SCIENCE AND HISTORICAL GEOLOGY

a1 Science and common sense < Ussher, Newton, epistemology >

> *Quaecumque ab Aristotele dicta sunt, commentitia sunt* (Everything that Aristotle said is false) is the thesis Petrus Ramus (1515-1572) defended for his M.A. at the University of Paris in 1536.[12]

> If there is any science that I am capable of promoting, I think it is the science of science itself, the science of investigation, or method. —John Stuart Mill (1866-1873) [13]

> The world is a flat plate, you say, resting on the back of an elephant that stands on the back of a turtle. What then does the turtle stand on? Ah! Its turtles all the way down.[14]

Science means knowledge. It is the cornerstone of our industrialized world. Science allows us to replace assumptions, wherever possible, with verifiable truth.

The world is round; not flat. Australians are in no danger in dropping off the world. We are on the top of the world. They, because of chauvinism, are thought of as down under. Recorded Western exploration started from centers of civilization in the northern hemisphere.[15]

In our solar system, one star, Sun, shines. Our planet, Earth, rotates on its axis. Thus, day and night follow upon each other. Sun neither rises nor sets, although without thinking we still say this is so. Sun's apparent motion across the sky is because Earth rotates. Earth also revolves, once a year, in an almost circular orbit. The slightly varying Earth-Sun distance cannot account for the seasons. Earth's rotational axis is tilted towards the plane of its orbit. This accounts for the seasons.

Earth's surface is flexed by tides and is deformed by internal forces. Its orbit is perturbed, in a complex way, by other heavenly bodies. The solar system orbits far from the center of the Milky Way which is speeding through space relative to other galaxies.[16]

Our present common-sense world view is distanced from primal awareness by many scientific revolutions.[17]

The universe is enormous. Archbishop James Ussher (***Figure a1.1***) upon learning this (after 1610 when Galileo published *Sidereus Nuncius* or "Sidereal Messenger")[18] from Keplerian astronomers' understanding of solar system distances and that celestial stars are so far away that they show no parallax even against those brought into view telescopically, recovered his equanimity and purpose by stating: "Be the universe as vast as you say, and be it not populated, what a waste of space. But, be it populated, what scope for human folly!"[19]

At the other extreme, beginning with Francesco Stelluti's low-power microscope, were depictions of never-before clearly seen sting of a bee in his *Melissographia* dedicated to Pope Urban VIII in 1625 and, half a century later, the surprise revelation by Leeuwenhoek (***Figure a1.2***) of the populous world of microscopic life.[20]

We can perceive speed but cannot feel it. This reality was evidently not apparent to the philosophers of ancient Greece. The distinction is first explicitly made by Galileo in *Two New Sciences,*1638.[21] His experimental science liberated the mind from the thrall of Aristotelian metaphysics and the numbing strictures of orthodoxy. We can feel acceleration (and thrill to the jerk, which is a change in acceleration). Given this observational information, Newton (***Figure a1.3***) in 1687 was able to revolutionize comprehension of planetary motion by publishing *Principia*. In 1704, his *Opticks* extended the existing understanding of color and light, provided exemplars of good scientific experimentation methods,[22] and revealed his fluxional calculus (pupated since ca. 1668).[23]

Ontology enquires: What objects exist in the world and what statements about these objects are true?[24] *Epistemology* is the study that looks to justify our knowledge and so recognize what part of it is delusion.[25] We need not delay. Present science, being successful, is its own justification.

The origin of rocks can now be explained. Fossils can be understood to be evidences of prehistoric life. ❑

Figure a1.2 **Antoni van Leeuwenhoek** (1632-1723) His single lens microscopes with magnification powers of up to 270 enabled him to peer at algae, protozoa, and rotifera,

> "The motion of most of them in the water was so swift, and so various, upwards, downwards, and roundabout, that I admit I could not but wonder at it. I judge that some of these little creatures were above a thousand times smaller than the smallest ones which I have hitherto seen on the rind of cheese, wheaten flour, mold and the like,"

and, in his pepper-water purge results, at bacteria,

> "Some of these are so exceedingly small that millions of millions might be contained in a single drop of water. I was much surprized at this wonderful spectacle, having never seen any living creature comparable to those for smallness; nor could I indeed imagine that nature had afforded instances of so exceedingly minute animal proportions." [26]

Robert Hooke (1635-1703) who received this historic communication as Secretary for the Royal Society (UK) in 1676, dryly noted that Leeuwenhoek had found "a vast number of small animals in his Excrements which were most abounding when he was troubled with a Loosenesse and very few or none when he was well."[27]

Figure a1.3 **Isaac Newton** (1642-1727)

"I do not know what I appear to the world; but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."[28]

To Hooke, February 5, 1676, Newton wrote "What Des-Cartes did was a good step. You have added much several ways, & especially in taking ye colours of thin plates into philosophical consideration." And famously, as a veiled put-down aping Robert Burton's (1577-1640) aphorism in *The Anatomy of Melancholy*, 1621: "If I have seen further it is by standing on ye shoulders of Giants."[29]

Newton had begun to develop his laws of motion as early as 1664 but was spurred to publish *Principia* in 1687 overtly to demonstrate to his friend Edmond Halley (of Comet fame) his priority in describing gravity as a force that kept planets in their orbits.

Newton's fascination with alchemy (he had returned in 1668 to Cambridge to study it but had soon become distracted by the brighter pebble of mathematics) and his friendship with alchemist Robert Boyle (1627-1691) could have been his downfall. "Red is last in the work of Alkimy" (said Norton of Bristol in the fifteenth century) to transform base metals such as lead into gold and also to prolong and sustain life. That all metals were mixtures of especially pure forms of sulfur and mercury was information promulgated by Islamic alchemists of the eighth and ninth centuries. But what was this mythical stone, sometimes called "the Red King"? For making it, one had to guide the raw ingredients through a series of color changes ending in red. Medieval alchemists' recipes included the precious pigment known as vermilion (a synthetic compound of sulfur and mercury and probably first made by ancient Chinese alchemists) and the mineral cinnabar (mercury sulfide). Philip Ball writes:

> The Anglo-Irish chemist Robert Boyle was an avid alchemist who, shortly before his death, found a way to produce what he believed was a rudimentary form of the stone; this 'red earth' probably contained mercury. Isaac Newton obtained some of Boyle's mysterious red powder and experimented on it. Shortly afterward, Newton had some kind of mental breakdown. His sickness may have been caused by mercury poisoning: high levels of this toxic metal were found in preserved samples of Newton's hair.[30]