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## In Search of Truth

The word science is derived from *Scientia*, which means knowledge in Latin. As knowledge is desired by all human beings, one would have expected science to be universally popular. Unfortunately, this is not the case because science has often undermined established beliefs, and therefore run into conflict with the orthodox elements of the society.

It is not possible to give credit to any single country for starting the scientific revolution, but the Greeks were probably the earliest contributors to scientific thought. The ancient Greeks had built a beautiful world of myths and legends, which explained virtually everything encountered by man. There were numerous gods, and they had to be continuously appeased, with prayers, incantations and sacrifice. But with the passage of time, philosophers arose, who started to express doubts about the validity of the ancient Greek beliefs. These doubters could be regarded as the earliest amongst the scientists: as without doubt, there is no questioning, and without questioning, there is no science. However, the doubters had a heavy price to pay, and the trial of Socrates is an example of this.

In his famous trial, Socrates (469–399 BCE), was charged with impiety and corrupting of the youth. Socrates took his stand upon the abstract principles of his philosophy, according to which wisdom consists in knowing how little we know, and that the world can best be served by truth and virtue, through knowledge. As the trial

went on, it became obvious that there was no desire on the part of the Athenians to impose the death sentence on Socrates, if he apologized or voluntarily left Athens. But Socrates did neither, and accepted the death sentence by drinking Hemlock, (a plant poison from the genus *Conium*). The death of this great man did not end the search for truth in Greece. Many great philosophers followed him, and eventually, it was the Greek philosophy which destroyed the myths and legends of the Greek religion. The Hippocratic School emerged, which did not look for divine influence in the causation of disease, but attributed it to environmental pollution and bad nutrition. This was the first secular concept of disease, which forms the basis of modern medicine.

Another conflict between science and religious orthodoxy occurred, when Copernicus published his book, *On the Revolution of Celestial Spheres*, in 1543. The Church banned it, as it proposed the Heliocentric or sun-centered concept of the solar system, whilst the church believed in the Geocentric or the earth-centered concept. Anyone who opposed the Church was severely punished; for example, in 1600, Bruno was burnt on the stake in Rome. In 1620, Vanini, who called himself a naturalist, was burnt on the stake in Toulouse. In 1621, Fountainier met a similar fate in Paris.

In 1663 followed the famous trial of Galileo because of his support and approval of the Copernican theory. For this he was brought before the inquisition, which pronounced him guilty of heresy and offered him absolution on condition of full abjuration. Unlike Socrates, Galileo submitted. He was asked to repudiate his belief that the earth goes around the sun, by declaring on his bended knee, that, “with sincere heart and unfeigned faith, I abjure, curse and detest the said error and heresy, contrary to the holy church, and I swear that I will never in future say or assert anything which may give rise to a similar suspicion...” Galileo was sentenced to house arrest for life and died a broken man in 1642. In 1992, the Holy See published an apology for the suffering inflicted on Galileo by the Church. This was a noble and a highly overdue gesture.

Galileo and Copernicus demonstrated a very important scientific concept, that our senses cannot always be relied upon to give correct

information. The “rising” and “setting” of the sun is an illusion caused by the rotation of the earth. Neither do stars in the sky mysteriously “appear” during the night and “disappear” during the day. Similarly, the sky is not a solid dome, as the ancients believed, but an illusion, due to the absorption of light by the earth’s gaseous atmosphere.

A major milestone of science was reached in the year 1859, when Charles Darwin published his famous book, *On the Origin of Species*. It hit the world like a bombshell, and again evoked a severe reaction from the Church. But the world had changed, and the Church was no longer as powerful as in Galileo’s time. Darwin’s ideas could not be suppressed. Evolution became a favorite topic of discussion all over the world. The “Darwinian revolution”, as it was called, brought about a wholesale change even in the cultural values of the society. Humans were firmly established as members of the animal kingdom, and subject to all the natural laws under which life exists.

In principle, there is no absolute certainty in science. Science continually grows, expands and changes, in an effort to better understand the working of nature. It is not partial to any individual or doctrine. Its impartiality is its strength and although sometimes perceived as anti-religious, it is not. However, it does take issue with incorrect and misleading ideas and regards it as its duty to challenge and disprove them.

The process of scientific enquiry starts with a hypothesis and is followed by a theory which may be accepted on the basis of evidence, or rejected because of the lack of evidence. This too is not final, and a theory which was accepted in the past, may be rejected in the future. In other words, theories are always tentative, and there is in fact a premium for change, with readiness to replace one theory with another. To a non-scientist this is inconsistency, but to a scientist this is the very basis of its success.

In science, well established ideas sometimes get categorized as “laws”. To reach the status of a “law”, they should be able to withstand numerous exams and tests. But even the so-called “laws”, are not as timeless as Homer’s poetry or Beethoven’s music! The

validity of the “law” is similar to the legal metaphor — “beyond any reasonable doubt”. In practice, this approach works very well.

Scientific knowledge, from the moment it is created, belongs to, or should belong to, all of humanity. It is the fruit of human history and the collective effort of scientists, from all over the world. Justice and fairness should be practiced in the dissemination of scientific information. Unfortunately, national interests sometimes prevent this from happening, especially if the information is of military significance.

With the passage of time, science has become highly specialized. Scientific research is, therefore, mostly a team work. Hardly any major discoveries are published nowadays under a single authorship. This holistic approach is mainly responsible for innovation in science. Scientific fraternity is by and large a friendly one and international co-operation continued even during the cold war years between the USSR and the West. One hopes that this tendency will grow, as is being witnessed in the construction of the space station, and the proposed exploration of the solar system by Russia, the USA, Japan and other European nations.

Science flourishes in an atmosphere of intellectual freedom, where asking questions, and expressing views, carries no penalties. In societies where such freedom does not exist, science suffers and the societies remain backward.

Scientific research has been artificially divided into basic and applied. Amongst the industrial nations, Japan concentrated mainly on applied research, mostly to satisfy its consumer oriented industry. As a result, it has one of the largest number of industrial patents but relatively few Nobel Prize winners. Traditionally, pure or basic research has been done mostly in the universities. That this kind of research can ultimately turn out to be of practical value should not be underestimated.

Where do the radically new scientific ideas come from? Nobody knows, because we don't understand how the brain creates ideas. But why should they be any different from the inspiration that produces the great works of art or poetry? One can call it intuitive knowledge. For the religious minded, it becomes “divine inspiration”, as Sir Ronald Ross, after discovering the mosquito as

a vector of malaria, wrote:

“This day relenting God  
Hath placed in my hand  
A wondrous thing...”

The structure of the Benzene ring came to Kekulé, a German chemist, in a dream of a snake chasing its own tail. So Kekulé wrote, “Let us learn to dream, gentlemen, then perhaps we may find the truth... but let us beware of publishing our dreams, before they have been put to the proof of the waking understanding”.

### **The Steps used in Scientific Research**

