ANCIENT AND CLASSIC WORLS

Until the 5-th Century

SUMMARY

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Ancient and Classical era: Important dates

25,000 BC	Human walks on two feet. Cave paintings.
15-10,000 BC	World warming from ice age. Domestication of animals.
10,000 BC	Spoken languages, agriculture
8,000 BC	Clay pots and other items (figurines)
3,500 BC	Writing scripts, applications of wheels.
3,000 BC	Giza pyramids, Stonehenge in England, Bronze age.
1,800 BC	Babylonian product tables
1,812 BC	Abraham born in Ur
1,792 BC	Hammurabi's laws in Babylon
1,312 BC	Israel exit from Egypt
1,272 BC	Joshua enters the biblical land of Cana 'an
1,200 BC	Processing of Iron tools
1,029 BC	King Saul
1,002 BC	King David
965 BC	King Salomon
732-3 BC	The Assyria exile of North Israel kingdom by Tiglath Pileser and Sargon
750 BC	Homer
547 BC	Thales in Small Asia
612 BC	Nineveh the Assyrian capital taken by the Babylonians
605 BC	Battle of Carchemish, Nebuchadnezzar of Babylon wins over Pharaoh Necho II
586-7 BC	The first temple in Jerusalem is destroyed by Nebuchadnezzar. Babylon exile.

522 BC	The Cyrus declaration. 512 BC rebuilding the temple. The Bible is “sealed”.
427 BC	Plato, Socrates student, and Aristo, his student, in Athens.
356-323 BC	Alexander of Macedonia (the Great)
312 BC	first aqueduct to Rome
260-100 BC	Chinese wall
250 BC	The bible is translated into Greek for the Alexandria library
167 BC	The Maccabee revolt against Antiochus
4 BC	Jesus
66 AC	Judea’s big revolt against the Romans. 70 AC Jerusalem destroyed by Titus
79 AC	Vesuvius eruption buries Pompeii and Herculaneum
300 AC	Christianity is the official Roman church
400 AC	“Chemistry” is termed in Alexandria
500 AC	Abacus
525 AC	Christian calendar year (Julian calendar)
600 AC	Block printing press in China
610 AC	Mohamed
623 AC	Jerusalem is taken by the Muslims
1096 AC	The beginning of crusades
1100 AC	Compass used in China
1250 AC	Feather pen
1492 AC	Discovery of America

Why are scientists researching nature ?

Sciences emerged from the struggle for existence, the developing awareness of the present, and the attempt to understand the past and predict the future to protect social groups and serve nutritional security. Science was first associated with priests and religious wisdom. It moved to practical knowledge and theoretical wisdom. Sciences covered both applications and philosophy, much like arts, and was most of the time supported by governing and religious authorities.

What are the questions asked by the natural scientists ?

The problems engaged by scientists in the ancient world are in essence similar to present days problems:

* The building of the universe–earth, stars, the sun and the moon; Astronomy, Geology. Animals and Plants–classification, foods, food preservation, diseases, death – Biology, Medicine.
* Materials and their purification-metals, colors, drugs – Chemistry.
* Mechanics, dynamics, statics, light, sound (music) – Physics
* Methods of computations, measurements, quantities presentation, costs and exchange rates for foods, clothes and other belongings – Mathematics, Geometry.
* Man in family, society, ethics, body & soul – Philosophy, Psychology, religion & belief
* The visual arts

Contributions of the scientific documentation:

Science started as a wisdom passed from teacher to student.

Writing was first used for emperors glorification and had administrative uses, and only later to document scientific knowledge. For example, Astronomical documentation accumulated for centuries and had agricultural and religious purpose.

Writing advanced quantitative mathematics and geometry, and provided publishing of yearly calendars.

Since scripts were hand written, knowledge accumulated in libraries, (were some copies and translations were done) and often summarized in encyclopedia.

Sciences in different ancient cultures

Mesopotamia – Assyrians and Babylonians developed agricultural technology, including irrigation channels. They used clay tablets to register contents of grain silos, astronomical diaries to indicate seeding times, calculations of quantities of clothing materials, weaving fabric from wool, linen and cotton. They constructed carts and ships for traffic and commerce (till India).
Hammurabi's law indicates an organized society.

The Hitties – from small Asia learned to process iron into swards. The Lydians were first to use money coins in Milatus.

The Persians – established the first empire in the 6-4 centuries BC with high level of political organization.

In Egypt – Agriculture depend on the Nile overflow. Measurements for Land surveys after overflow to recover field borders. Timing by the sun. Chemistry of gold, colors and drugs. Medications (often useless…) and ointments for curing skin diseases. Medicine linked to religious priests, but became highly professional and specialized according to disease classification and anatomical knowledge.

The Phoenician – invented the basis of Greek script, discovered glass, developed marine technologies (wood masters) and knew well the geography of the Mediterranean European and African coasts, the red sea, the Indian ocean and Atlantic Europe.

The Hebrew – had the first monotheistic religion. Advanced social laws, hygiene, balanced nutrition and agriculture (seed cycle and rest for the land every 7th year)

In Greece – Theoretical and logical sciences (philosophy). Laid the basis of Academic studies. Since knowledge was so well and systematically presented, classical science persisted through the middle ages despite many wrong theories that were not challenged.

~600 BC Pre-Socrates scientists from Small Asia and the Aegean islands, known from Aristo's quotations: Thales, Anaxagoras, Anaximenes, Anaximander
470-399 BC Xenophon, Plato, Socrates (who was sentenced to death for corrupting the Athenian youth), Aristo, Plato (social sciences).
~400 BC Hippocrates, the first medical school in Cos, Theophrastus (Aristo's student, studies medical plants)
~200 BC Herodotus, Polybius – geographers, map of the world. Practical chemistry – metals purification, clay pots, extraction of colors and drugs, precious stones.

3400 BC Gold 2900 BC Bronze 1500BC Iron

Indian sciences - (Harpan culture in the Hindus valley) – Agriculture, Cotton, Mathematics, Life philosophy, medications, metals, grammar of language.

Chinese sciences – Agricultural culture on the yellow river. Scripting, computations- both practical and riddles, chemistry of metals – weapons, ceramics, printing.

Central America – Olmec culture. Hieroglyphs, Astronomy for agriculture, calculations for trade and commerce.

Roman Empire – Strong in applications of science to building (roads, amphitheaters, temples) and war technologies (sails + multilevel paddle ships to be independent on winds in battle, metal ship front to break the opponent ships, catapults of heavy stones and fire bombs, torch arrows, charged arcs, ramps with wall-crumbling towers). Water projects (aqueducts, public toilets, city sewage enabling technologies for large cities), Soldiers medicine (fixation of bone fractures, ointments for wounds). Collection and documentation of classic science. Scientific language is Greek in all the Roman empire, facilitated spread of scientific knowledge.

Alexandria, the city established by Alexander the great, becomes world center of classical sciences: Euclid, Eratosthenes, Ptolemy, Hypatia.

Ptolemy I establishes the library with collections in Geometry, Algebra and Astronomy.

391 AC, ordered by Theodosius Caesar, Theophilus, the Patriarch of Alexandria, commands to burn the library as “pagane center”.

Byzantine, taking over from Rome, became a melting pot for a mixture of eastern and western cultures and sciences. After the library in Alexandria was burnt, translations of the scientific literature into Arabic remained the main source of classical knowledge. Some books survived secretly in monasteries during the middle ages, and translated from Greek and Arabic to Latin during the renaissance.

Although we find similarities between sciences in countries that did interact, there are also cultural differences affecting development of their scientific heritage. We do not really know if the American cultures had ever contacts with China or Europe, but even within the Americas or the Mediterranean basin cultural differences persisted, with ethnic anchorage to scientific evolution, causing different subjective ways that we understand the same nature around us.

Scripts of language and numbers, as well as mythologies and religions, display some basic similarities between nations that presumably evolved independently, yet they are “colored” differently by the cultural characteristics that also shaped the flavors of sciences: philosophical Greek, practical Babylon, rich Egypt, supervised Roman empire, etc.

Modern science is international, communicated by interactive community via open publications and conferences. Research is supported by states, companies and establishments. Yet, even today, science at different countries has different flavors. This is important, since scientists are no more believing in absolute” true” description of nature, but rather on a description that provide the best predictions and no contradictions to measurements. Alternative descriptions are therefore acceptable and enrich scientific innovation.

What did we learn from the history of ancient and classical sciences?

Scientific methods were established early: Presenting an hypothesis or a model, examine its compatibility with observations and logics, and predict experimental measurements. Various scientific schools emphasized differently theoretical logical argumentations (closer to pure truth…) versus experiments (with poor precision due to limits of measuring tools). Development of all branches of mathematics was necessary for quantitative description of nature, but soon also became an attractor to intellectual activity without obvious practical purpose.

Scientific ideas emerged from natural events observed systematically and cyclically (day-night, phases of the moon, motion of stars, seasons), as well as nature responses to launched activities (push an object, dissolve a salt, melt metals). They raise ideas about cause and effect and described by theories. Irregular events (sun eclipse, rainbow as well as diseases) were hard to explain and promoted metaphysics and godly intervention. Birth, aging and death brought about false models (e.g. homunculus, after death worlds) due to lack of research tools (e.g. microscope). Fossils of marine creatures found on high mountains raised ideas about geographic changes and the age of earth, and were found in unresolved conflict with religious dating. Diversity of compounds, their transmutations by fire, water and air, together with inaccurate weighting, gave birth to wrong chemical models including hopes to make gold from anything that had yellow flare... The lack of good measurements of time and velocity of falling bodies created wrong dynamic theories, that also wrong theories about the circular motion of stars. Confusion about vacuum and gases prevented understanding plant metabolism. Nevertheless, humanity developed good early perception of distance scales (“atoms” up to the distance to the sun), and time scales (seconds up to historical and theological times).

Most scientific discoveries are based on existing knowledge stimulated by observations. Similar discoveries were often made independently. We tend to attribute a discovery to one scientist, but always have to acknowledge the contribution of the background knowledge. The rate of advancement of science is roughly proportional to the amount of known science and its accessibility. Therefore documentation of sciences advances its progression. Incremental contributions of most scientists is intervened by geniuses, from Archimedes to Einstein, singularly advancing science.

Prevention of knowledge from people, or even destruction of scientific documents happened in history and associated with political and religious power struggles trying to control people by suppressing freedom of thought.

Developing of technology is necessary for advancement of science, and vice versa: To test and confirm scientific theories we need precise measurement technologies, accurate measurement tools as well as consistent scientific methodologies. And to develop technologies we need to understand laws of physics: measuring volume of liquids depend on calculation of the volumes of geometrical shapes. Evaluating the distance to stars depend on geometry and precise spherical angles measurements. Measuring short times e.g. with hourglass (sand watch) are related to long times (day, month, year and astronomical measurements) by calculation capabilities. Agriculture needed knowledge in botany (pollination of fruit trees, irrigation, fertilization, soil preservation, seeds cycle and selective improvement of grains).
Last, agricultural technologies made countries wealthy economically, motivated collective organized efforts in construction, commerce, food security, and processing of materials (wood, building stone, metals, including for military uses) . In turn these countries offered support for science development, being aware of its applications, but also for national prestige.

An example of extensive documentation of scientific knowledge:
Pliny's encyclopedia: "Naturalis Historia"

Galius Plinius Secundus 23-7 9 AD

Pliny the father died in the eruption of the volcanic Vesuvius which covered Pompey with ashes.

The areas covered by Pliny's encyclopedia:

Mathematical and physical description of the world, the elements (chemistry),
States, nations, sees and oceans, cities, the sky, mountains (Geography and ethnography)
Anthropology and physiology of humans
Zoology of animals, fish, birds, insects.
Botany - fruit trees, forests, cultivated trees, ointments and creams from exotic trees, fruits, grains, wheat, garden plants, flowers, fruits, (agriculture).
Forest products, medical plants, extraction of drugs (pharmacology).
Produce from land live and see life.
Metals, colors, mines, precious stones, mineralogy. Sculpturing in bronze and marble.

What is missing?

Geometry, mathematics, science philosophy − was not considered applied sciences
Mechanics, application to war machines (catapults) and shipping − may have considered engineering and separated from sciences.
Road architecture, aqueducts, civil engineering design (buildings, villas, public centers, temples, amphitheaters, cities) − may have not considered important, although this was a major achievement of the Romans.

The volume titles:

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