HSS 102
History of Science
Lecture II

What Science?

What Science?

- A Working Understanding to Begin With: Science to be recognized as simultaneously a body of knowledge about nature (the Latin word ‘Scientia’ means knowledge) and a process of acquiring that knowledge.
- The primary focus of the course (as discussed) will be on the empirical rather than on the theoretical processes.
- It is our contention that science developed through trial and error procedures>science cannot get rid of its artisanal traces.
- Privileging hands over the brain and look at the hand-brain coordination that changed the world.
- The Indian case: Why did the hand-brain coordination happen seldom?

The Theoretical/Empirical Hierarchy: How can we think of science in an inclusive way?

- Benjamin Farrington (‘Science in Antiquity’):

In its origin science is not in fact so divorced from practical ends as histories have sometimes made out. Textbooks, right from the Greek times, have tended to obscure the empirical element in the growth of knowledge by their ambition of presenting their subjects in a logical orderly way…Behind Euclid’s definition of a straight line as ‘one that lies evenly between the points on it’ one divines the mason with his level.

- The emergence of Physics as the standard for doing science and its Problems

Science, Technology, Need: Does the Context Matter?

- Is technology just ‘applied science’, a derivative? > ‘The beginning of science was not the *word* but the *deed*’.
- The science/technology relation is ‘one of cumulative mutual reinforcement with the initial impulses coming from the technology side’.
- ‘The craft first uncovered the aspects of nature upon which philosophies were based’. Example: Navigation and its connection with hydrography, oceanography, meteorology, geology, cartography, astronomy, etc.
- Theory began to take lead in scientific discoveries only with the Second World War.

Conversations between Social Necessities, Science and Technology

- Three Major Areas of Transformation between 15th and 18th century
- 1) Transport: New water-ways, vessel as the dominant instrument of long-distance communication
- 2) Mining, Industry: Gold rush in a robustly exchange-driven economy, iron rush and copper rush due to the emergence of firearms and artillery driven warfare>enormous progress in metallurgy
- 3) Warfare

Transport [generated from Hessen 1932]

New Tasks/Puzzles	Identification of the Underlying Physical Problems	Physical Themes/Individuals Representing the Era
Tonnage capacity and the speed of the vessels to be increased	Hydrostatics: laws governing bodies floating in fluids. The estimate of tonnage capacity depends on the vessels' water displacement	
Vessels' buoyancy to be increased	Hydrodynamics: Laws governing the motions of bodies in fluid	Kepler, 1609, Galileo, 1609-16, Robert Hook, 1670s
Position of the vessels in the sea: latitude, longitude, magnetic deviations, times of tide	Celestial Mechanics: Observation of heavenly bodies>optical instruments, chart of the motion of heavenly bodies. Anomalies in the motion of the Moon>theory of gravitation	
Sea routes needed to be connected to inside waterways: canal mania		Stevin, 1598: water could exert pressure on the bottom of the vessel greater than its weight. Torricelli, 1646: theory of efflux of fluids

Mining, Industry and Warfare [generated from Hessen 1932]

New Tasks/Puzzles	Identification of the Underlying Physical Problems	Themes/Individual Representing the Era
Ore to be extracted from depths	Lifting>designing windlasses and blocks, mechanical machines	
Ventilation to be ensured underground through blast-engines	Aerostatics as a part of statics,	
Water to be pumped and drained from mines	Piston pumps>research on hydro and aerostatics	Torricelli and Pascal>problems of raising liquids in tubes and of atmospheric pressure
From damp-blast method to blast-furnace (16th c)	Large blast-furnaces with water-wheels, bellows, rolling machines, heavy hammers>understanding the motion of air and air compression.	The problem of simple machines, inclined planes, general problem of statics> da Vinci (late 15th c), Cardano (mid 16th c), Stevin, 1587, Galileo (1589-1609)
Processing of the ores by the aid of rolling and cutting machinery		

Warfare [generated from Hessen 1932]

New Tasks/Puzzles	Identification of the Underlying Physical Problems	Themes/Individual Representing the Era
Improvement of firearms>lighter, accurate, long range, improving the trajectories of the projectile through the air and vacuum, deviations, air resistance upon speed of the projectile, etc.	Essential was to know the laws of compression and expansion of gases>mechanics and recoil (law of action and reaction) and also the problem of gravity to a great extent	Free fall of bodies and trajectory of projectile> Galileo (1589-1609), Grassendi (1649).
The stability of firearms with minimum weight.	The study of the resistance of material and their durability (also relevant for the booming construction industry)> Galileo spent years to study these phenomena.	

Next Class

What History?