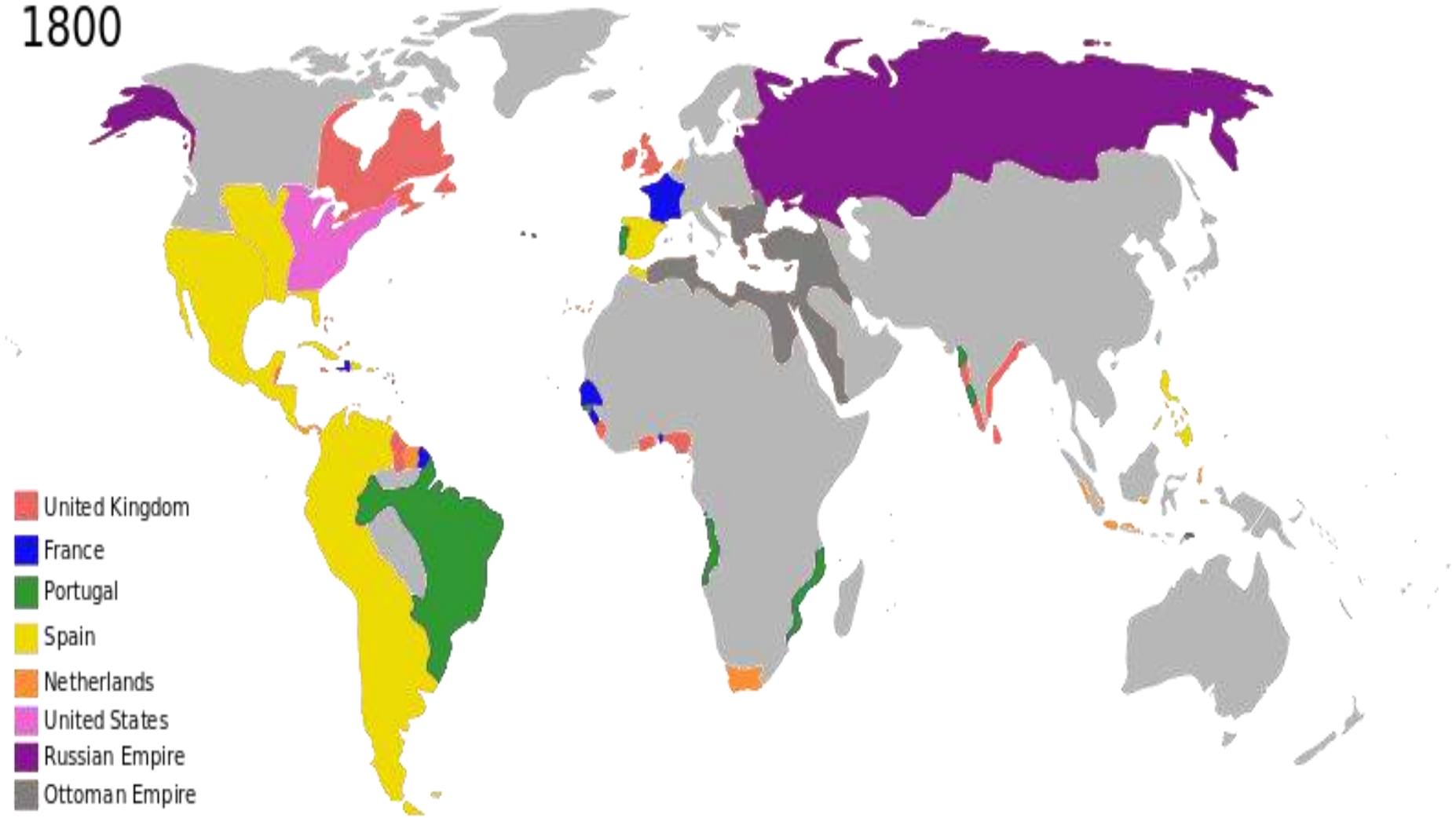
- Social, political, and economic inequality due to feudalism.
- Fragile food supply and famine.
- Poor health and the spread of infectious diseases.
- Deforestation for industry, shipping and clearing lands for urbanisation
- Uncertain economy.
- Overpopulation.
- Dangerous standards of living in urban and rural areas.
- Child victimization.
- Intolerance.
- Warfare.
- An idealistic image of the "New World."

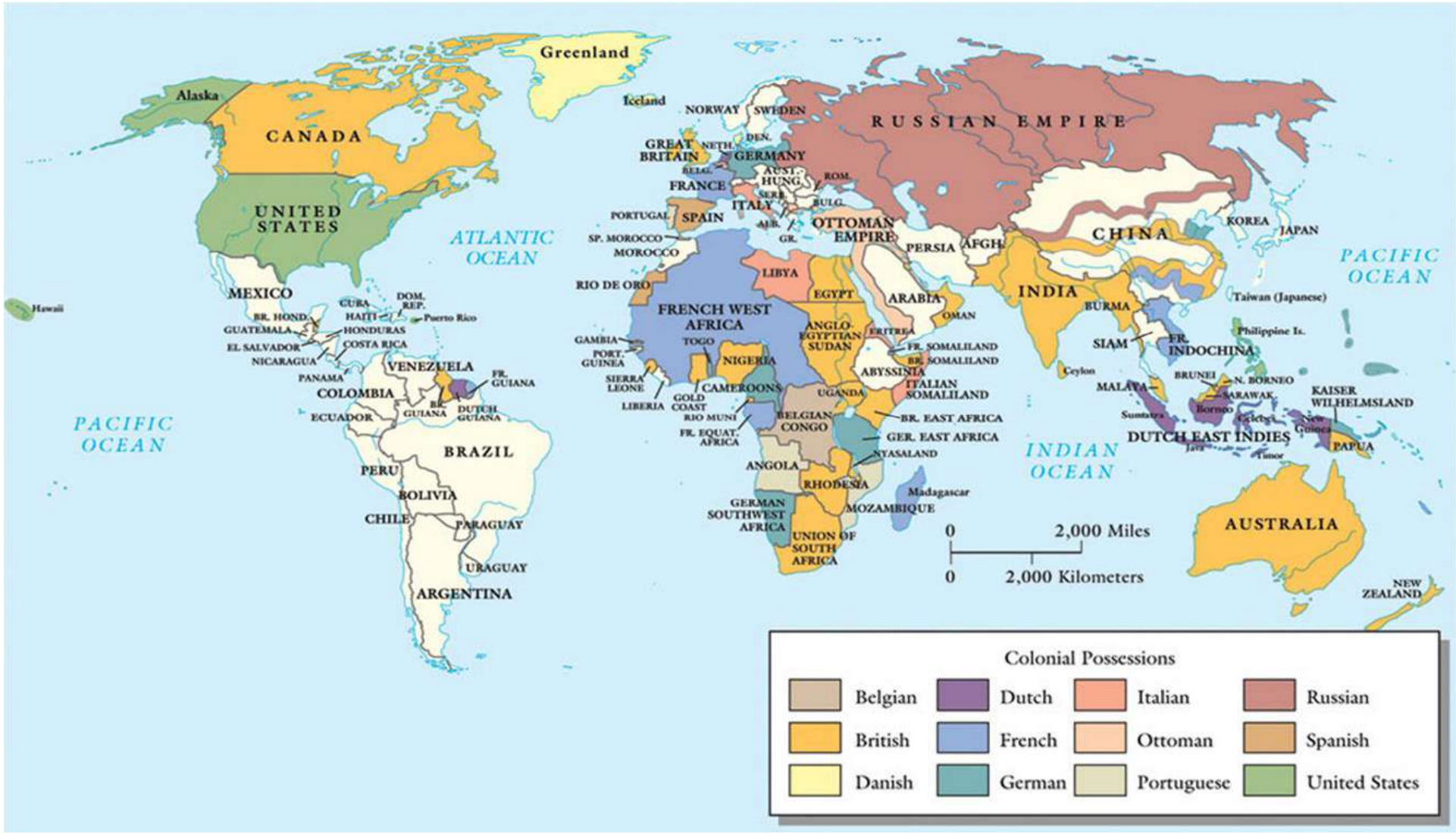


Colonisation often associated with wars in the new territories

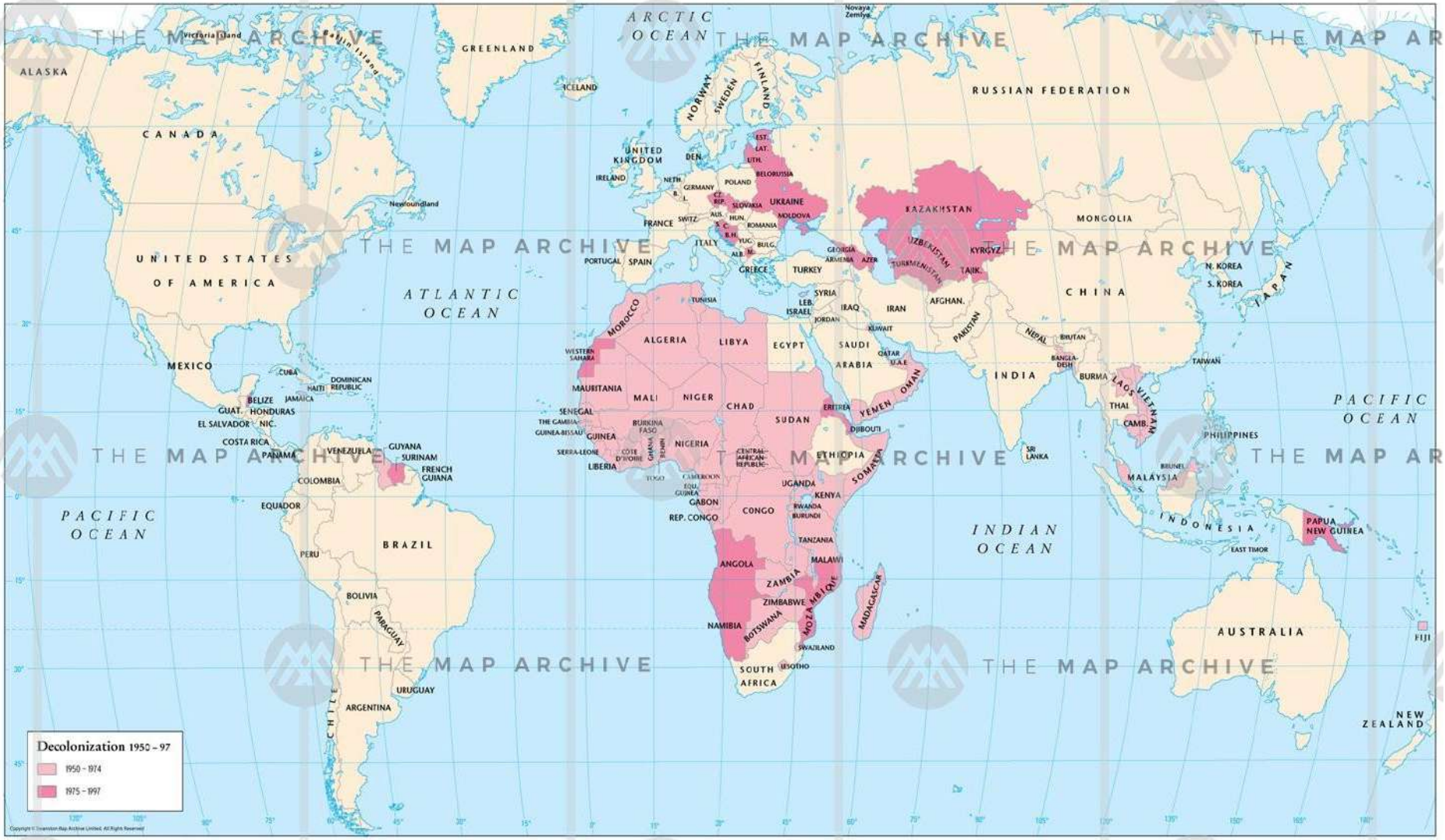


1700


1800
United Kingdom
France
Portugal
Spain
Netherlands
United States
Russian Empire
Ottoman Empire


Greenland
Alaska
CANADA
Iceland
NORWAY
SWEDEN
RUSSIAN EMPIRE
UNITED STATES
ATLANTIC OCEAN
GREAT BRITAIN
NETH.
DEN.
GERMANY
BELG.
AUST.-HUNG.
ROM.
FRANCE
SERB.
ITALY
BULG.
PORTUGAL
SPAIN
ALB.
GR.
OTTOMAN EMPIRE
SP. MOROCCO
MOROCCO
PERSIA
AFGH.
CHINA
KOREA
JAPAN
PACIFIC OCEAN
LIBYA
RIO DE ORO
EGYPT
ARABIA
INDIA
Taiwan (Japanese)
MEXICO
CUBA
DOM. REP.
Hawaii
FRENCH WEST AFRICA
BURMA
BR. HOND.
HAITI
Puerto Rico
GUATEMALA
HONDURAS
ANGLO-EGYPTIAN SUDAN
ERITREA
OMAN
Philippine Is.
EL SALVADOR
COSTA RICA
GAMBIA
TOGO
FR. SOMALILAND
SIAM
FR. INDOCHINA
NICARAGUA
VENEZUELA
PORT. GUINEA
NIGERIA
BR. SOMALILAND
Ceylon
PANAMA
FR. GUIANA
ABYSSINIA
BRUNEI
N. BORNEO
SIERRA LEONE
CAMEROONS
ITALIAN SOMALILAND
MALAYA
SARAWAK
COLOMBIA
LIBERIA
GOLD COAST
UGANDA
KAISER WILHELMSLAND
BR. GUIANA
DUTCH GUIANA
RIO MUNI
BELGIAN CONGO
BR. EAST AFRICA
Sumatra
Borneo
Celebes
New Guinea
ECUADOR
FR. EQUAT. AFRICA
GER. EAST AFRICA
DUTCH EAST INDIES
PACIFIC OCEAN
BRAZIL
NYASALAND
INDIAN OCEAN
Java
Timor
PAPUA
PERU
ANGOLA
RHODESIA
Madagascar
BOLIVIA
GERMAN SOUTHWEST AFRICA
MOZAMBIQUE
CHILE
PARAGUAY
0
2,000 Miles
AUSTRALIA
UNION OF SOUTH AFRICA
0
2,000 Kilometers
URAGUAY
NEW ZEALAND
ARGENTINA
Colonial Possessions
Belgian
Dutch
Italian
Russian
British
French
Ottoman
Spanish
Danish
German
Portuguese
United States

1900



1950-1997 Decolonisation (early part was western Europe relinquishing its global Colonies, later part was Russia relinquishing its colonies after cold ward and aftermath of proxy wars)


THE EMPIRE OF ALEXANDER THE GREAT
Alexander's route
Alexander's empire
Battle
Danube R.
Black Sea
Caspian Sea
Aral Sea
THRACE
Pella
Granicus
Troy
MACEDONIA
Gordium
ASIA MINOR
ARMENIA
Athens
Tigris R.
Issus
Arbela
MESOPOTAMIA
MEDIA
Ecbatana
ASSYRIA
Mediterranean Sea
Tyre
Babylon
Susa
BABYLONIA
Alexandría
Gaza
ARIANA
Memphis
Euphrates R.
Persepolis
Ammon
EGYPT
PERSIS
Nile R.
Red Sea
ARABIA
Persian Gulf
Amu Darya
SOGDIANA
BACTRIA
Indus R.
Hydaspes (Jhelum) R.
INDIA
Arabian Sea
0 60 120 mi
0 75 150 km
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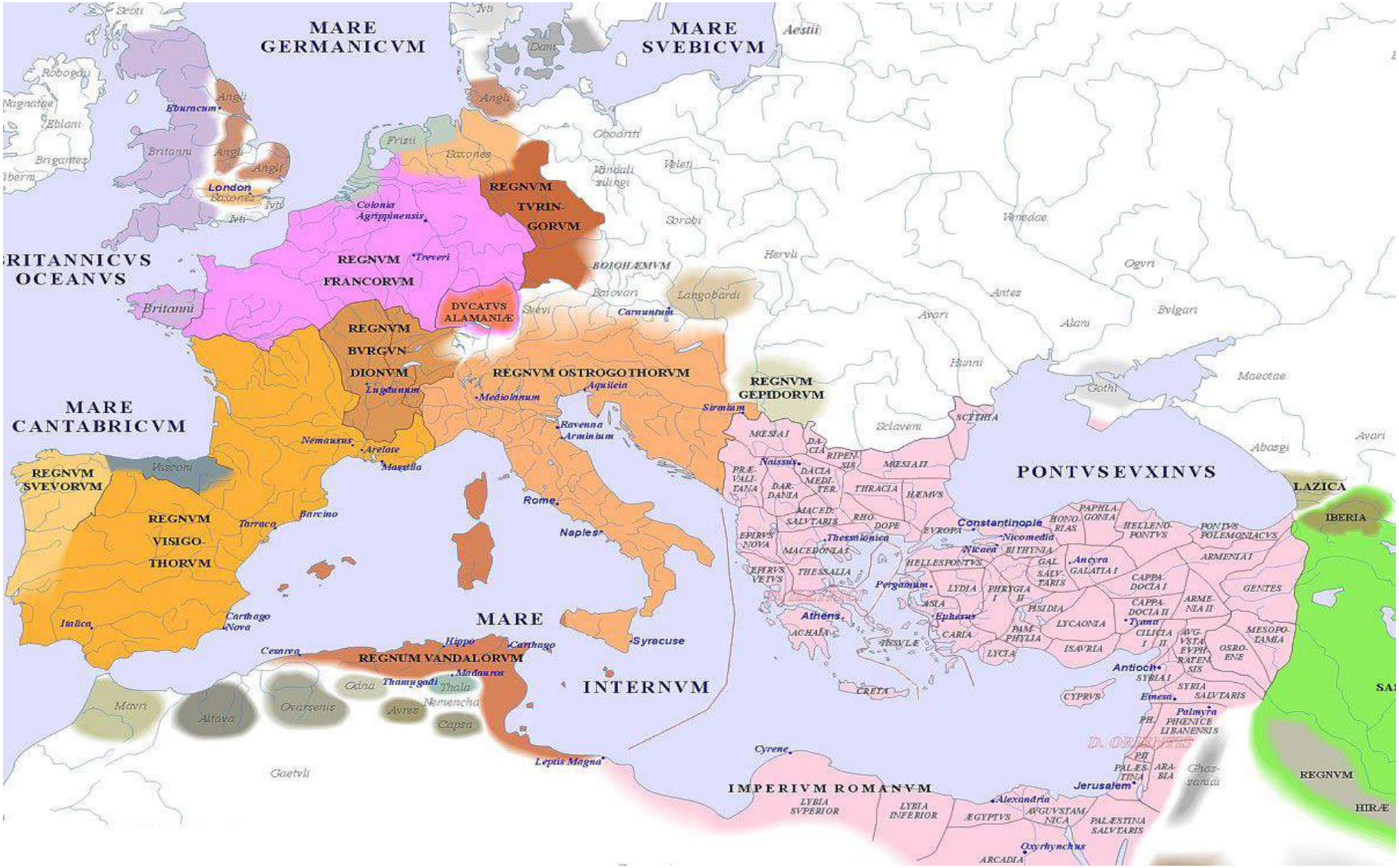
About 320 BC

Western Roman Empire 100 AD – 400 AD

Europe 500AD Byzantine Empire

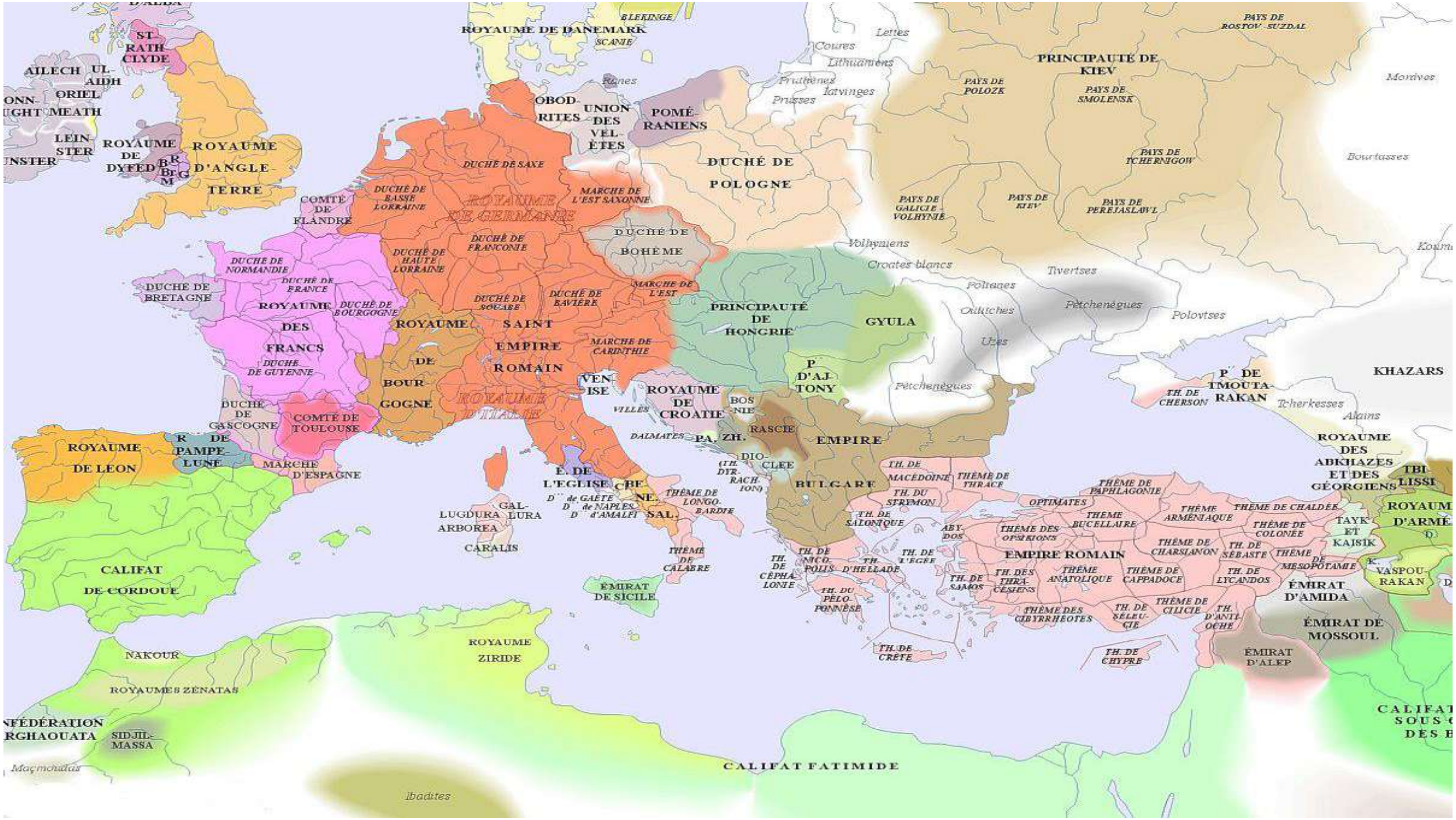


Europe 700 AD - France

Europe 800 AD

Europe 900 AD

Europe 1000 AD – England and Germany



Greatest extent of the Holy Roman Empire (Church Sees) reached during 12th century (500 AD – 1500 AD)

Europe 1300 AD - Spain

Europe 1500 AD

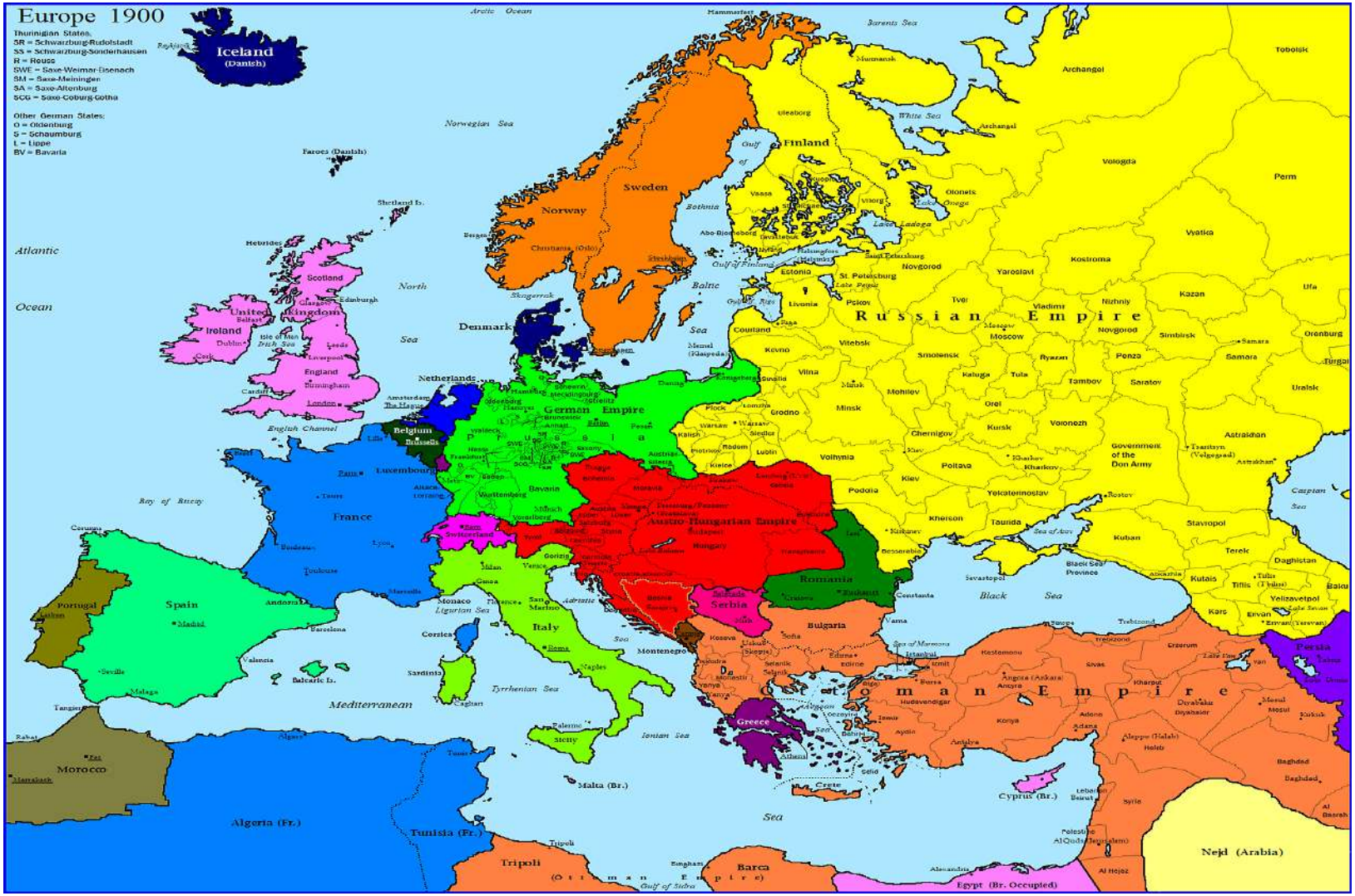
Europe 1600 AD

Europe Main Map at the Beginning of the Year 1600

Europe 1800 AD

Europe Main Map at the Beginning of the Year 1800

Europe 1900 AD

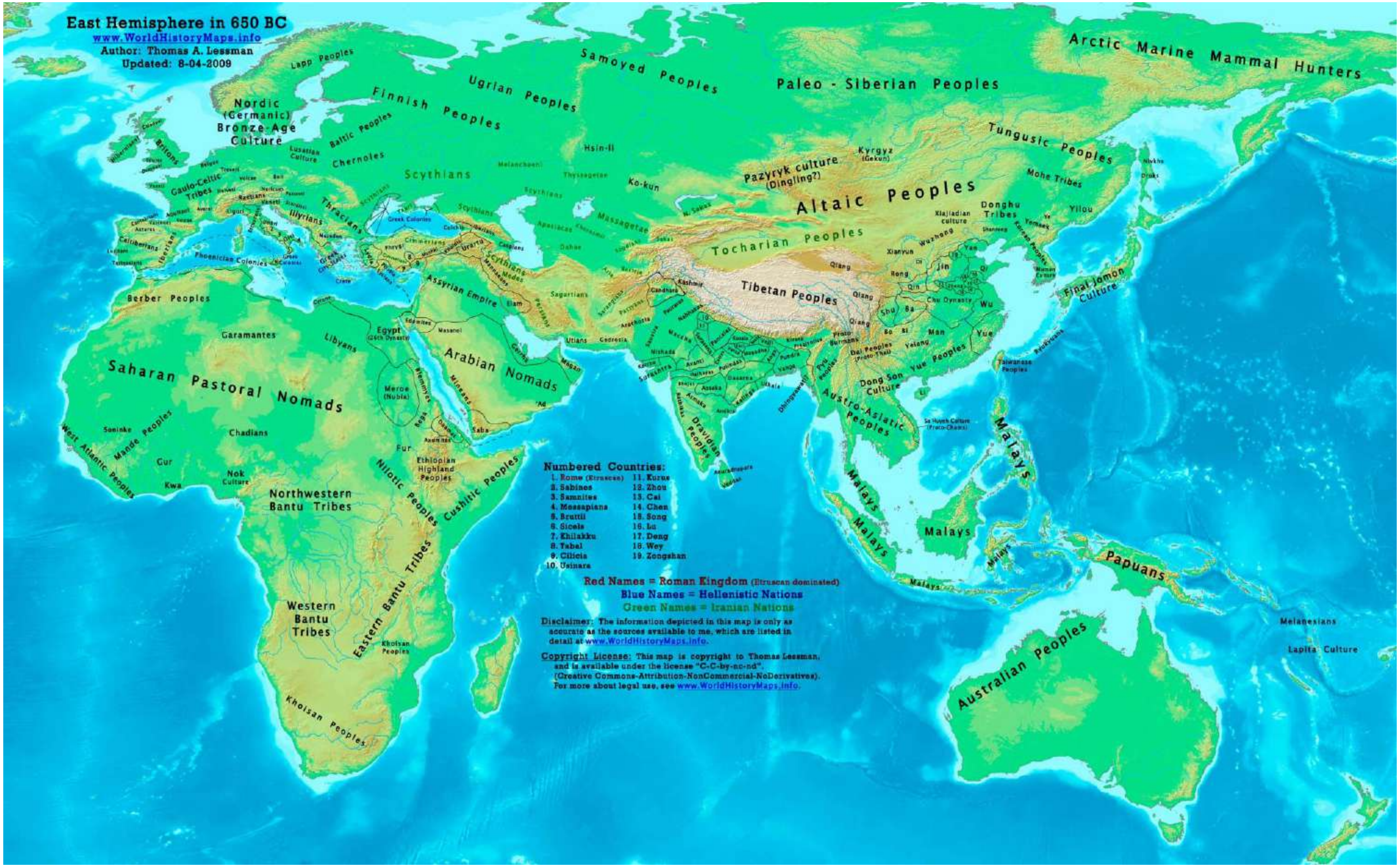


World War I

World War II

Europe at the end of World War II

Visual history of the Eastern Hemisphere



East Hemisphere in 650 BC
www.WorldHistoryMaps.info
Author: Thomas A. Lessman
Updated: 8-04-2009
Lapp Peoples
Samoyed Peoples
Paleo - Siberian Peoples
Arctic Marine Mammal Hunters
Nordic (Germanic) Bronze Age Culture
Finnish Peoples
Ugrian Peoples
Baltic Peoples
Chernoles
Scythians
Hsin-li
Ko-kun
Pazyryk culture (Dingling?)
Kyrgyz (Gekun)
Altaic Peoples
Tungusic Peoples
Mohe Tribes
Donghu Tribes
Yilou
Tocharian Peoples
Massagetae
Gaulo-Celtic Tribes
Illyrians
Thracians
Phoenician Colonies
Berber Peoples
Assyrian Empire
Tibetan Peoples
Qiang
Jin
Chu Dynasty
Wu
Yue
Final Jomon Culture
Garamantes
Libyans
Egypt
Arabian Nomads
Saba
Saharan Pastoral Nomads
Meroe (Nubia)
Ethiopian Highland Peoples
Chadians
Mande Peoples
West Atlantic Peoples
Gur
Kwa
Nok Culture
Northwestern Bantu Tribes
Nilotic Peoples
Cushitic Peoples
Dravidian Peoples
Austro-Asiatic Peoples
Dong Son Culture
Vue Peoples
Malays
Papuans
Western Bantu Tribes
Eastern Bantu Tribes
Khoisan Peoples
Australian Peoples
Melanesians
Lapita Culture
Numbered Countries:
1. Rome (Etruscan)
2. Sabines
3. Samnites
4. Messapians
5. Bruttii
6. Sicels
7. Khilakku
8. Tabal
9. Cilicia
10. Usinara
11. Kurus
12. Zhou
13. Cai
14. Chen
15. Song
16. Lu
17. Deng
18. Wey
19. Zongshan
Red Names = Roman Kingdom (Etruscan dominated)
Blue Names = Hellenistic Nations
Green Names = Iranian Nations
Disclaimer: The information depicted in this map is only as accurate as the sources available to me, which are listed in detail at www.WorldHistoryMaps.info.
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East Hemisphere in 300 BC
www.WorldHistoryMaps.info
Author: Thomas A. Lessman
Updated: 7-13-2009
Arctic Marine Mammal Hunters
Samoyed Peoples
Paleo - Siberian Peoples
Ugrian Peoples
Finnish Peoples
Baltic Peoples
Germanic Tribes
Venedae
Sarmatians
Tungusic Peoples
Kyrgyz
Hun-yü
Mohe Tribes
Gaoche or Tiele (Dingling)
Xiongnu
Donghu Tribes
Yilou
Tochari (Yuezhi)
Tocharian City States (Twenty Six Kingdoms)
Gaulo-Celtic Tribes
Dacians
Illyrians
Lysimachus
Pontus
Armenia
Atropatene
Seleucid Empire
Tibetan Peoples
Chu Dynasty
Qin Dynasty
Magadha Empire (Mauryan Dynasty)
Final Jomon Culture
Yayoi (Japanese)
Berber Peoples
Caramantes
Libyans
Ptolemaic Kingdom
Arabian Nomads
Saharan Pastoral Nomads
Meroe (Nubia)
Chadians
Soninke Peoples
Mande Peoples
West Atlantic Peoples
Gur
Kwa
Nok Culture
Fur
Ethiopian Highland Peoples
Nilotic Peoples
Cushitic Peoples
Northwestern Bantu Tribes
Western Bantu Tribes
Eastern Bantu Tribes
Khoisan Peoples
Dravidian Kingdoms
Mon Khmer Peoples
Óc Eo Culture
Malays
Papuans
Melanesians
Polynesians
Australian Peoples
Numbered Countries:
1. Etruscan League
2. Picentis
3. Samnites
4. Lucani
5. Bruttii
6. Tarentum
7. Sparta
8. Bithynia
9. Zongshan
10. Shangtang
11. Chou
12. Song
13. Lu
14. Deng
Red Names = Rome & its Vassals
Blue Names = Hellenistic Nations
Green Names = Iranian Nations
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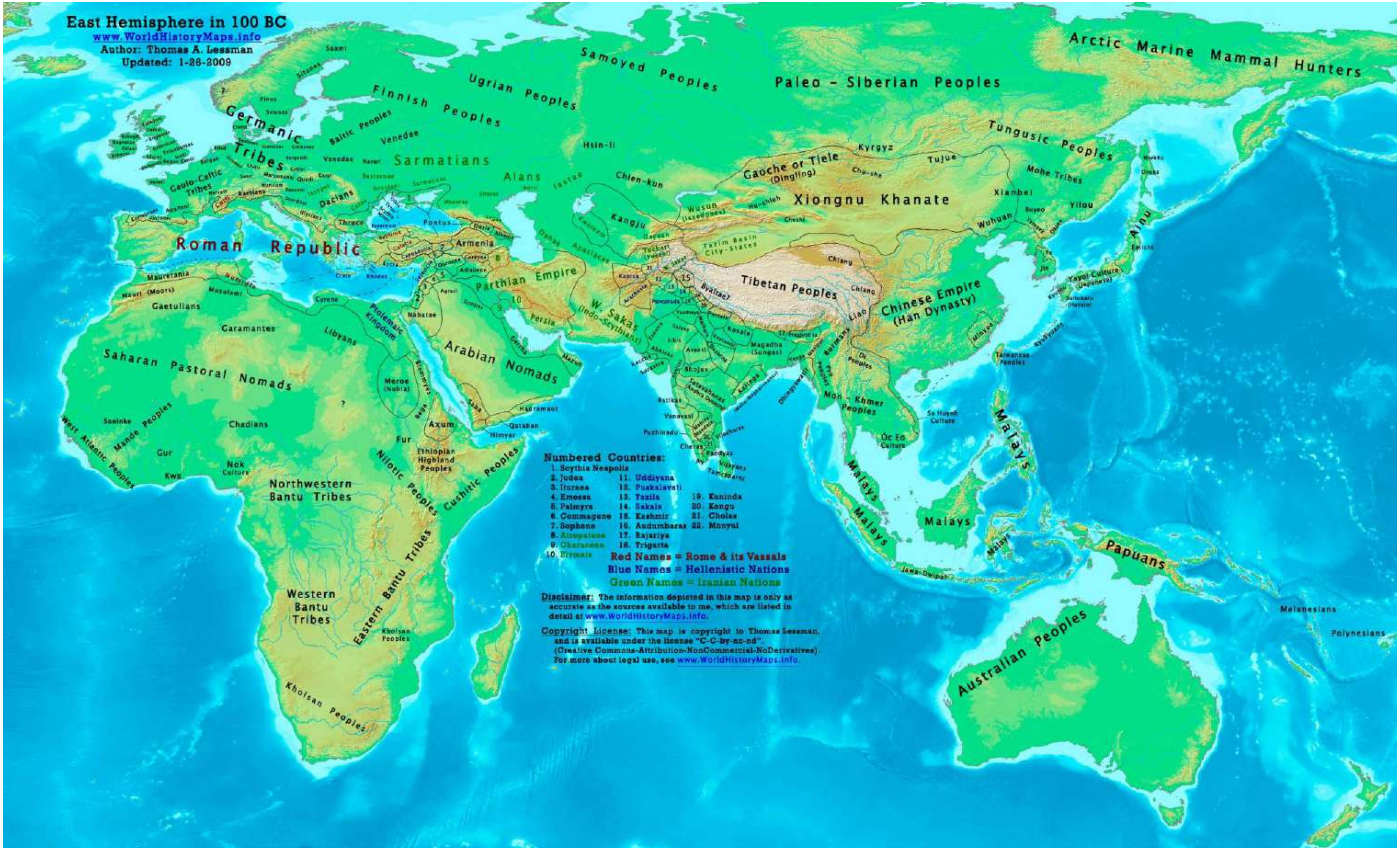
East Hemisphere in 100 BC
www.WorldHistoryMaps.info
Author: Thomas A. Lessman
Updated: 1-26-2009
Arctic Marine Mammal Hunters
Samoyed Peoples
Paleo - Siberian Peoples
Ugrian Peoples
Finnish Peoples
Germanic Tribes
Baltic Peoples
Venedae
Sarmatians
Alans
Hsin-li
Chien-kun
Kyrgyz
Gaoche or Tiele (Dingling)
Tujue
Tungusic Peoples
Mohe Tribes
Xiongnu Khanate
Xianbei
Wuhuan
Yilou
Ainu
Emishi
Gaulo-Celtic Tribes
Dacians
Thrace
Pontus
Armenia
Roman Republic
Mauretania
Mauri (Moors)
Gaetulians
Garamantes
Cyrene
Ptolemaic Kingdom
Nabatae
Libyans
Parthian Empire
Persia
Kangju
Wusun
Tarim Basin City-States
Tibetan Peoples
Chiang
Chinese Empire (Han Dynasty)
Yayoi Culture (Japanese)
W. Sakas (Indo-Scythians)
Arabian Nomads
Saharan Pastoral Nomads
Meroe (Nubia)
Axum
Hadramaut
Qataban
Himyar
Fur
Ethiopian Highland Peoples
Nilotic Peoples
Cushitic Peoples
Chadians
Soninke
Mande Peoples
West Atlantic Peoples
Gur
Kwa
Nok Culture
Northwestern Bantu Tribes
Eastern Bantu Tribes
Western Bantu Tribes
Khoisan Peoples
Kosala
Magadha (Sungas)
Bhojas
Kalinga
Satavahanas
Rstikas
Vanavasi
Puzhinadu
Cheras
Pandyas
Vijayans
Tamraparni
Mon - Khmer Peoples
Oc Eo Culture
Sa Huynh Culture
Taiwanese Peoples
Malays
Papuans
Jawa-Dwipa
Australian Peoples
Melanesians
Polynesians
Numbered Countries:
1. Scythis Neapolis
2. Judea
3. Iturea
4. Emessa
5. Palmyra
6. Commagene
7. Sophene
8. Atropatene
9. Characene
10. Elymais
11. Uddiyana
12. Puskalavati
13. Taxila
14. Sakala
15. Kashmir
16. Audumbaras
17. Rajariya
18. Trigarta
19. Kuninda
20. Kongu
21. Cholas
22. Monyul
Red Names = Rome & its Vassals
Blue Names = Hellenistic Nations
Green Names = Iranian Nations
Disclaimer: The information depicted in this map is only as accurate as the sources available to me, which are listed in detail at www.WorldHistoryMaps.info.
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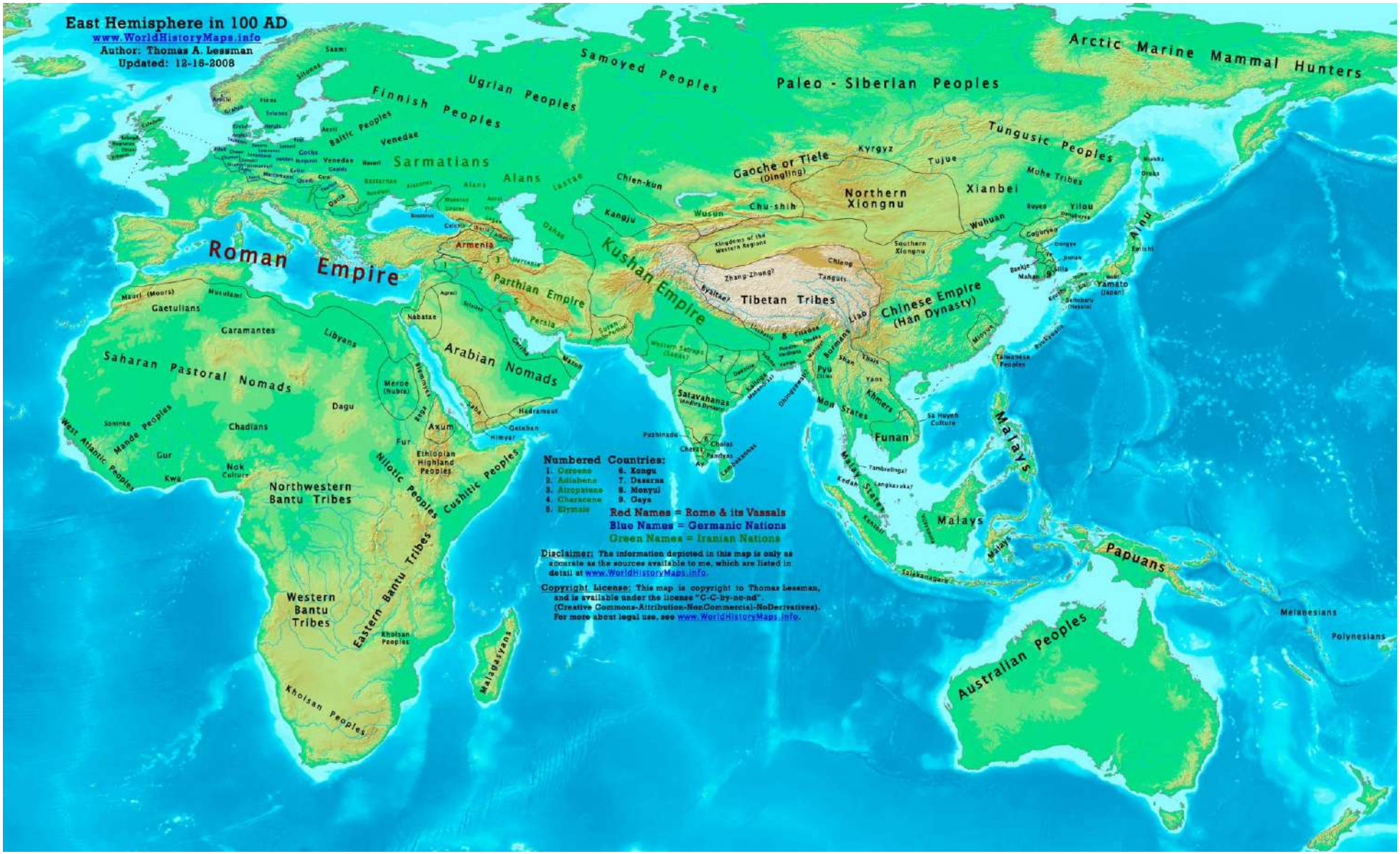
East Hemisphere in 100 AD
www.WorldHistoryMaps.info
Author: Thomas A. Lessman
Updated: 12-16-2008
Arctic Marine Mammal Hunters
Samoyed Peoples
Paleo - Siberian Peoples
Ugrian Peoples
Finnish Peoples
Baltic Peoples
Venedae
Sarmatians
Alans
Tungusic Peoples
Kyrgyz
Tujue
Gaoche or Tiele (Dingling)
Mohe Tribes
Northern Xiongnu
Xianbei
Chien-kun
Kangju
Wusun
Chu-shih
Wuhuan
Buyeo
Yilou
Ainu
Roman Empire
Armenia
Parthian Empire
Kushan Empire
Kingdoms of the Western Regions
Southern Xiongnu
Zhang-Zhung?
Chiang
Tanguts
Tibetan Tribes
Chinese Empire (Han Dynasty)
Liao
Yamato (Japan)
Maurl (Moors)
Musulami
Gaetulians
Garamantes
Nabatae
Persia
Arabian Nomads
Saharan Pastoral Nomads
Libyans
Meroe (Nubia)
Dagu
Chadians
Soninke
Mande Peoples
West Atlantic Peoples
Gur
Kwa
Nok Culture
Axum
Himyar
Hadramaut
Qataban
Fur
Ethiopian Highland Peoples
Nilotic Peoples
Cushitic Peoples
Northwestern Bantu Tribes
Western Bantu Tribes
Eastern Bantu Tribes
Khoisan Peoples
Malagasyans
Satavahanas
Pyu
Burmans
Thais
Shan
Yaos
Khmers
Mon States
Funan
Sa Huynh Culture
Malays
Malay States
Papuans
Melanesians
Polynesians
Australian Peoples
Numbered Countries:
1. Osroene
2. Adiabene
3. Atropatene
4. Characene
5. Elymais
6. Kongu
7. Dasarna
8. Monyul
9. Gaya
Red Names = Rome & its Vassals
Blue Names = Germanic Nations
Green Names = Iranian Nations
Disclaimer: The information depicted in this map is only as accurate as the sources available to me, which are listed in detail at www.WorldHistoryMaps.info.
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East Hemisphere in 500 AD
www.WorldHistoryMaps.info
Author: Thomas A. Lessman
Updated: 10-27-2008
Saami
Suomi
Finno - Ugrian Peoples
Samoyedic Peoples
Yakuts
Paleo-Siberian Peoples
Arctic Marine Mammal Hunters
Tungusic Peoples
Kyrgyz
Turks (Tujue)
Mohe Tribes
Rouran Khaganate
Kangly
Oghuz
Avars
Sabirs
Proto-Magyars
Uzes?
Hephthalites
(White Huns)
Northern Wei
Dynasty
Khitans
Goguryeo
Ainu
Franks
Ostrogoths
Visigoths
Suevi
Vandals
Roman Empire
(Byzantine)
Persian Empire
(Sassanid Dynasty)
Huna Empire
Zhang Zhung
Tibetans
Tanguts
Nepal
Gupta Empire
Southern Qi
Dynasty
Liao
Maurs (Moors)
Gaetulians
Garamantes
Tuaregs
Saharan Pastoral Nomads
Kindah
Himyar
Axum
Ghana
Gao
Mande Peoples
Gur
Kwa
Chadians
Zaghawas
West Atlantic Peoples
Sao
Northwestern
Bantu Tribes
Nilotic Peoples
Cushitic Peoples
Ethiopian
Highland
Peoples
Western
Bantu
Tribes
Eastern Bantu Tribes
Khoisan Peoples
Malagasyan Peoples
Vakatakas
Funan
Malays
Malay States
Papuans
Melanesians
Polynesians
Australian Peoples
Maori
Numbered Countries:
1. Altava & Mauretania
2. Cantabria
3. Vascones
4. Oriel
5. Ulaid
6. Dumnonia
7. Dyfed
8. Ceredigion
9. Gwynedd
10. Powys
11. Rheged
12. Strathclyde
13. Creones
14. Caledoni
15. Gododdin
16. Elmet
17. The Fens
18. Luitcoyt
19. Durotrigia
20. Atrebatia
21. Regia
22. Goths
23. Kashmir
24. Monyul
25. Manipur
26. Gaya
Red names = Roman territories
Blue names = Germanic nations
Green names = Iranian nations


East Hemisphere, 900 AD
Author: Thomas Lessman
www.WorldHistoryMaps.info
Updated: 8-24-2008
Icelanders
Saami
Finns
Ugrians
Samoyedic Peoples
Paleo - Siberian Peoples
Arctic Marine Mammal Hunters
Yakuts
Volga Bulgars
Tungusic Peoples
Kurikans
Merkits
Yu-chih
Shi-wei
Jurchens
Tatars
Kyrgyz
Kimek Khaganate
Kipchaks
Basmyls
Keraits
Naimans
Khitans
Oghuz Turks
Kara - Khanids (Karluks)
Xinjian (Uyghurs)
Gansu (Uyghurs)
Shajou
Balhae (Parhae)
Ainu
Yamato (Japan)
Samanid Dynasty
Tanguts
Tibetan Kingdoms & Tribes
Chinese Empire (Tang Dynasty)
Abbasid Caliphate
Saffarid Dynasty
Roman (Byzantine) Empire
Khazar Khanate
Principality of Kiev
Magyars
Bulgaria
Italy
West Frankish Kingdom
Umayyad Emirate
Kingdom of Tahert
Tulunid Emirate
Berbers
Tuaregs
Bedouins
Qarmatians
Oman
Gurjara - Pratiharas
Nanzhao
Rashtrakuta Dynasty
Mon States
Champa Kingdoms
Cambodia (Khmers)
Malays
Srivijayan Empire
Papuans
Australian Peoples
Maoris
Melanesians
Polynesians
Ghana
Mandes
Hausa
Kanem-Bornu
Gao
Anbiya
Takrur
West Atlantic Peoples
Gur
Yorubas
Igbos (Nri)
Akans
Azandes
Fur
Luo
Somalis
Cushites
Axum
Alodia (Alwa)
Fangs (Beti-Pahuins)
Bachwezis (Kitara)
Bantu Peoples
Swahili Peoples
Bakubas
Burundas
Khoisan Peoples
Malagasyans
Numbered Countries:
1. Toledo
2. Pamplona
3. Dublin
4. Meath
5. Strathclyde
6. Norse
7. Gwynedd
8. Seisyllwg
9. Gwent
10. Normans
11. Abodrites
12. Upper Burgundy
13. Lower Burgundy
14. Pirate States
15. Caralis
16. Papal States
17. Benevento
18. Salerno
19. Venice
20. Pagania
21. Dioclea
22. Sijilmassa
23. Tayk
24. Georgia
25. Kartli
26. Gangas
27. Tirabhukti
28. Hidambas
29. Harapunchai
30. Dvaravati
Red Nations = Roman Empire & Vassals
Blue Nations = Germanic Kingdoms
Green Nations = Islamic Nations

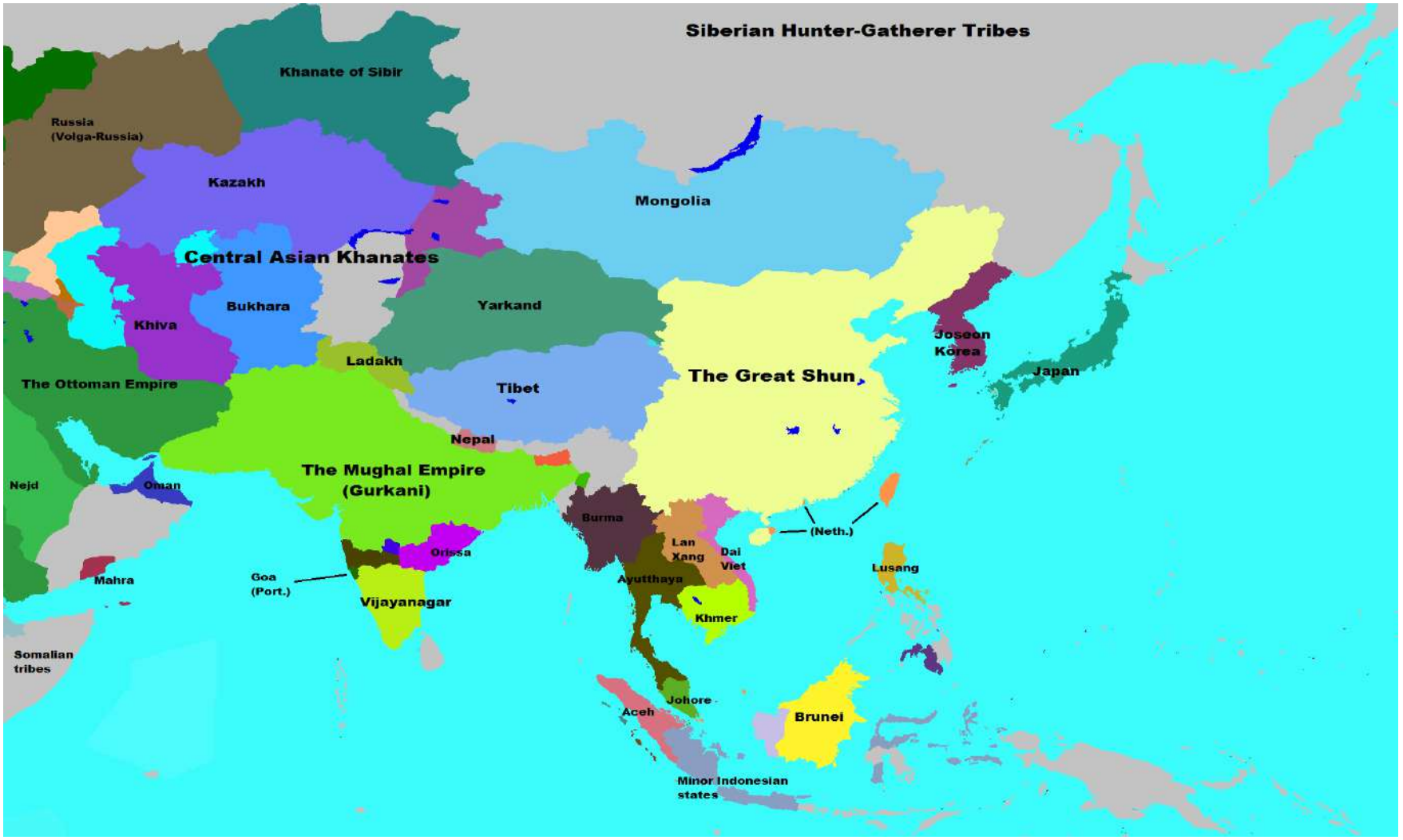

Eastern Hemisphere, 1000 AD
Created by Thomas A. Lessman
www.WorldHistoryMaps.info
Updated: 2-27-2008
Iceland
Saami
Samoyedic Tribes
Arctic Marine Mammal Hunters
Paleo - Siberian Tribes
Finnish Tribes
Kievan Russian Principality
Volga Bulgar Khanate
Yakuts
Khakass
Tungusic Tribes
Norway
Sweden
Denmark
England
German "Holy Roman" Empire
Poland
Bohemia
Hungary
Pecheneg Tribes
Cuman Tribes
Kyrgyz
Merkits
Mongols
Jurchen Tribes
Naimans
Keraits
Brittany
France
Kingdom of Leon
Khazar Khanate
Guzz Turks
Kara-Khanid Khanate
(Uyghurs & Karluks)
Kara-Khoja States
Liao Dynasty
(Khitans)
Xixia Dynasty
(Tanguts)
Ainu
Goryeo
Japan
Ummayad Caliphate
Roman Empire
Fatimid Caliphate
Abbasid Caliphate
Buyids
Ghaznavid Empire
Kashmir
Shahis
Marul
Tibetan Kingdoms
Song Dynasty
Berber Tribes
Tuareg Nomadic Tribes
Arabian Tribes
Oman
Kusdar
Sumras
Chauhanas
Pratiharas
Parmaras
Selankis
Palas
Kamarupa
Nepal
Kingdom of Dali
Dai Viet
Uchina Kingdom
Taiwanese Tribes
Chalukyas
Arakan
Bagan Kingdom
Pegu
Thaton
Khmer Empire
Champa Kingdoms
Malays
Ghana
Songhay
Wagaduga
Mali
Hausa States
Zaghawa
(Kanem Empire)
Makuria
Alodia
Yemen
Kokoto Kingdom
Yoruba Tribes
Zaghwe
Somalis
Luo Peoples
Cushites
Chola Empire
Lambakannas
Srivijayan Empire
Sunda
Mataram
Papuans
Bantu Tribes
Swahili Kingdoms and City-States
Khoisan Farmers
Malagasyan Peoples
Australian Peoples
Numbered Countries:
1. Pamplona
2. March of Spain
3. Toulouse (County)
4. Burgundy (King.)
5. Papal States
6. Benevento
7. Salerno
8. Venice (Republic)
9. Leinster
10. Meath
11. Oriel
12. Uliad
13. Strathclyde
14. Unknown
15. Flanders (County)
16. Abodrites
17. Ajtony (Prince.)
18. Tmutarakan (Prince)
19. Cherkess
20. Alans
21. Tiflis
22. Georgia
23. Tayk and Kaisik
24. Vaspourakan
25. Kakheti
26. Chandellas
27. Kalacharis
28. Harapunchai
29. Damot
30. Shewa
Blue Names = Germanic Nations
Green Names = Islamic Nations


Eastern Hemisphere, 1100 AD
Created by Thomas A. Lessman
www.WorldHistoryMaps.info
Updated: 3-12-2008
Arctic Marine Mammal Hunters
Iceland
Saami
Samoyedic Tribes
Paleo - Siberian Tribes
Paleo - Siberian Tribes
Finnish Tribes
Norway
Sweden
Novgorod
Volga Bulgar Khanate
Yakuts
Khakass
Tungusic Tribes
Orkney
Scotland
Denmark
Kyrgyz
Merkits
Mongols
Tatars
Bashkirs
Kimaks
Buryats
Keraits
Naimans
Cuman (Kipchak) Khanates
Guzz Turks
Kara-Khanid Khanate
Kara-Khoja Khanates
Jalayr
Liao Dynasty (Khitans)
Jurchen Tribes
Aimu
Xixia Dynasty (Tanguts)
Goryeo
Japan
Roman Empire
Kashmir
Marul
Tibetan Tribes and Kingdoms
Seljuk Sultanate
Song Dynasty
Almoravid Empire
Ghaznavid Sultanate
Fatimid Caliphate
Taureg Nomadic Tribes
Arabian Tribes
Oman
Dali
Taiwanese Peoples
Dai Viet
Pegu
Chalukyas
Khmer Empire
Champa Kingdoms
Luzon?
Visayans
Takrur
Songhay
Bornu
Kanem Empire
Alodia
Ethiopia
Yemen
Adal
Mandinka Kingdoms
Yoruba Tribes
Ife
Cholas
Pandyas
Lambakannas
Numbered Countries
1. Navarre
2. Aragon
3. Saragossa
4. Valencia
5. Anjou
6. Flanders
7. Blois
8. Gwynedd
9. Deheubarth
10. Leinster
11. Meath
12. Oriel
13. Uliad
14. Amalfi
15. Venice
16. Zeitz
17. Meissen
18. Lusatia
19. North
20. Abodrites
21. Lusians
22. Pomerania
23. Pomerelia
24. Bosnia
25. Ragusa
26. Unknown
27. Zeta (Montenegro)
28. Rashka (Serbia)
29. Percjaslavl
30. Kartli
31. Dzoragets
32. Kanzag
33. Zangezur
34. Ani
35. Kars
36. Erzerum
37. Erzincan
38. Edessa
39. Antioch
40. Jerusalem
41. Sassun
42. Shah Armen
43. Moks
44. Nepal
45. Mithila
46. Senas
47. Harapunchai
Brunei (Berune)
Srivijaya
Malay Kingdoms
Bugis
Maluku
Papuans
Sunda
Kediri
Australian Peoples
Bantu Tribes
Bantu Tribes
Bantu Tribes
Khoisan Farmers
Khoisan Farmers
Zengi Kingdoms and City-States
Malagasyan Peoples
Blue names = Germanic Nations
Green Names = Islamic Nations

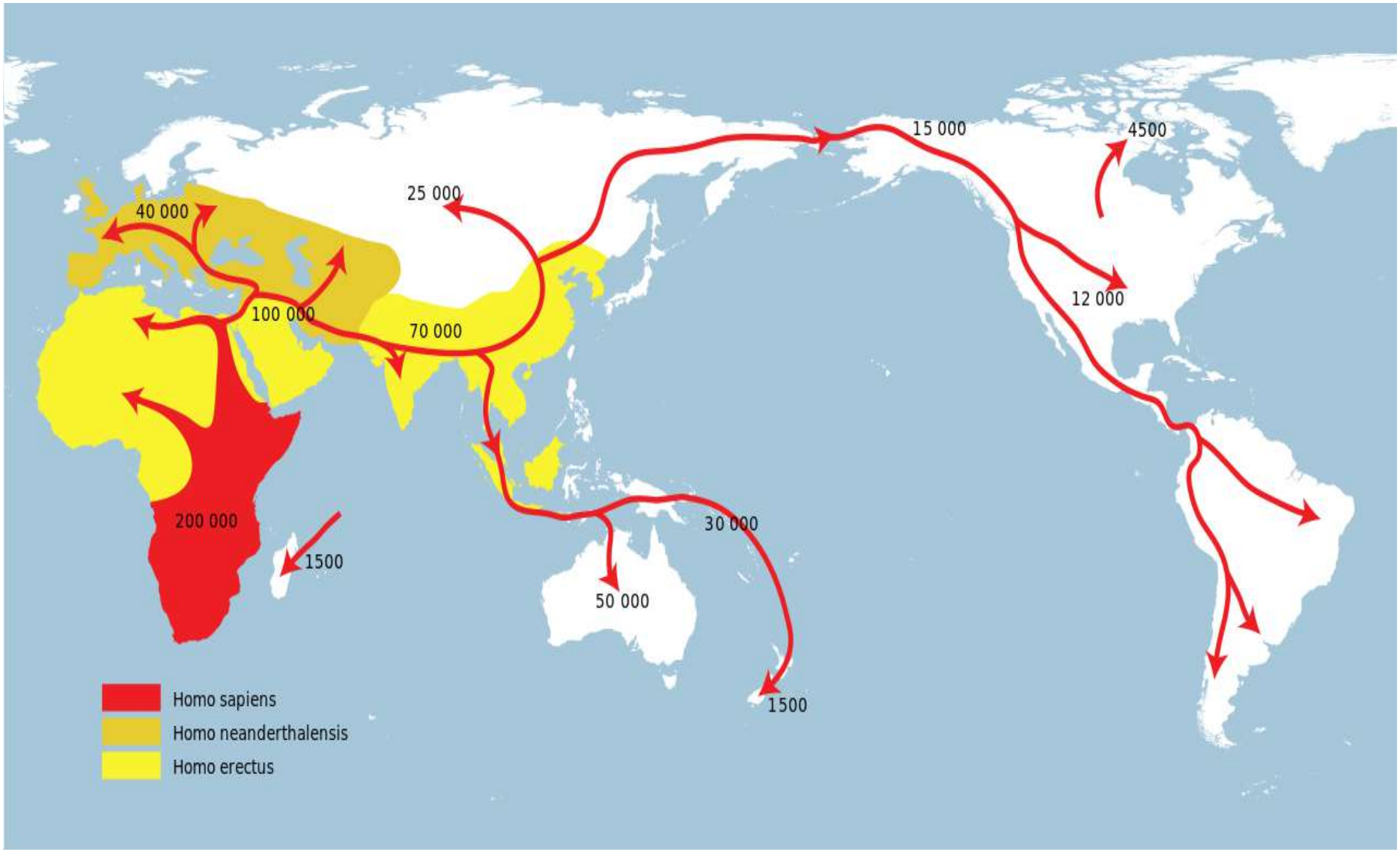

Eastern Hemisphere, 1400 AD
Created by Thomas A. Lessman
Source: www.WorldHistoryMaps.info
Updated: 2-28-2008
Iceland
Saami
Union of Kalmar
Sweden
Norway
Denmark
Scotland
England
Russian Principalities
Samoyeds
Paleo-Siberian Peoples
Arctic Marine Mammal Hunters
Tungusic Peoples
Golden Horde Khanate (Mongol)
Oirats Khanate (East Mongol)
German "Holy Roman" Empire (Fragmented States)
France
Hungary
Wallachia
Kingdom of Poland and Grand Duchy of Lithuania
Teutonic Order
Nogai Khanate
Aragon
Castille
Portugal
Naples
Sicily
Ottoman Sultanate
Chagatai Khanate (Mongol)
Ainu
Japan
Empire of Timur
Ming Dynasty
Tibetan Tribes and Kingdoms
Zayyanid Kingdom
Hafsid Kingdom
Marinids
Ibadites
Berber Tribes
Tuareg Nomadic Tribes
Mamluk Sultanate
Beduins (Arab Tribes)
Medina Sharifs
Mecca Sharifs
Oman
Sind
Delhi Sultanate
Gujarat
Nepal
Sharqis
Bengal
Ava
Shan
Khandesh
Small States
Eastern Ganga
Arakan
Bahmani Kingdom
Reddis
Pegu
Siam
Cambodia
Champa
Dai Viet
Lao
Taiwanese Tribes
Malays
Kanem Empire
Daju
Hausa States
Empire of Mali
Makurian States
Blemmyes
Alodia
Rasulids
Ethiopia
Ifat
Somalis
Vijayanagar Empire
Luo Peoples
Cushites
Bantu Peoples
Interlacustrine States
Swahili Kingdoms and City-States
Malagasyan Peoples
Khoisan Peoples
Malay States
Malays
Papuans
Majapahit
Pajajaran
Australian Aboriginal Peoples
Numbered Countries:
1. Leinster (Eng)
2. Meath (Eng)
3. Uriel (Eng)
4. Brefni
5. Aileach
6. Ulster
7. Navarre
8. Venice
9. Croatia
10. Hermann of Cilli
11. Bosnia
12. Müldos Garai
13. Maeso
14. Zeta, Mat. Croja, & Valona
15. Moravia
16. Mazovia
17. Pskov
18. Circassians
19. Ossetians
20. Erzincan
21. White Sheep Fed.
22. Black Sheep Fed.
23. Mardin
24. Dulkadir
25. Ramazan
26. Karaman
27. Tekke
28. Sidama
29. Ahom Kingdom
30. Kachari
31. Chutiya
32. Toungoo
33. Chiengmai
34. Sokhuthai
Red Names = Roman Nations
Blue Names = Germanic Nations
Green Names = Islamic Nations

Eastern Hemisphere, 1500 AD
Created by Thomas A. Lessman
Source: www.WorldHistoryMaps.info
Updated: 2-24-2008
Iceland
Saami
Sweden
Norway
Denmark
Scotland
England
Russian Principalities
Grand Duchy of Lithuania
German "Holy Roman" Empire (Fragmented)
Bohemia
Hungary
Wallachia
France
Kingdom of Spain
Portugal
Naples
Sicily
Ottoman Sultanate
Riazan
Golden Horde (Collapsing)
Kazan Khanate
Crimean Khanate
Astrakhan Khanate
Turkish tribes
Samoyeds
Sibir Khanate
Shaybanids (Uzbek Khanate)
Chagatai Khanate (Mongol)
Paleo-Siberian Peoples
Arctic Marine Mammal Hunters
Buryats
Tungusic Peoples
Oirats Khanate (East Mongol)
Ainu
Japan
Ming Dynasty
Tibetan Tribes and Kingdoms
Timurids
Federation of the White Sheep Turks
Mamluk Sultanate
Beduins (Arab Tribes)
Oman
Fartak
Yemen
Adal
Somalis
Ethiopia
Fez
Berber Tribes
Tuareg Nomadic Tribes
Songhay Empire
Takrur
Empire of Mali
Hausa States
Kanem Empire
Tunjur
Makuria
Funj
Akon States
Luo Peoples
Cushites
Bantu Peoples
Interlacustrine States
Congo
Swahili Kingdoms and City-States
Malagasyan Peoples
Khoisan Peoples
Sind
Delhi Sultanate
Nepal
Bengal
Gujarat
Malwa
Gondwana
Gajapatis
Vijayanagar Empire
Ceylon
Ava
Arakan
Pegu
Siam
Cambodia
Champa
Dai Viet
Taiwanese Tribes
Malays
Malacan Sultanate
Malay States
Brunei
Ternate Sultanate
Papuans
Pajajaran
Majapahit
Australian Aboriginal Peoples
Numbered Countries:
1. Navarre
2. Burgundy
3. Switzerland
4. Venice
5. Croatia
6. Bosnia
7. Montenegro
8. Beni Snassen
9. Algiers
10. Kuko
11. Thalibas
12. Labbes
13. Constantine
14. Bizerta
15. Shabiyyas
16. Nemenchas
17. Pskov
18. Circassians
19. Ossetians
20. Ramazan
21. Dulkadir
22. Ahom Kingdom
23. Kachari
24. Chutiya
25. Toungoo
26. Cheingmai
Blue Names = Germanic Nations
Green Names = Islamic Nations

Turco-Mongol Empire by 15th century AD



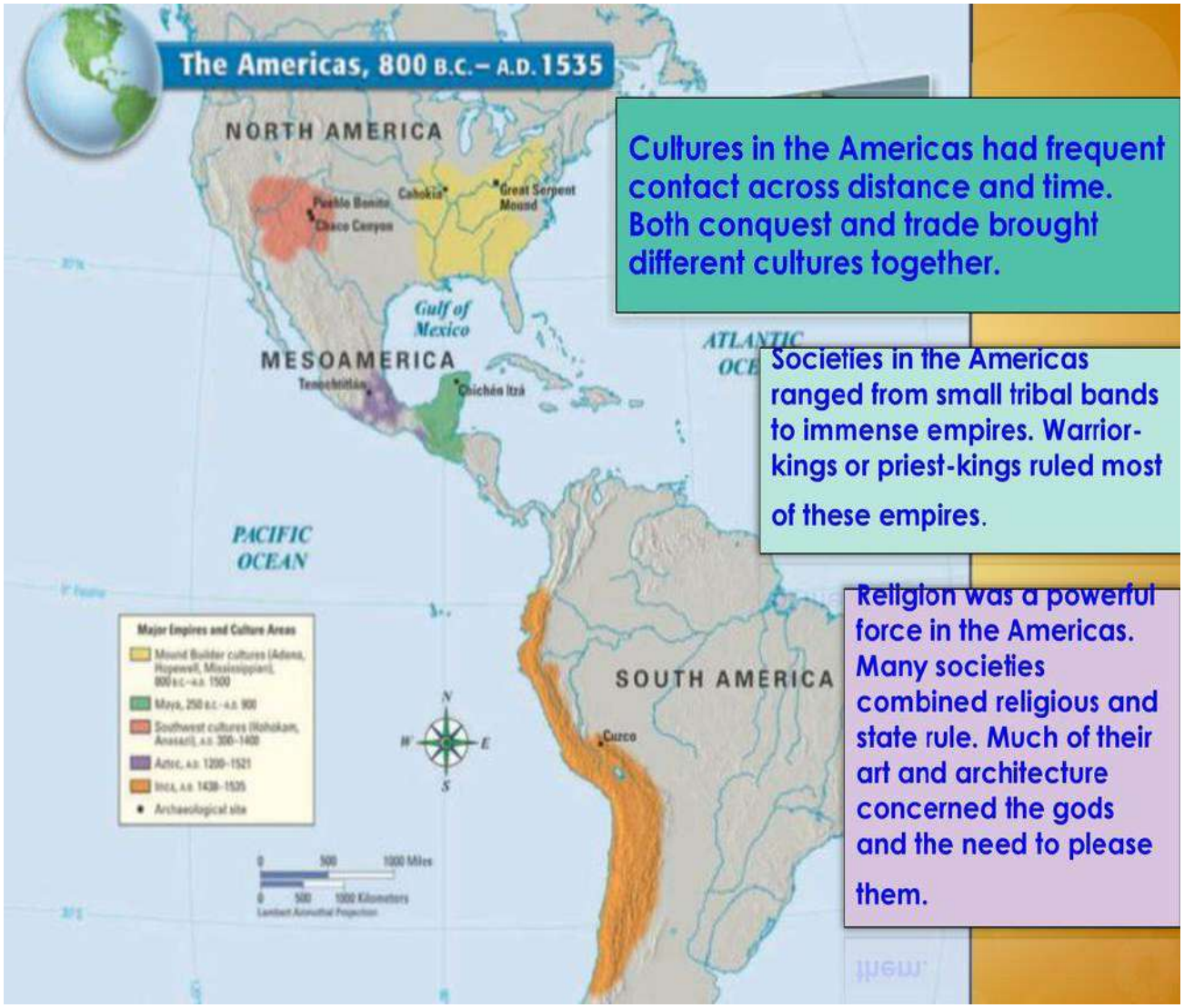
Map of Asia 1700AD prior to colonisation



Early human migrations in thousands of years


Arctic marine mammal hunters
Arctic marine mammal hunters
Aleuts
Subarctic forest hunter-gatherers
Plateau fishers and hunter-gatherers
North American Pacific foraging, hunting and fishing peoples
Plains bison hunters
Eastern North American woodland hunter-gatherers
Desert hunter-gatherers
Poverty Point culture
Maize farmers
Olmec civilization
Caribbean hunter-gatherers
Manioc farmers (replacing hunter-gatherers)
Chorrera culture
El Paraiso culture
Amazon forest hunter-gatherers
Chinchoros culture
Savanna hunter-gatherers
Shellfish gatherers
Andean hunter-gatherers
Pampas cultures
Patagonian shellfish and marine mammal hunters

1000 BC



In addition to Aztec, Maya and Inca civilizations, there were several other tribal groups throughout the Americas pre colonisation. The estimated population of indigenous people ranges from 10 – 100 million.

In summary, the extant human species of Homo sapiens evolved about 300,000 years ago around Morocco. The primitive humans migrated across the world from Africa until about 5000BC when they reached Oceania. The hunter gatherer status changed to a farming one about 12,000 years ago. Uruk in Mesopotamia at around 4500BC is the earliest known city settlement. This paved way to early city civilisations about 3,000 BC with their fortifications in Mesopotamia. Our written history starts from around this time. The earliest empire (Monarch is sovereign) known is the Akkadian stretching from Mesopotamia along the banks of the Persian-gulf about 2,300 BC. Migration, formation of city states, kingdoms and empires are associated with war. The historic maps of Europe, Americas and Asia illustrate this point of expanding territories. At no previous time in human history has there been so much border stability as has been the case since the end of Cold War. At the conclusion of wars, there are treaties that need to be adhered to with terms and conditions.

Warfare technologies

Prehistory

Stone Age implements (before 7000 BC) (Spear from 400,000 BC, atlatl or dart from 40,000 BC, Boomerangs and bows and arrows from 20,000 BC

Bronze age implements (7000 BC – 1000BC) (Daggers, swords)

Domestication of horse ~ 5000BC (Plains of Kazaksthan)

Systematic use of Archery in warfare, 3000 BC Egypt

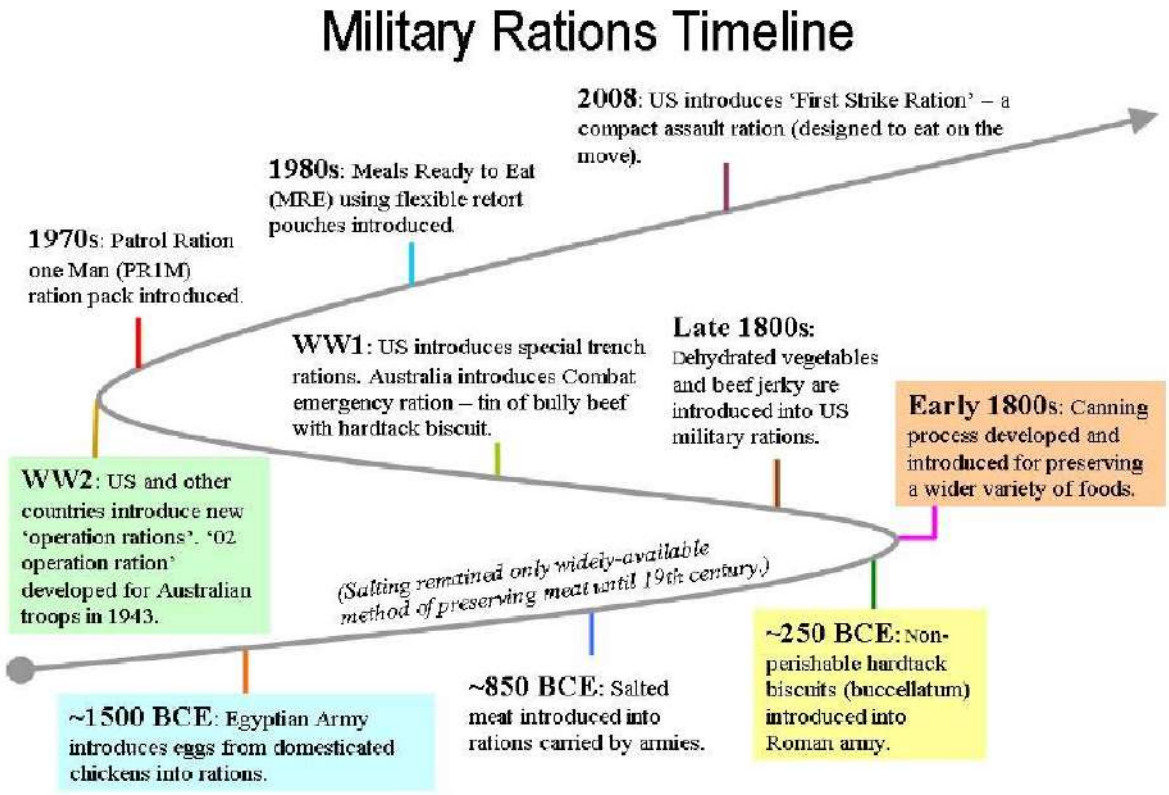
Homing Pigeons using magnetoreception could fly back to its home with messages (Used by Egyptians about 3000BC) and light weight objects tied to its legs. This method was used as late as the second world war.

Iron age implements (after 1000 BC)

Recorded history

Ancient and medieval

Spoke wheeled chariot ~ 2000BC (Mesopotamia)



Crossbow – Greece ~ 500 BC

Recorded evidence of espionage – 500BC, Sun Tzu (China) and Chanakya (India), ancient Egypt and Hebrews in acquiring their promised land of Israel. It formed an integral part of intelligence gathering in all empires over time.

Trebuchet – China 400 BC

Fire beacons started to be used for distant communication until the middle ages

Gunpowder for warfare – China 900 AD - This changed the dispersion (square metres per man in combat) especially with new mechanical devices to provide a range of artillery use and also increased the risk of non-military casualties. Islamic Caliphates used hand canons by 1200 AD. Gunpowder reaches Europe by 13th century.

An organised system of intelligence and counterintelligence called mstovaris in Georgia – 1100AD

Longbow – Britain, 1400 AD

Aztechs in Central America used traders and infiltrators with diplomatic immunity by the 14th century AD

Colonial

Firearm technology furthered in China 1400-1700 AD including shrapnel shells. Major developments in Europe occur with firearms.

Modern espionage methods started in Britain (Francis Walsingham, principal secretary Queen Elizabeth I) ~ 1600 AD (cryptographers, seal breakers, interception of personal communications and networks of intelligencers around Europe – Foreign Intelligence). By 1700 AD, Cabinet noir was jointly operated by Britain and France in Europe. Paris was an epicentre of intelligence surveillance. An organised system led by Charles Whitworth was spying on Russia for Britain by 1700 AD.

Rocket Artillery – Tipu Sultan against the British 1750 AD

Industrial espionage commences in Western Europe by 1750 AD.

England screens for Jacobite sympathisers within Britain to halt the Jacobite uprising from France by 1750 AD

American Revolutionaries establish the Culper Ring of Intelligence about 1775 to observe the British army in New York; an integral component of the American war of Independence to track the British Invasion Army.

By 1800, William Wickham establishes Central Intelligence Services and the process of the Intelligence cycle in Britain. France and Britain were engaged in multiple and long wars in early 18th century, including coastal blockade and trade embargo. This involved Intelligence systems on both sides.

Alessandro Volta (Italy) made the voltaic pile (precursor to electric battery) in 1800

Revolver gun – 1835, USA

Morse electrical telegraphy was invented and a suitable device to transmit and receive the codes were built ~ 1844. This was the first application of Electricity. This was used by light, sound and radio communication over time.

Underwater communications cable first laid under river Rhine in Germany in 1847.

Machine guns – Belgium and USA, 1850

First submarine telegraph cable laid across the English-channel in 1850

Military attache's were attached to diplomatic services in the Crimean war (UK vs Russia, 1850) for intelligence gathering centred around Afghanistan. Austria established the first military intelligence 'Evidenzbureau' unit in 1850 at the time of the European Springs (people uprising).

The first transatlantic cable was laid between Ireland and Newfoundland ~ 1860

Iron clad warship – Sweden, 1860

The Pinkerton agency provided covert and sympathiser recruits with counter espionage for intelligence gathering and neutralising threats in the American civil war of 1860's.

The Intelligence branch of the British Military war office was set up in 1873 as an outcome of the Crimean war and the word 'classified' came into existence. Several other nations followed suit later on. Military intelligence broadened to Naval intelligence. With growing espionage activities all over Europe and their colonies, Austria again led the new movement of gathering information on espionage – the counterintelligence service: as part of their Evidenzbureau activities. Russian Okhrana was formed in 1880, operating from outside Russia (Paris), to spy on revolutionary parties in Russia. They used covert, undercover and perlustration methods (inspecting and surveying) with added provocative agents. A similar method was used by the French intelligence at the time of Dreyfus Affair – it even started the spy novel genre.

French invented the optical telegraph used in a relay (Semiophore) for distant communication used until 1880.

Telephone lines were established by 1880

Hydroelectric generated power lines were used in USA by 1880 for street ligting

USA Office of Naval Intelligence was established in 1882

Heliograph, a mobile optical communication device was used for communication in the late 19th and early 20th century. It continued to be used as late as 1975.

World's first counter terrorism unit is established in England in 1883 to counter terror campaigns from Irish Fenians

Military submarine & automatic machine gun – USA, 1890

The Great Game (Britain vs Russia colonial ambitions in central asia and India) led to the establishment of the Indian Civil Services in late 19th century.

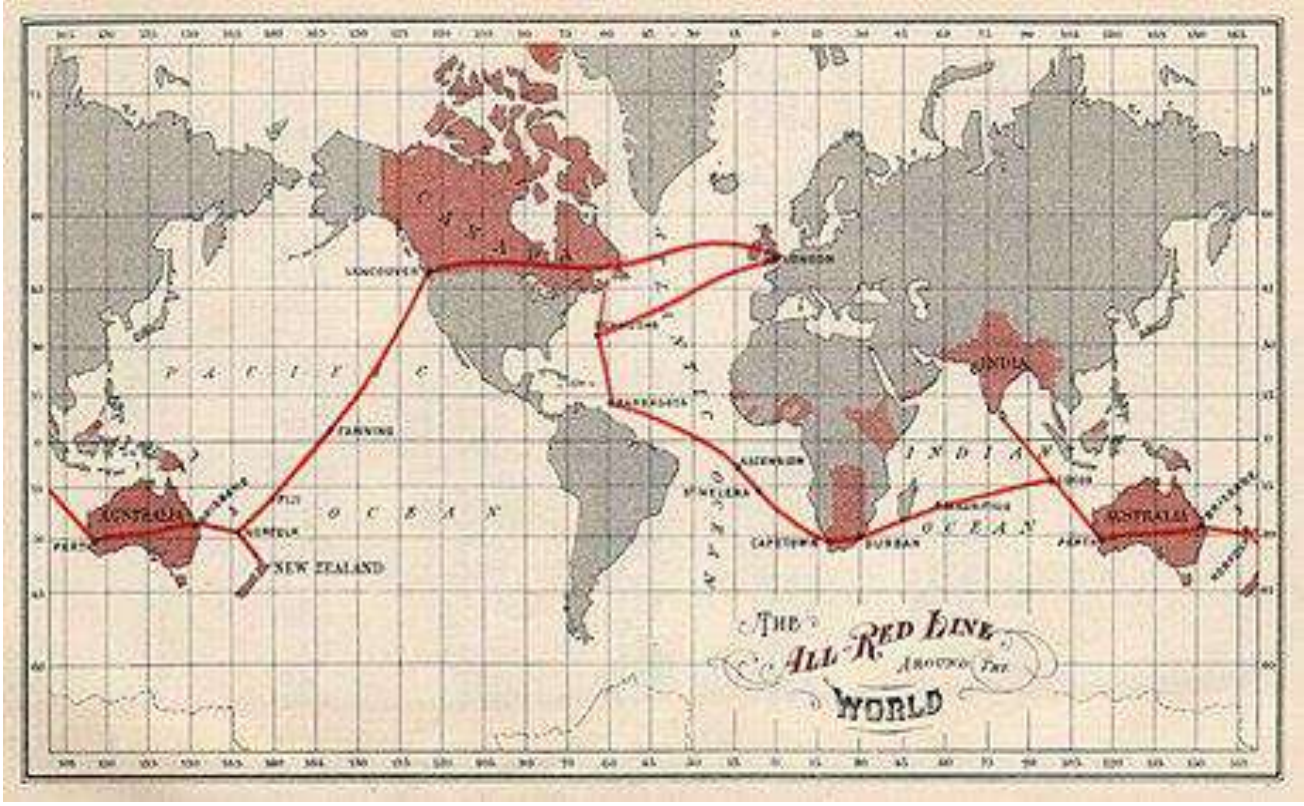
Radio communication was developed separately by JC Bose and Marconi by 1900

Bullet proof vest – 1900, USA

Beginning of military robotics (Nikola Tesla, Serbian American) – 1900, only used in world war II

Gun silencer – 1910, USA

The British All Red Line was inaugurated in 1902 (submarine cable communication)



Limited use of aircraft (turbo)– USA & Germany, 1910

Military tanks – Britain, 1910

British Secret Service Bureau was split into Foreign and Domestic in 1910, in all MI I to MI 19 were formed. German Empire espionage and counterintelligence was a key study target. This system was interdepartmental and reported to the respective government departments directly to overcome internal agendas. World War I was replete with Intelligence/counterintelligence methods with advantage to the Allies because Germans were in new territories. Although Netherlands was a neutral country in World War I, Allies used most of their intelligence routes through Netherlands. Aerial photography and decryption of radio signals were invented and used.

Henry Moseley (British) demonstrated the beta cell with electron decay from tritium in 1913. This over the century has moved over to micro (MEMS) and nano devices (NEMS) fuelled by nuclear power and wireless transmission especially used in medical devices, defence and space applications.

The British cut German submarine cables in 1914 across Europe and the Atlantic that went under the English-channel as part of World War I strategies. This opened German radio communication to interception which was heavily coded. Interception and analysis were done at Room 40 (British Admirality cryptoanalysis wing)

Psychological warfare to influence opinion and behaviour of desired groups were introduced in World War I. The objective being to induce fear, shift opinions, delay decision making, induce gradual harm, and ultimately achieve one's goals and obtaining surrender from the targeted group.

Foreign military battalions from colonised countries participated in WW I & II with the respective colonisers, which later continued as direct recruitment of individual foreigners into the military services of a nation.

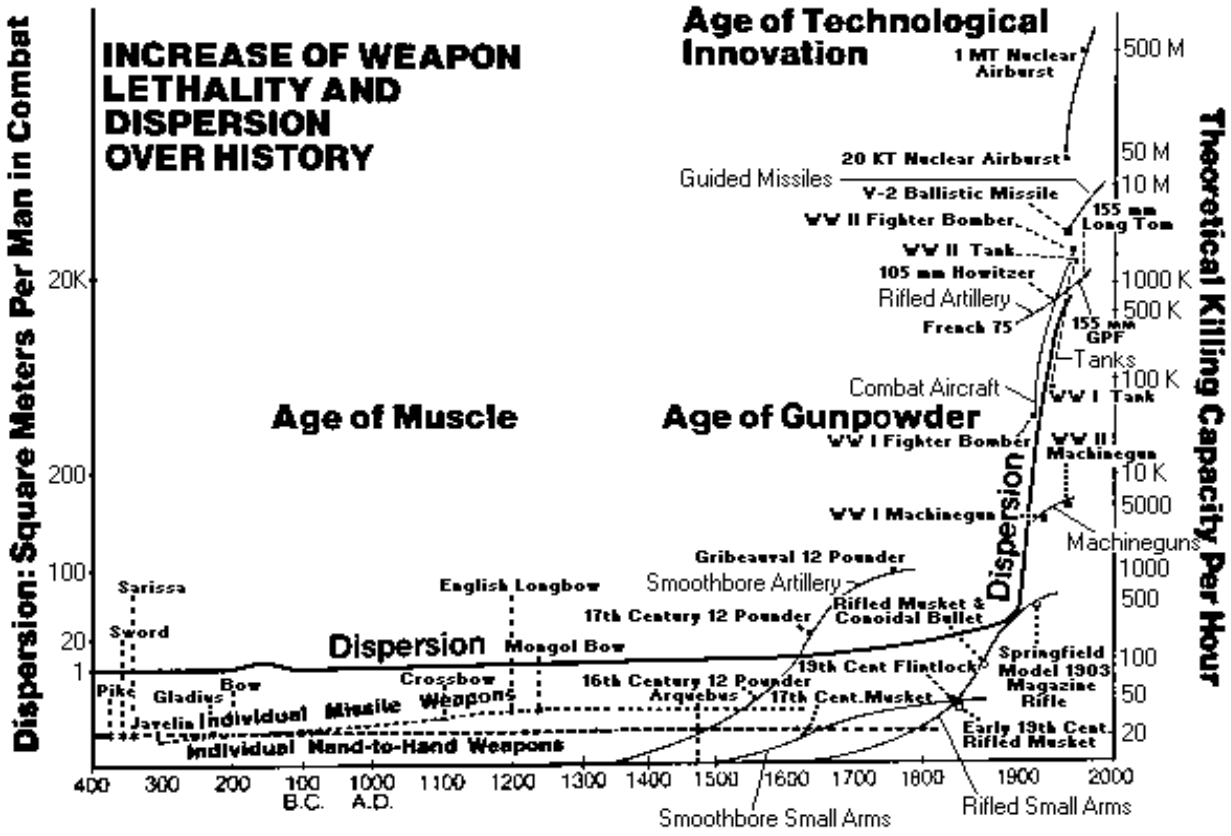
Jet aircrafts – 1940, Germany

RADAR for radio communication developed ~ 1940 USA

Nuclear bomb – USA, 1945

USA forms the first womens' military unit in 1948 but not allowed into combat until 2013.

Israeli Intelligence Service, Mossad, was formed in 1949

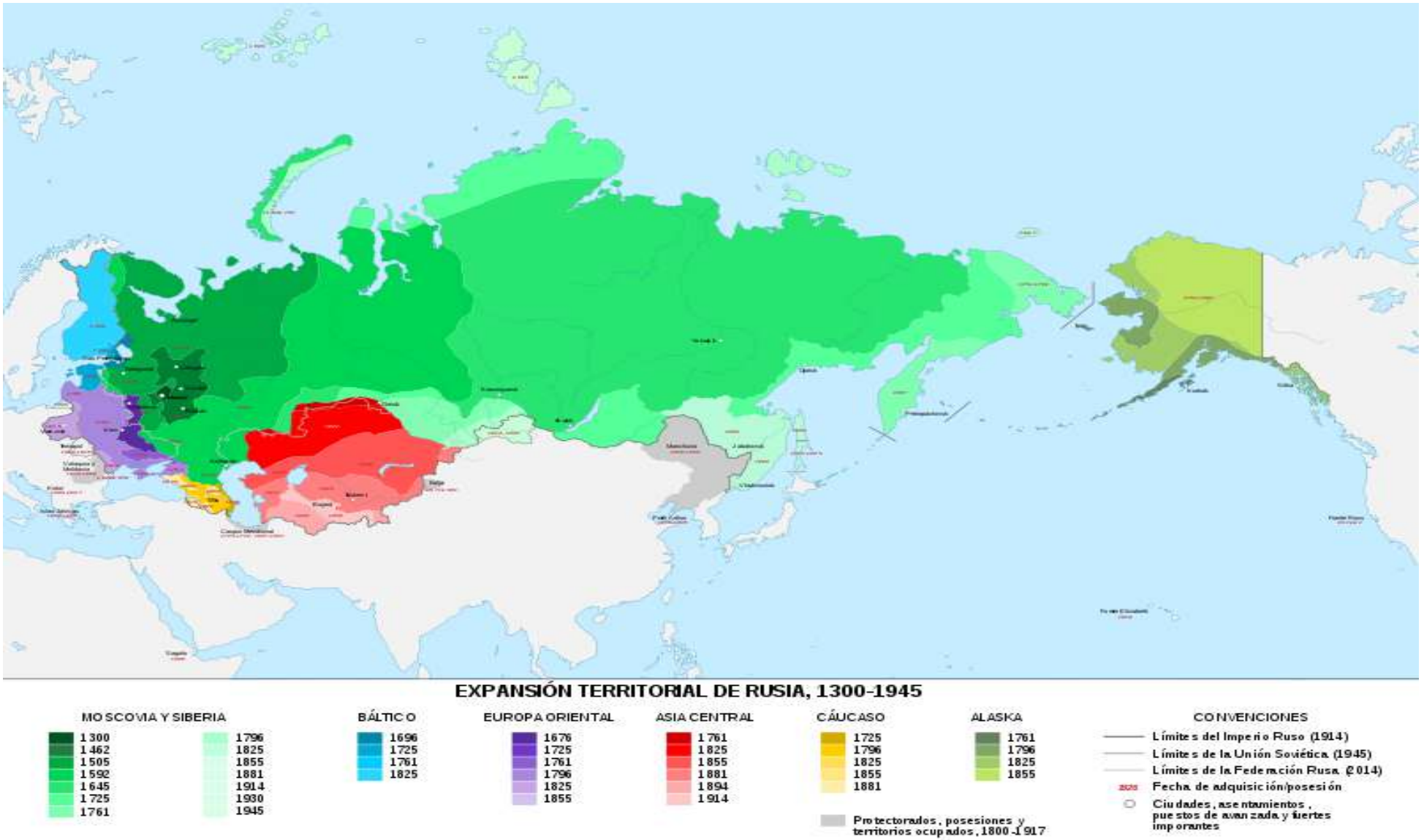


Source: T.N. Dupuy, The Evolution of Weapons and Warfare (New York: Bobbs-Merrill, 1980), p.288

Figure 1. Relationship of Lethality to Dispersion

Cold war

The Russian federation was formed after the overthrow of monarchy in the Russian Empire (1721 – 1917). It gained control over 7 east European nations after the WW II treaty but these were ceded in addition to 14 states under the USSR. In total, the cold war saw the separation of 21 Russian federation states. The east European states slowly joined the European Union formed in 1958 while the Asian states of the Russian federation became independent countries towards the end of the cold war (1947 -1991)


EXPANSIÓN TERRITORIAL DE RUSIA, 1300-1945
MOSCOVIA Y SIBERIA
1300
1462
1505
1592
1645
1725
1761
1796
1825
1855
1881
1914
1930
1945
BÁLTICO
1696
1725
1761
1825
EUROPA ORIENTAL
1676
1725
1761
1796
1825
1855
ASIA CENTRAL
1761
1825
1855
1881
1894
1914
CÁUCASO
1725
1796
1825
1855
1881
ALASKA
1761
1796
1825
1855
Protectorados, posesiones y territorios ocupados, 1800-1917
CONVENCIONES
Límites del Imperio Ruso (1914)
Límites de la Unión Soviética (1945)
Límites de la Federación Rusa (2014)
Fecha de adquisición/posesión
Ciudades, asentamientos, puestos de avanzada y fuertes importantes

Psychological operations were used extensively in the cold war and the proxy wars of the cold war era, including the Korean war of the 1950's by USA. This was later applied to other regime changes such as Vietnam, Guatamela, Panama, Nicaragua.

Hydrogen (fusion) bomb – USA 1952

MASER (Microwave) – USA, 1953

Reconnaisance Satellite – USA, 1955

LASER (light) targeting – USA, 1960

MOSFET NEMS was invented by Atalla (Egypt) and Kahng (Korean-American) of Bell labs in 1960

Unarmed aerial vehicles just beginning around World War I, used in 1960's for reconnaissance and later led to military drones

Optic fibres were developed for telecommunication by 1970 which enhanced information transmission rate and volume

TASER (electrowave) – USA, 1974

Space technology – USA and USSR

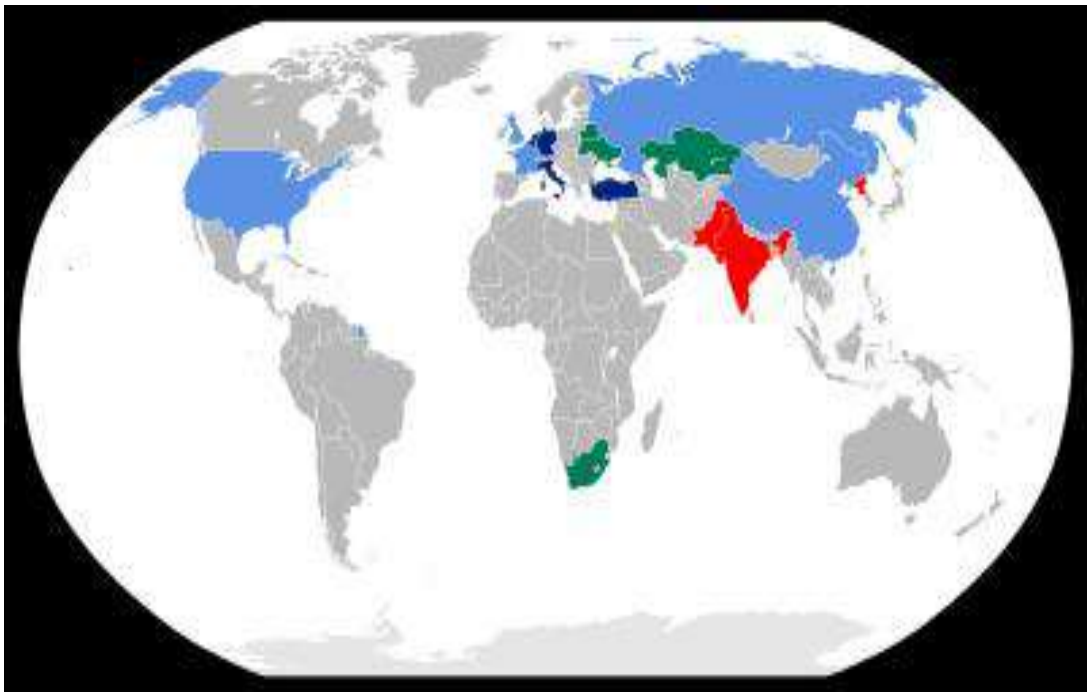
Portable cameras and recording devices – USA and USSR

Arpanet – USA, 1970

USA Global Positioning Systems (is independent of telephonic and internet reception) – started in 1973

United States Intelligence Community was formed in 1981 (includes 22 Intelligence departments and employs nearly a million public and private individuals)

Supercavitation torpedo – USSR, 1990



Map of nuclear-armed states of the world

The NPT (Treaty on the non-proliferation of Nuclear weapons) is a landmark international treaty since 1970 which now has 190 member states, whose objective is to prevent the spread of nuclear weapons and weapons technology, to promote cooperation in the peaceful uses of nuclear energy and to further the goal of achieving nuclear disarmament and general and complete disarmament.

New developments

Psychological warfare was pursued in relative peacetimes / early war periods and used intensively during war such as Iraq, Bosnia-Herzegovina, Afghanistan

Anti-satellite LASER – USA, 1997

Radio hafnium (simple device claimed to emit massive amounts of Gamma rays) – USA, 1999

Microwave national defence shield – USA, 2001

Pulsed energy projectile (Laser to shoot down missiles) – USA, 2002

Metal Storm (machine gun capable of firing a million rounds a minute) – Australia, 2007

Airborne lasers and plasma shields – USA, 2008

Early reports of psyops strategies being used in civilian life such as news reporting by 2008 in USA.

Counter terrorism units in many countries following the attack on New York trade tower (red team – a group that provides opposite view to the organisation they are helping in order to assist the organisation they are helping: extension to perlurstration)

Wikileaks and Snowden files paint an ambivalent picture of ongoing activities but they are found to lack credibility ~ 2010. Cambridge Analytica made similar news from UK about a private company harnessing online data to influence USA election.

Many countries/regions have their own GPS equivalents now and simultaneous use of data from multiple systems improves precision of ground position.

The world military expenditure per annum ~ 3 trillion dollars; with 80% of military trade originating in the USA.

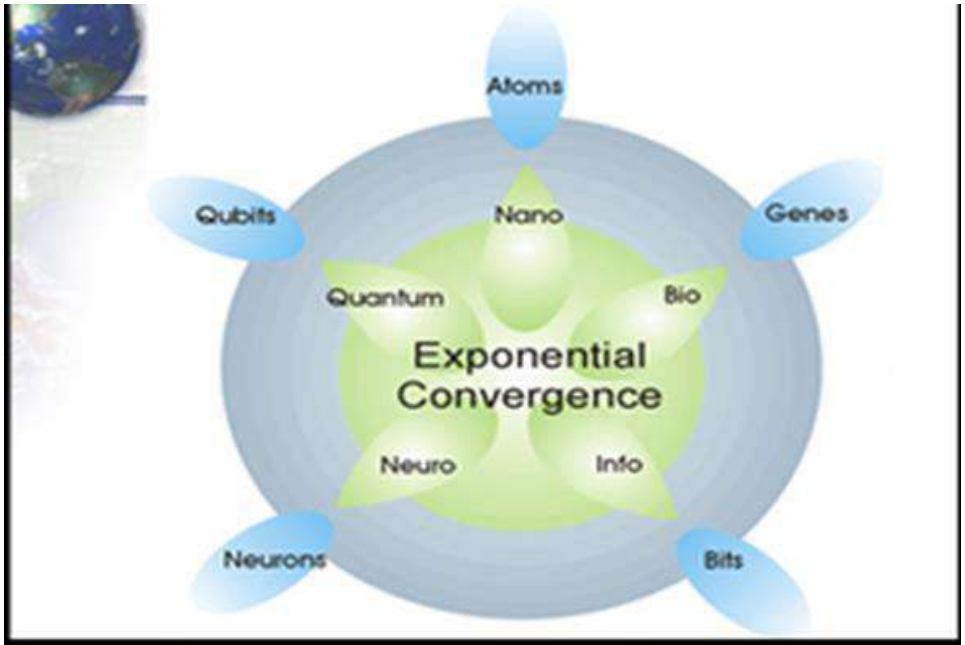


Figure 1 Exponential Convergence - Five converging technologies that will drive the exponential development of increasingly capable Artificial Intelligence.

Likely future potentials for warfare

It can be observed that most technologies and methods developed and applied in war usually passes over to peace time activities and to commercial industry after a few years, although the relationship is not linear nor one directional.

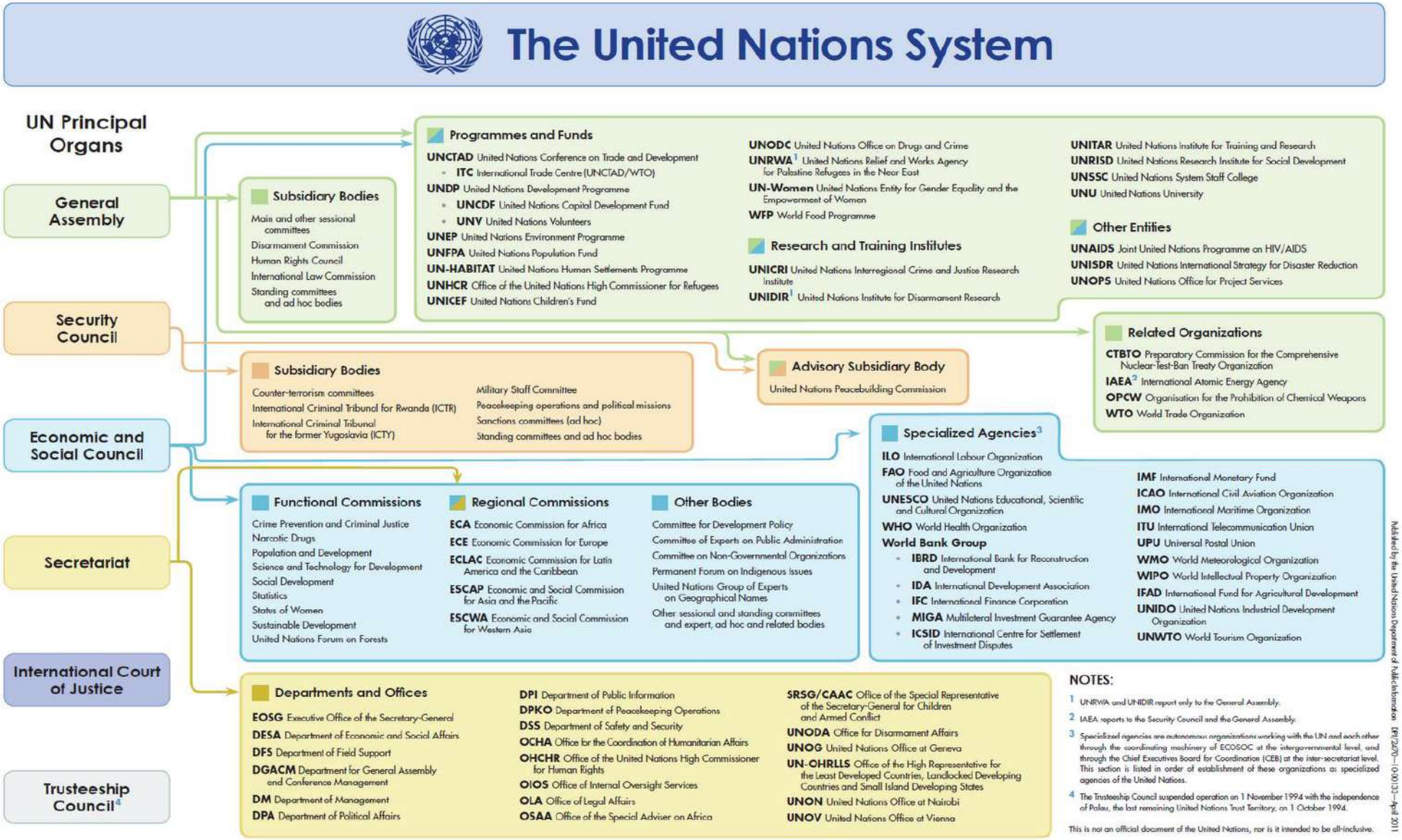
On protection, negotiation and stability

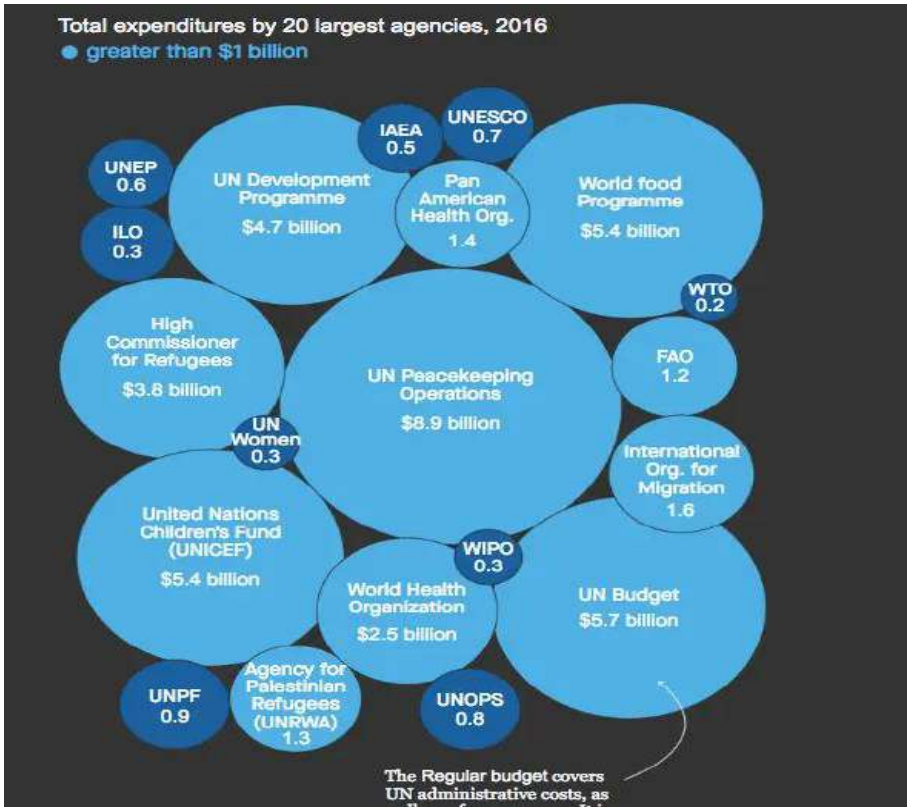
As long the history of human conflicts, so is the attempt to neutralise it. International law evolved globally along with wars between territories since ~ 1500 BC. Several imminent legal reformists, national laws and treaties went into consideration to the evolution of this process over the millenia. The UN was formed in 1945 with its six principal organs: UN General Assembly (deliberative assembly of member states), UN Secretariat (administrative organ of the UN), International Court of Justice (Universal Court for International Law), UN Security Council (international security issues), UN Economic and Social Council (global economic and social affairs), UN Trusteeship council (for administering trust territories – inactive since 1994). It evolved into subsidiary bodies, autonomous bodies and related by other measures as in figure on next page. The Headquarters is in New York (USA). Sovereign states can access membership to these divisions under conditions. Its annual expenditure is $53 billion.

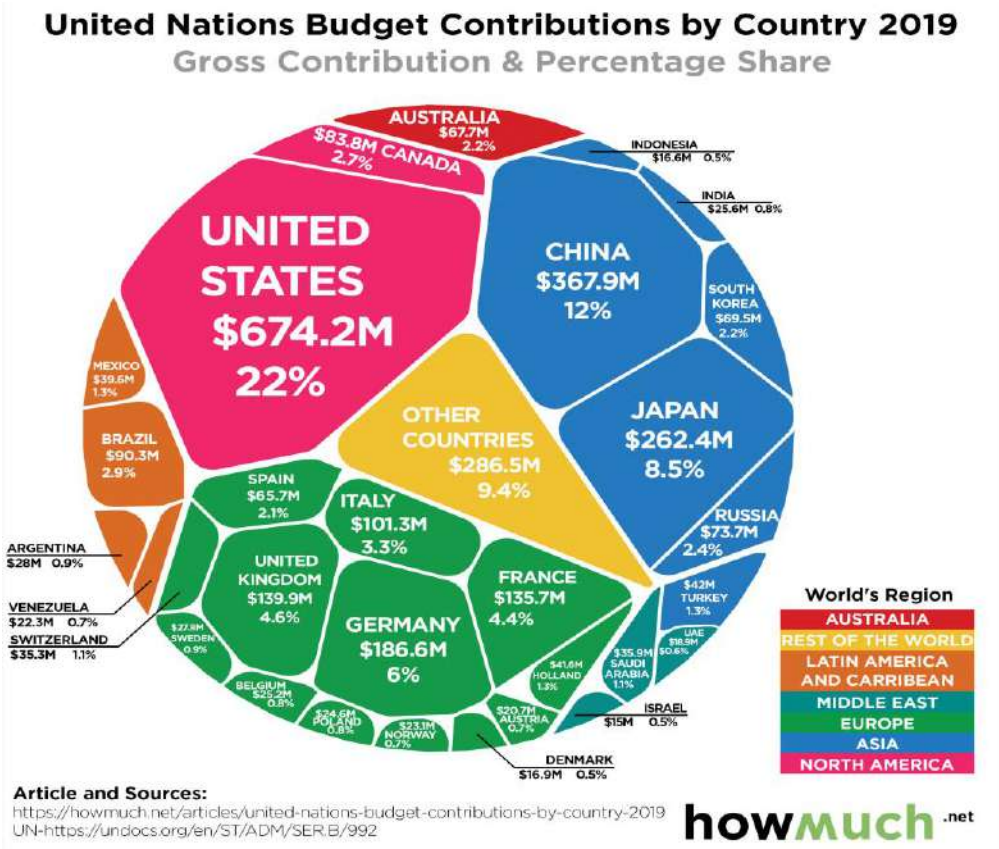
There are other International Government Organisations (IGO) [~5,000] and supposing a modest annual budget of $50 million dollars for each; brings the estimated spending to $250 billion (5 times the UN annual budget).

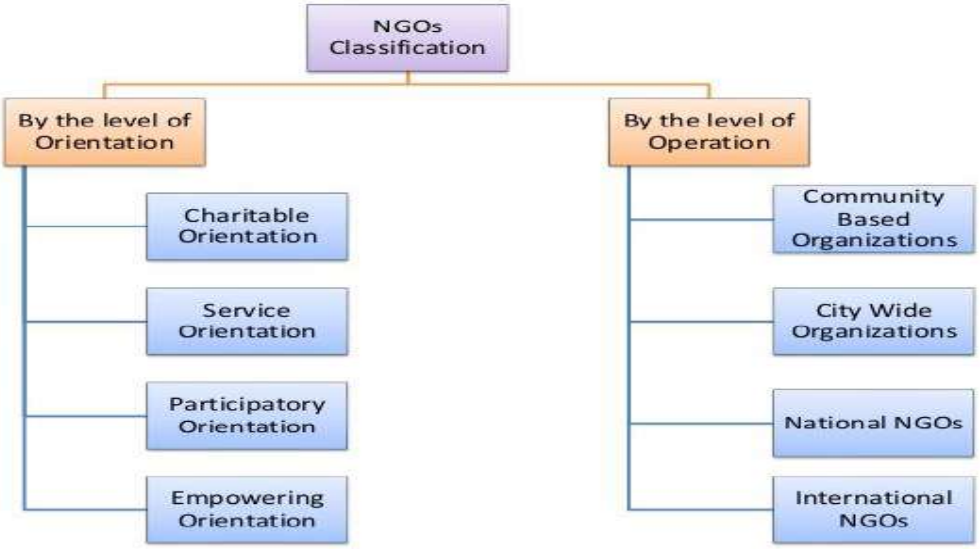
Regional Inter-Governmental Organisations have an estimated $1.5 trillion annual budget

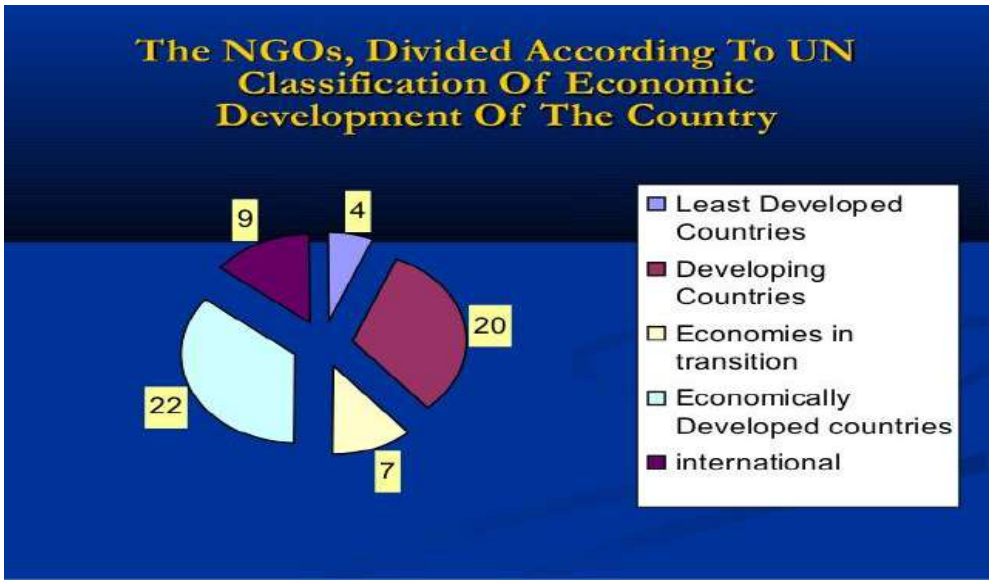
There are about 50,000 NGO's currently in the world with specific objectives and mixed funding sources (inception to annual investments spanning government, private and individual contributions). There is no current legal status for NGO's. They contribute to ~ 15% of total international development aid (ODA). There are several areas of NGO work: interdisciplinary, health, children & youth, education, human rights, environment, religion etc.


The United Nations System
UN Principal Organs
General Assembly
Security Council
Economic and Social Council
Secretariat
International Court of Justice
Trusteeship Council[4]
Subsidiary Bodies
Main and other sessional committees
Disarmament Commission
Human Rights Council
International Law Commission
Standing committees and ad hoc bodies
Programmes and Funds
UNCTAD United Nations Conference on Trade and Development
ITC International Trade Centre (UNCTAD/WTO)
UNDP United Nations Development Programme
UNCDF United Nations Capital Development Fund
UNV United Nations Volunteers
UNEP United Nations Environment Programme
UNFPA United Nations Population Fund
UN-HABITAT United Nations Human Settlements Programme
UNHCR Office of the United Nations High Commissioner for Refugees
UNICEF United Nations Children's Fund
UNODC United Nations Office on Drugs and Crime
UNRWA[1] United Nations Relief and Works Agency for Palestine Refugees in the Near East
UN-Women United Nations Entity for Gender Equality and the Empowerment of Women
WFP World Food Programme
Research and Training Institutes
UNICRI United Nations Interregional Crime and Justice Research Institute
UNIDIR[1] United Nations Institute for Disarmament Research
UNITAR United Nations Institute for Training and Research
UNRISD United Nations Research Institute for Social Development
UNSSC United Nations System Staff College
UNU United Nations University
Other Entities
UNAIDS Joint United Nations Programme on HIV/AIDS
UNISDR United Nations International Strategy for Disaster Reduction
UNOPS United Nations Office for Project Services
Subsidiary Bodies
Counter-terrorism committees
International Criminal Tribunal for Rwanda (ICTR)
International Criminal Tribunal for the former Yugoslavia (ICTY)
Military Staff Committee
Peacekeeping operations and political missions
Sanctions committees (ad hoc)
Standing committees and ad hoc bodies
Advisory Subsidiary Body
United Nations Peacebuilding Commission
Related Organizations
CTBTO Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization
IAEA[2] International Atomic Energy Agency
OPCW Organisation for the Prohibition of Chemical Weapons
WTO World Trade Organization
Functional Commissions
Crime Prevention and Criminal Justice
Narcotic Drugs
Population and Development
Science and Technology for Development
Social Development
Statistics
Status of Women
Sustainable Development
United Nations Forum on Forests
Regional Commissions
ECA Economic Commission for Africa
ECE Economic Commission for Europe
ECLAC Economic Commission for Latin America and the Caribbean
ESCAP Economic and Social Commission for Asia and the Pacific
ESCWA Economic and Social Commission for Western Asia
Other Bodies
Committee for Development Policy
Committee of Experts on Public Administration
Committee on Non-Governmental Organizations
Permanent Forum on Indigenous Issues
United Nations Group of Experts on Geographical Names
Other sessional and standing committees and expert, ad hoc and related bodies
Specialized Agencies[3]
ILO International Labour Organization
FAO Food and Agriculture Organization of the United Nations
UNESCO United Nations Educational, Scientific and Cultural Organization
WHO World Health Organization
World Bank Group
IBRD International Bank for Reconstruction and Development
IDA International Development Association
IFC International Finance Corporation
MIGA Multilateral Investment Guarantee Agency
ICSID International Centre for Settlement of Investment Disputes
IMF International Monetary Fund
ICAO International Civil Aviation Organization
IMO International Maritime Organization
ITU International Telecommunication Union
UPU Universal Postal Union
WMO World Meteorological Organization
WIPO World Intellectual Property Organization
IFAD International Fund for Agricultural Development
UNIDO United Nations Industrial Development Organization
UNWTO World Tourism Organization
Departments and Offices
EOSG Executive Office of the Secretary-General
DESA Department of Economic and Social Affairs
DFS Department of Field Support
DGACM Department for General Assembly and Conference Management
DM Department of Management
DPA Department of Political Affairs
DPI Department of Public Information
DPKO Department of Peacekeeping Operations
DSS Department of Safety and Security
OCHA Office for the Coordination of Humanitarian Affairs
OHCHR Office of the United Nations High Commissioner for Human Rights
OIOS Office of Internal Oversight Services
OLA Office of Legal Affairs
OSAA Office of the Special Adviser on Africa
SRSG/CAAC Office of the Special Representative of the Secretary-General for Children and Armed Conflict
UNODA Office for Disarmament Affairs
UNOG United Nations Office at Geneva
UN-OHRLLS Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States
UNON United Nations Office at Nairobi
UNOV United Nations Office at Vienna
NOTES:
1 UNRWA and UNIDIR report only to the General Assembly.
2 IAEA reports to the Security Council and the General Assembly.
3 Specialized agencies are autonomous organizations working with the UN and each other through the coordinating machinery of ECOSOC at the intergovernmental level, and through the Chief Executives Board for Coordination (CEB) at the inter-secretariat level. This section is listed in order of establishment of these organizations as specialized agencies of the United Nations.
4 The Trusteeship Council suspended operation on 1 November 1994 with the independence of Palau, the last remaining United Nations Trust Territory, on 1 October 1994.
This is not an official document of the United Nations, nor is it intended to be all-inclusive.
Published by the United Nations Department of Public Information DPI/2470—10.00133—April 2011


Total expenditures by 20 largest agencies, 2016
greater than $1 billion
IAEA 0.5
UNESCO 0.7
UNEP 0.6
UN Development Programme $4.7 billion
Pan American Health Org. 1.4
World food Programme $5.4 billion
ILO 0.3
WTO 0.2
High Commissioner for Refugees $3.8 billion
UN Peacekeeping Operations $8.9 billion
FAO 1.2
UN Women 0.3
International Org. for Migration 1.6
United Nations Children's Fund (UNICEF) $5.4 billion
WIPO 0.3
World Health Organization $2.5 billion
UN Budget $5.7 billion
UNPF 0.9
Agency for Palestinian Refugees (UNRWA) 1.3
UNOPS 0.8
The Regular budget covers UN administrative costs, as


United Nations Budget Contributions by Country 2019
Gross Contribution & Percentage Share
AUSTRALIA $67.7M 2.2%
$83.8M CANADA 2.7%
INDONESIA $16.6M 0.5%
INDIA $25.6M 0.8%
UNITED STATES $674.2M 22%
CHINA $367.9M 12%
SOUTH KOREA $69.5M 2.2%
MEXICO $39.6M 1.3%
OTHER COUNTRIES $286.5M 9.4%
JAPAN $262.4M 8.5%
BRAZIL $90.3M 2.9%
SPAIN $65.7M 2.1%
ITALY $101.3M 3.3%
RUSSIA $73.7M 2.4%
ARGENTINA $28M 0.9%
UNITED KINGDOM $139.9M 4.6%
FRANCE $135.7M 4.4%
$42M TURKEY 1.3%
VENEZUELA $22.3M 0.7%
SWITZERLAND $35.3M 1.1%
GERMANY $186.6M 6%
$35.9M SAUDI ARABIA 1.1%
UAE $18.9M $0.6%
$41.6M HOLLAND 1.3%
ISRAEL $15M 0.5%
$20.7M AUSTRIA 0.7%
DENMARK $16.9M 0.5%
World's Region
AUSTRALIA
REST OF THE WORLD
LATIN AMERICA AND CARRIBEAN
MIDDLE EAST
EUROPE
ASIA
NORTH AMERICA
Article and Sources:
https://howmuch.net/articles/united-nations-budget-contributions-by-country-2019
UN-https://undocs.org/en/ST/ADM/SER.B/992
howmuch.net


NGOs Classification
By the level of Orientation
Charitable Orientation
Service Orientation
Participatory Orientation
Empowering Orientation
By the level of Operation
Community Based Organizations
City Wide Organizations
National NGOs
International NGOs


The NGOs, Divided According To UN Classification Of Economic Development Of The Country
9
4
20
22
7
Least Developed Countries
Developing Countries
Economies in transition
Economically Developed countries
international


Different NGO Roles
Protection
providing relief to victims of disaster and assisting the poor
Prevention
reducing people's vulnerability, through income diversification and savings
Promotion
increasing people's chances and opportunities
Transformation
redressing social, political and economic exclusion or oppression
"Give A Man A Fish"
"Teach A Man To Fish"
"Organise a Fishermans' Co-Op"
"Protect Fishing & Fishing Rights"

Foreign aid/ Official Development Assistance is the voluntary transfer of resources from one country to another country—typically capital. Here are the six types of foreign aid:

1. Bilateral Aid: Direct government-to-government assistance

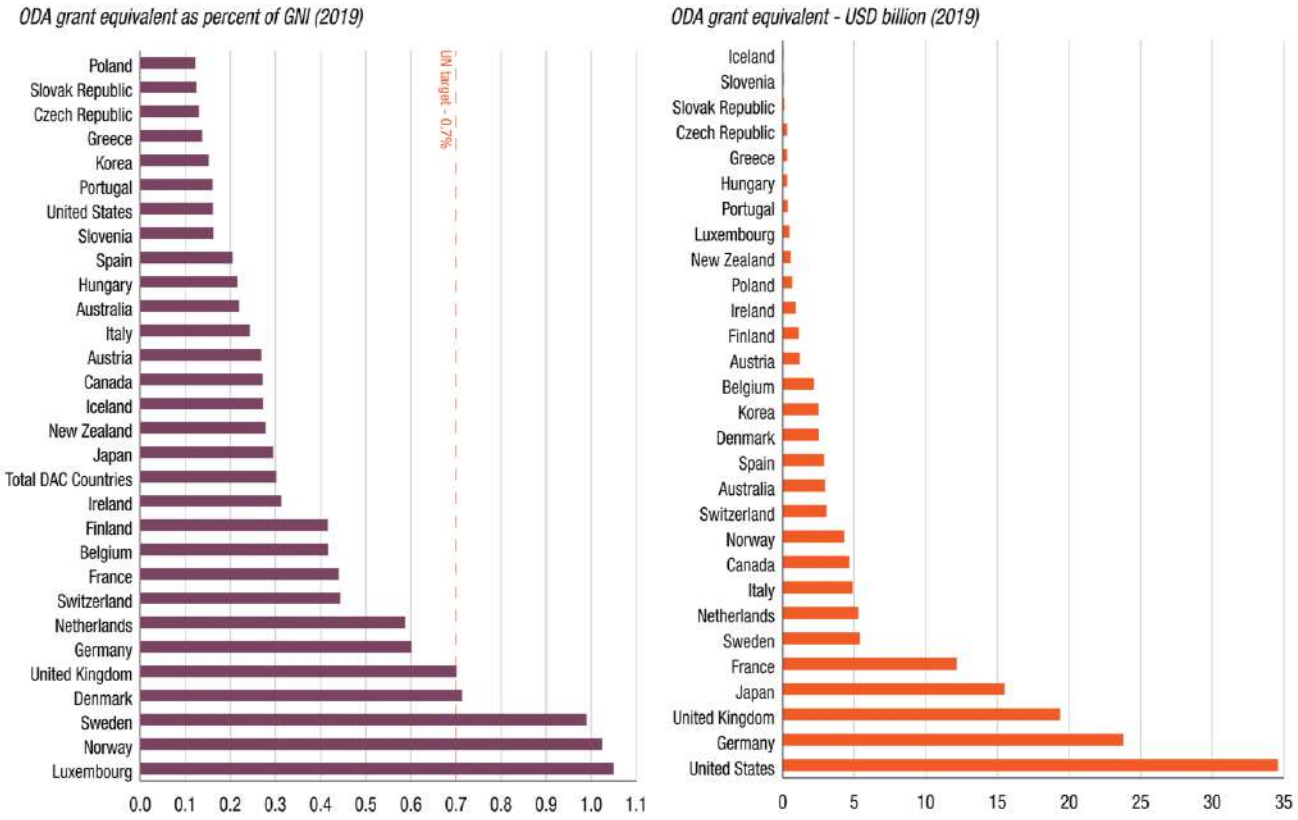
2. Multilateral Aid: When multiple governments pool resources in cooperation with organizations like the World Bank, the IMF, and the UN

3. Tied Aid: The receiving country accepts aid with the expectation that it is spent in the lending country

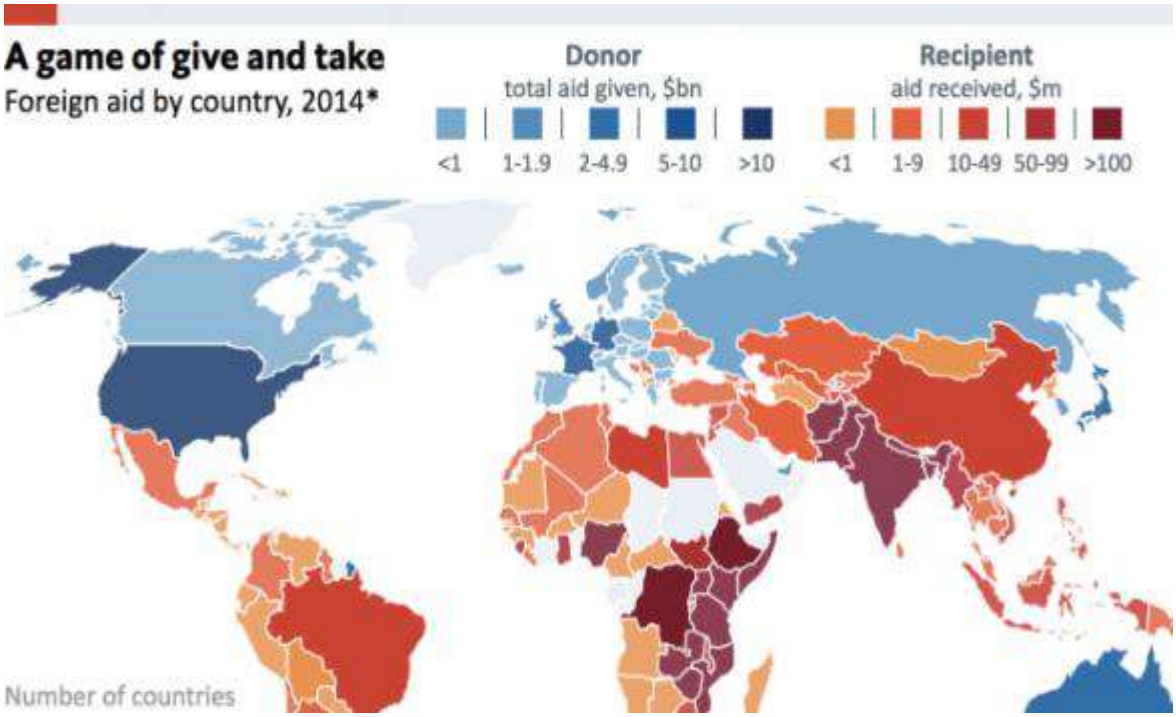
4. Voluntary Aid: A charitable donation, particularly when countries are facing a humanitarian crisis

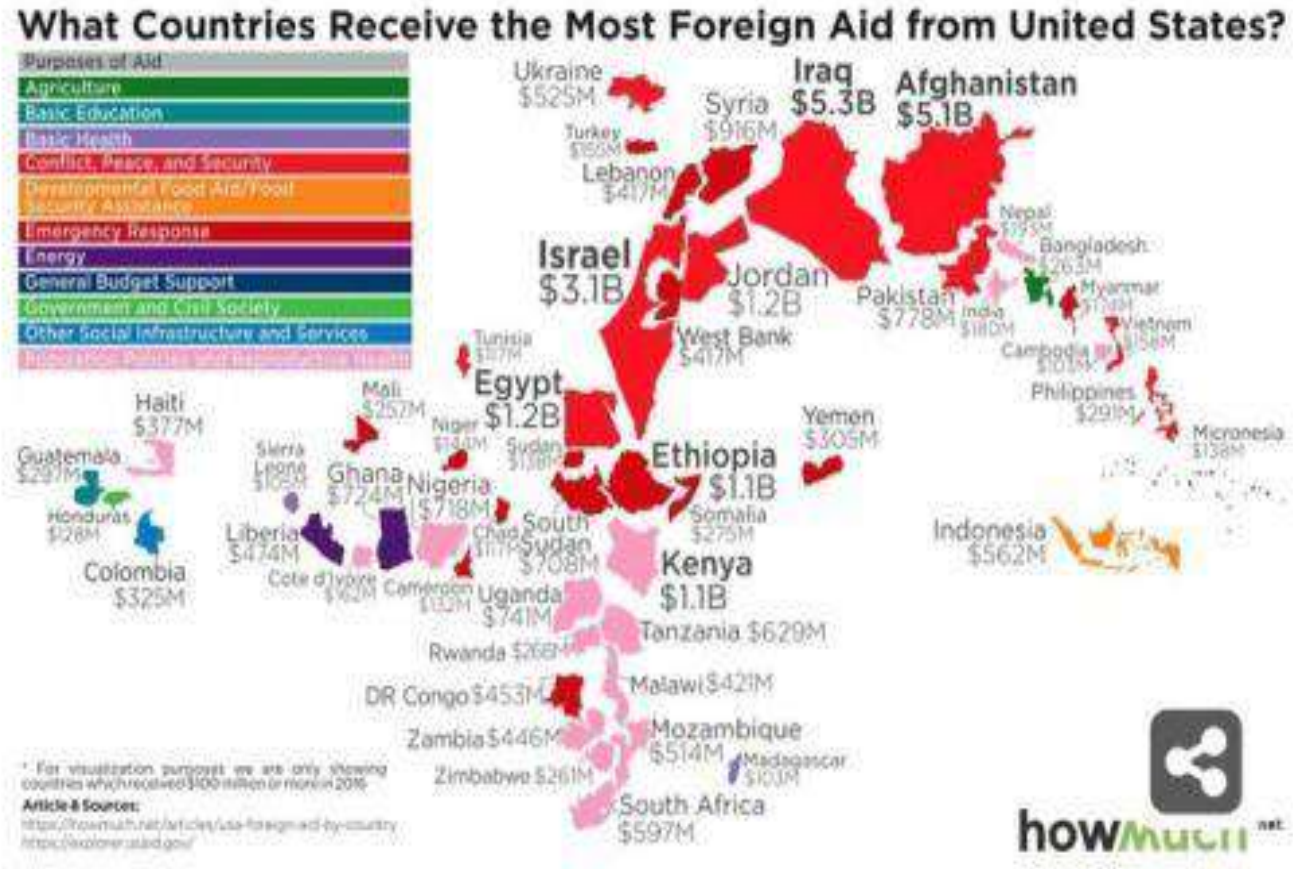
5. Project Aid: When aid is used to finance a specific project

6. Military Aid: Similar to tied aid, but specific to weapons and military supplies

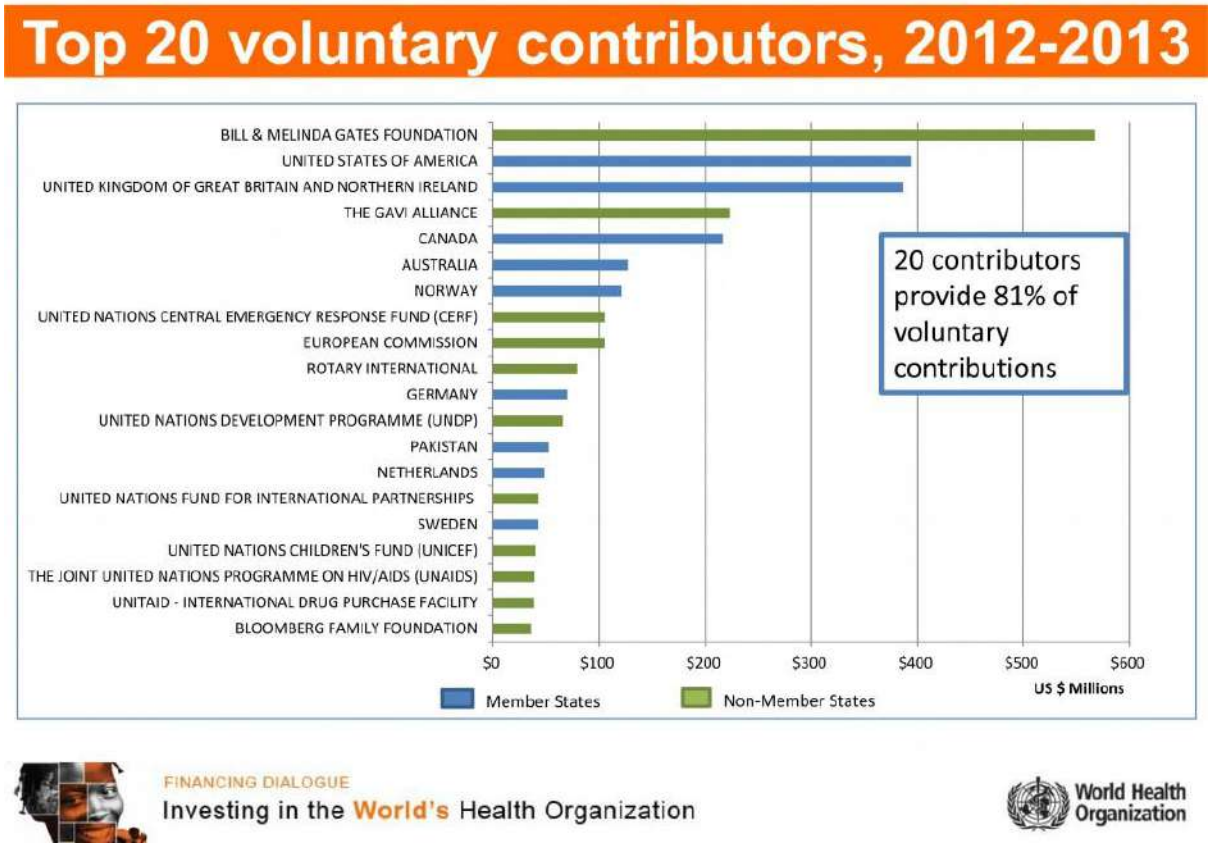


The World Bank's statement of ODA for 2019 was $165 Billion Dollars. ~ 5 Billion dollars of this amount is Voluntary aid including corporate aids.





An example for USA shows that its ODA is twice its annual UN contributions.



In summary, International law through the UN, IGO, NGO's and ODA's maintain the international negotiations on all matters. Their estimated expense (2.5 trillion dollars) as a proportion of Global annual GDP ~ 1.8%.

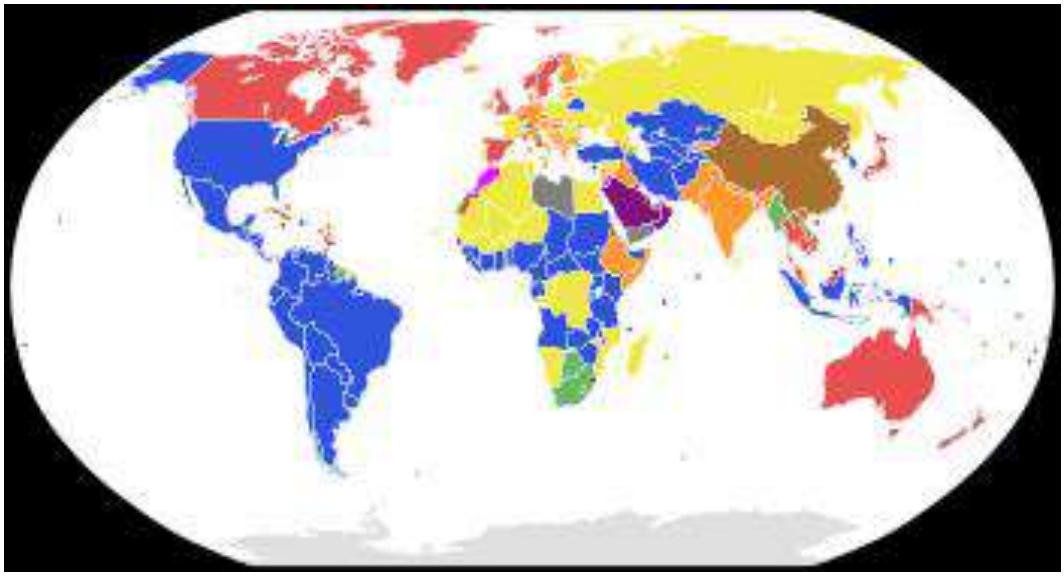
On Governments

Chieftains governing tribes is the earliest unrecorded history of governance

With the formation of early cities and civilisations, groups of people formed councils, usually with a chief

Kingdoms and Empires were the norm for most part of written history with familial succession, although some Empires worked in a senate model (Some periods of Roman and Carthage Empires). The Roman Empire's official emblem was SPQR with a wreath, as a connotation for Senate, and people of Rome. The Roman Empire, Carthage and the Mahajanapadas in India were Republics (People are the Sovereign) around 400BC. Parliament as a process of discussion on state matters existed since early civilisations.

Over much of written history, various forms of governing having existed in local pockets around the world. The power of monarchy over its people was negotiated by the English Church in the Magna Carta of 1215, laying the grounds for the British habeas corpus (recourse in law). However, regarding scaling up governance to the size of a country, the progress was different. By the late 15th century, absolute monarchies changed in some places to decentralised monarchies. Republics (country as a matter for the public rather than the property of its rulers) started forming. Initially it was the mercantile republics of prominent businessmen who had small republics; while the monarchies still had the major land expanses to rule. Another group was the Calvinist Republic (ex: Swiss confederacy formed in 14th century, Protestant reformation in the 16th century Northern Germany, led to a few more republics being formed. In France, England and America, there were people uprising and resistance usually resulting in surveillance and violent outcomes. In many places, the struggle between monarchy and republics went circular for a period. However, on the formation of modern parliaments, there was a new balance in constant transition between monarchies, parliament and public in government representations. The agendas and ideologies of political parties vary with time and hence their representative values in the running of a government.



Full presidential republics[2]

Semi-presidential republics[2]

Republics with an executive president elected by or nominated by the legislature that may or may not be subject to parliamentary confidence.

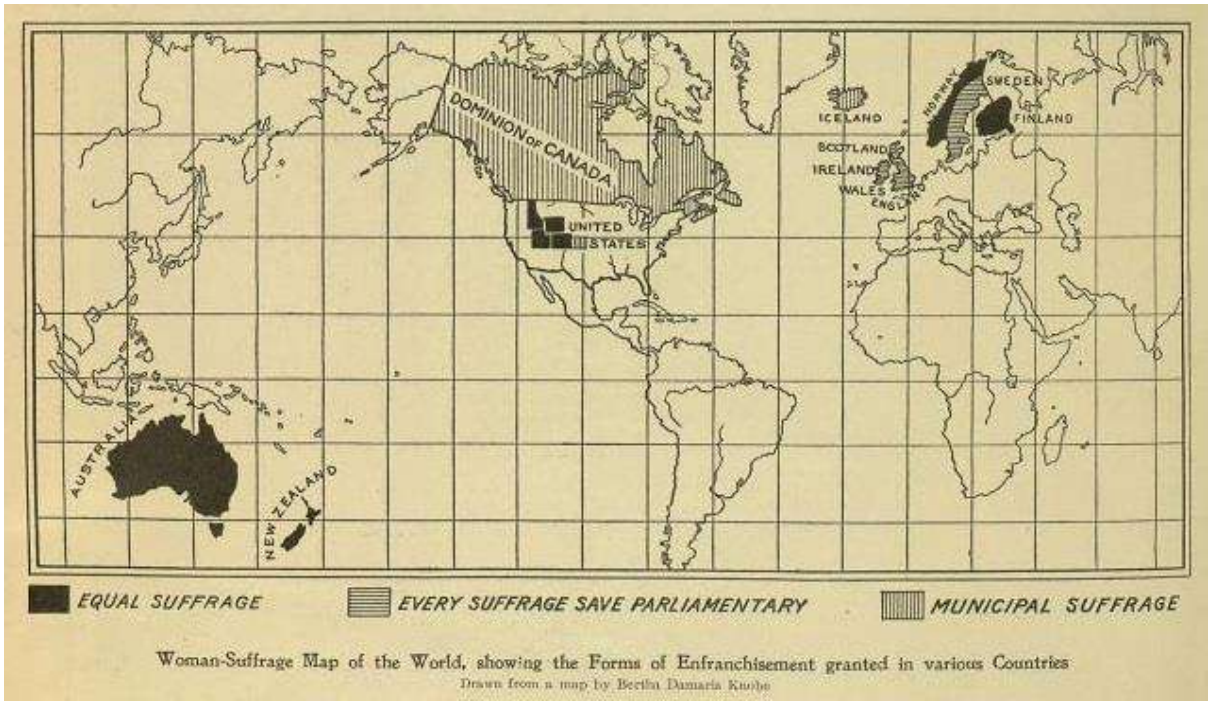
Parliamentary republics[2]

Parliamentary constitutional monarchies	Constitutional monarchies which have a separate head of government but where royalty still hold significant executive and/or legislative power
Absolute monarchies	One-party states
Countries where constitutional provisions for government have been suspended (e.g. military dictatorships)	Countries which do not fit any of the above systems

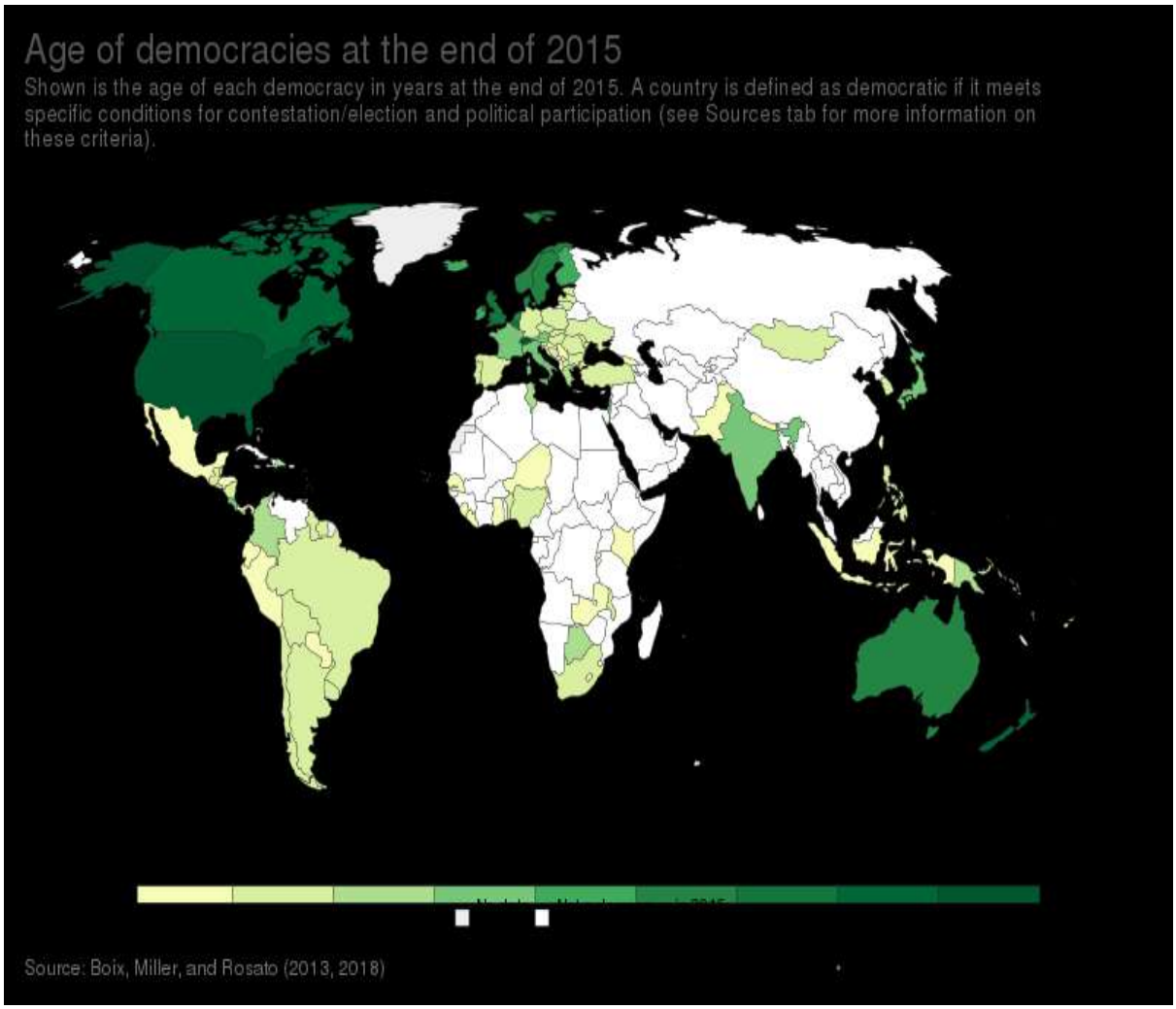
The earliest modern Republic in the world, in 1769, was a 35 square kilometer area in the Poland-Lithuania commonwealth. Paulava was a farming village founded by Paweł Ksawery Brzostowski, a Catholic priest. This was sold to the province after 36 years.

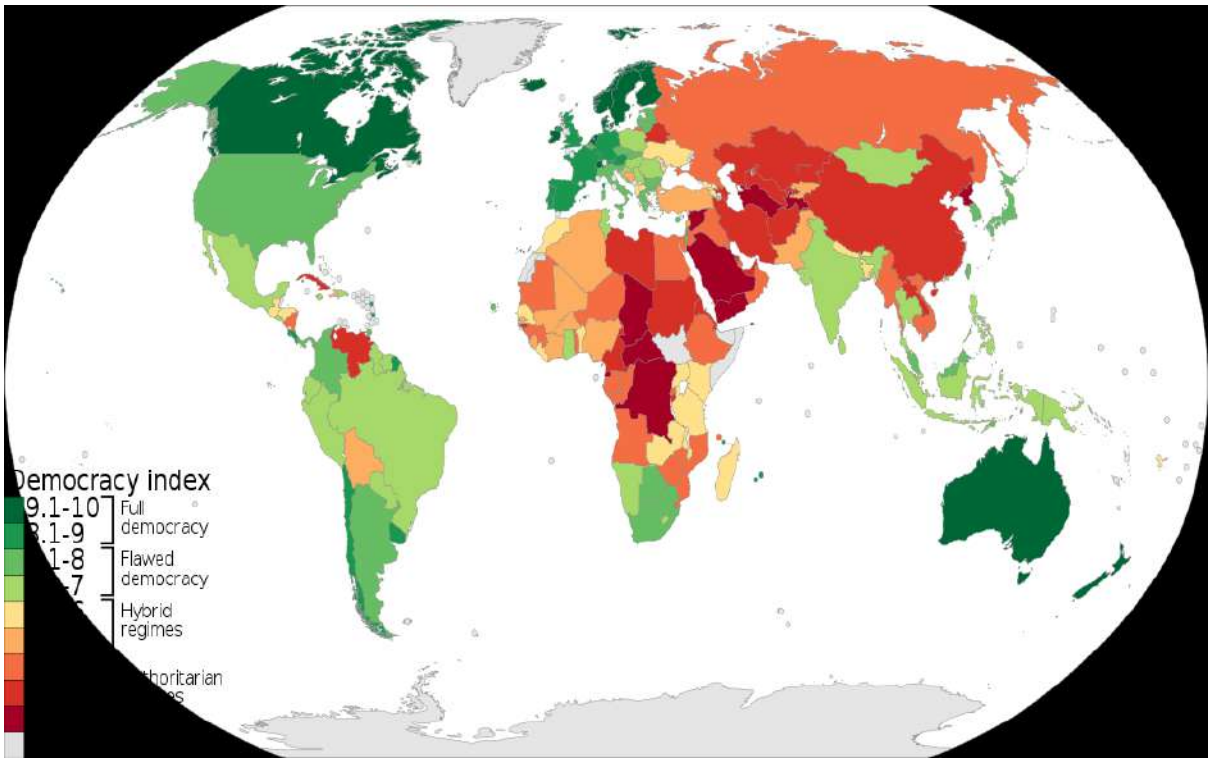
The first parliament of Great Britain was established in 1707 with < 3% suffrage (voting rights). The regions and countries that followed suit had a slowly increasing suffrage contribution to the election of the parliament. The North American 13 colonies declared themselves a Republic, forming the USA in 1776. Western European countries followed later. Universal male suffrage was achieved in France in 1848. The first universal women's suffrage was achieved in New Zealand in 1893. The Soviet Union was formed as a socialist Republic in 1922. End of colonialism with world war II led to the colonies following suit. A Republic may have a written or unwritten constitution. By power source distribution - Democracy, a representative rule by the people; Oligarchy, rule by few; Autocracy, rule by one. By ideology distribution – Authoritarian vs Libertarian; global vs Local. Various degrees of mix in this spectrum are in constant flux in any Government.

Basic tenets of Democracy include free and fair elections, active participation of people, common rule of law; however, there are no specific definitions and boundaries to the use of this term.



Women's suffrage globally at ~ 1910





Hence, a summative order of change in Global governance history:

Empires – Republic – Communism/Democracy

They are not absolute concepts but the governance structure is usually more defined within each country and is different around the world. Moreover, various forms of governance coexist with different degrees of influence and parties in power. The parties representing the elected parliament have differing ideologies. As can be seen from Democracy related images, it is an evolving process with different degrees of uptake around the world.