27. Birds Eye View of Science Communication

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Abstract. History of science is the story of mans progress in understanding the world around him in gaining control over the forces of nature. Right from the ancient scientists in dawn of recorded history, we try to bring the history of science from pre historic age to today's race for space, information technology and nano-science.

Keywords: History, Science, Development, Discovery, Communicate

Introduction

One of the most important contribution in mans progress has been perfecting the communication system by which a constant inter change of knowledge is brought about. The early men were able to communicate with one another only through the use of signs. Then came the development of language and writing, by means of which men could express an infinite variety of concepts and also transfer them from one generation to the next. The centuries that followed, saw the rise of other forms of communication ,printing, type writing, photography, telegraph, telephone, sound recording devices, radio, television, radar, facsimile transmission, micro filming , internet, mobile communication and so on.

Science is not always contained merely to learn about the world, and its application to industry (technology) it is greatly concerned with modifying it as far as possible. We shall never know when this never ending task began. The word science which we use today is a comparatively new word in the English language. Man's greatest scientific discovery, the use of fire dates back to pre-historic time. Importance of writing in the development of every other branch of knowledge can never be ruled out.

Science communication is a discipline that has very rapidly developed in theory and practice since 1995. A good communication between science and society leads to the development of scientific culture which can be utilized to solve global, regional, physical and social problems. Good science communication can help in the economic, cultural and social progress and overall well being of the global society.

Bird's Eye View of Science Communication

Ancient science

We can date back man's greatest scientific discovery, the use of fire and use of language to communicate to pre historic period. In this period man learnt to make some tools, which enabled him to survive and win mastery over other creatures. From the dawn of history, sun-the source of heat and light for earth has been worshipped as God. The movement of heavenly bodies like sun and moon may be recorded as the earlier scientific observations. The early observers impressed by the regularity with which they swept the sky and earlier calendars were based on the movement of moon. 4236 BC may be recorded as the earliest fixed date when first lunar calendar was developed. Later on for more accurate calendar were developed based on rising star called Dog Star. We can say that science of observation started with priests who can be called Priest-Scientists. These priests' scientists were anonymous. Both, Egyptian and Babylonian developed number system.

As the time progressed, the Egyptian architect-Physician 'Imhotep" designed the step pyramid in 2980 BC. His contemporaries had knowledge about medicine and surgery, the EDWIN SMITH SURGICAL PAPYRUS is the oldest scientific document written on papyrus and rolled up in the form of a scroll. 450 BC Hippocrates is known as father of medicine. Among primitive people medicine, magic and religion all went together. Babylonian had knowledge of Botany as well because they were familiar with date palm. Ancient Hebrew was more eager to know the relation between man and god rather than man and surroundings.

Early Greek thinkers were keen to find what the world is made of? To early Greek thinkers what we call today science was only a part of philosophy. It is only embracing search for wisdom. It was a religious cult philosophical school and a political movement. Pythagorean brotherhood was one of the most important groups that influenced the development of science in Greece. Pythagoras was founder of this group. He travelled widely. He set up a philosophical school whose members were bound by a vow to follow religious rites prescribed by which it remained powerful till 450BC. Pythagoras Theorem still appears in the geometry textbooks all over the world. Plato has been impressed by the Pythagorean belief in the importance of mathematics as the key for understanding the universe.

In fourth century BC, Greek philosophy reached its peak with Plato, Aristotle and their followers. Their ideas and metaphysics and ethics influenced the development of science. Socrates, 399BC was the creator of scientific method: inquiry, dielectric and conclusions. Plato, 347BC was one of the accomplished mathematician and a philosopher. He introduced logic into study of mathematics and made the way for Euclid in the next century. Aristotle was the student of Plato, he introduced the concept of diagrams, reviewed and criticised the previous knowledge and gave his own observations and opinions. Aristotle's work on biology in which he described life and breeding habits of 540 species of animals is very close to modern scientific method.

Aristotle reigned as supreme in the scientific matter even up to two thousand years after his death. The errors of Aristotle in physics and in astro physics held up the scientific progress till seventeenth century. Newton demonstrated that forces operating between heavenly bodies and that which makes the apple fall on ground are same.

Middle age science

From seventh century Islam religion founded by Prophet Mohammad played a great role in transmitting knowledge. Followers of Prophet spread their master's knowledge, by ninth century Arabs become the standard bears of scientific knowledge. It lasted from 900-1100 AD. The number system which we use today, Hindu-Arabic system derived from Al-Kwarizmi (ninth century) from Hindu mathematician of India. It originated with the Hindus and was carried to the western world by the Arabs. It fits into the most of our commercial and technical needs very well. Hindus also introduced the concept of negative numbers. Persian born physician Rhazes classified substances as animals, vegetables and minerals, a classification which still prevails in day to day dialogue. He was the first person to distinguish between small pox and measles.

One of the great Arab physicists Alhazen, his main contribution was the treasury of Optics, he worked out laws of reflection, atmospheric refraction, theory of vision. Eminent physician Avicenna was the author of Canon of Medicine, its translation became the famous text book for Western Europe for several centuries.

By the end of twelfth century, translations in Latin were available to European scholars. Greek work was translated into Arabic and Arabic into Latin. In the middle age advancements in pure sciences were comparatively insignificant but application of science to industry started developing. Glass making, iron foundries, paper making, printing press, marines/compasses, gun powder to be used in warfare. There was some of the outstanding industrial development. The first complete book printed from movable type of printing press was an edition of bible known as Gutenberg Bible 1455 AD. The importance of printing press in Science communication is to involve masses in scientific culture, to create an awareness of technological revolution which 20th century had witnessed and an attempt to achieve 'need to know" type of awareness.

In the Middle Age Science was linked to traditions. The ninth and tenth century it was predicted that the year 1000AD would mark the end of the world, but the calamity did not arrive. By the end of twelfth century the language barrier has been crossed, and Greek and Arabian scientific work has been translated to Latin. West came in contact with east, their literature, philosophy, science, architecture, art and industry. The growing thirst for learning resulted in setting up of universities and cathedral schools which were influenced by religion. The incorrect scientific views were hardly challenged. Aristotle, Ptolemy and physicians were supreme authorities. This view point was entirely hostile to spirit of free investigation.

In the thirteenth century, Robert Brown (1214-94) challenged the restriction for free investigation. He developed the science of experimentation. He was the first to suggest the use of lens for spectacles. But he is today remembered more popularly for the invention of gun powder. He was ahead of his age, he predicted horseless carriages, ships with sail, flying machines, and machines to lift weights, and fortunately we are using all these things today.

Progress in science comes from communication and criticism of ideas and theories. In the seventeenth century for scientists and philosopher's income and support came from other sources, they had to struggle hard to communicate with each other .This lead to development of scientific societies. Probably the earliest scientific society Secretornm Naturae, founded in Naples in1560 but it was abandoned for the fear of magic and black art. Another Italian academy was founded in Rome in 1603 Accademia dei Lincci. This was more respectable and its modern version still exists today. These invisible colleges were more in number in England during seventeenth century. Robert Boyle was a regular user of it at the one at oxford. These invisible colleges had no building, no faculty, no students, no resources and no regular funding. They were informal association of brilliant men anxious to share and compare thoughts, ideas and observations. The humble beginnings of invisible colleges led to the development of Britain's famous Royal Society in about 1645. This society flourishes today also. In March 1665, the society began the publication called The Philosophical Transaction of the Royal Society. This and the French JOURNAL DES SAVANTS are one of the few oldest journals published. With the founding of Royal society the science became fashionable, many rich noble men,

dressed up well, attended the theatre to watch a 'show'. They observed the spectacular experiments in each weekly meeting. Royal Society focussed on experimental demonstrations [9]. The evolution of scientific societies had the most beneficial effect on the process of careful observation and experimentation, acute criticism of contemporary scientists had to be faced. They learnt the advantages of selfless cooperation among each other to find out the scientific truth.

New age science

The period of 1660AD to 1700 AD may be called the classical period of microscopy. The achievements made were unsurpassed up to nineteenth century. In 1672 Newton reported to Royal Society his findings on which he was already working and an Era of Newton began. Newton's Principia was published in Latin. In 1669 he was also elected as one of the eight foreign members of French Academy of Science. In his later years of life, he had a quarrel with noted mathematician Leibnitz over calculus, but Leibnitz method of writing was better so it has been adopted. Newton system of universe remained uncontested for more than two hundred years.

One of the Newton good friend and learned disciple, astronomer and mathematician Edmund Halley is best remembered for the accurate prediction in 1704 of Halley planet which bears his name. Halley's' chief contribution was the "estimate of the degree of mortality of mankind" which laid the foundation of life insurance business, life tables were drawn. His wife was devoted to him but was complaining against him for dissipating family fortune in useless scientific experiments, expedition and publication. He also intended to publish Newton's Principia with his own expense.

The period of 1765 -1815 may be called as age of chemistry; Lavoiset has been called the Father of Chemistry. He published Elementary Treatise of Chemistry, and Methods of Chemical Nomenclature. He and Joseph Priestly were sympathetic towards French Revolution. Joseph Priestly's one of the discovers of oxygen published in History and Present State of electricity. Henry Cavendish performed great many electrical experiments but did not publish them; he thought them to be not as per his high standards. His laboratories notes were published by James clerk Maxwell in 1879. French military engineer Charles Augustine Coulomb made significant contribution in electricity.

Last of eighteenth century was the age of American and French revolution and Industrial revolution, that is substitution of machines for hands that led to mass production and factory setups. Scientific thinking was employed for solving industrial problems

The period of 1800-1900 saw a group of Britain scientists Faraday, Maxwell and Hertz and other making unifying generalization intimate connection between light, electricity and magnetism. Twentieth century enjoyed the fruits of discovery that light heat and radio waves are EM waves in the field of radio, TV, radar, mobiles etc. Concept of Ether was introduced and Maxwell's electromagnetic theory of light was based upon this hypothetical medium called Ether.

Law of conservation of energy is one of the great contributions of nineteenth century to the development of science. Up to nineteenth century a rigid distinction was made between matter and energy but the twentieth century scientist has demonstrated that matter and energy can be transferred into each other, and the era of atomic energy and atomic bomb began. Bombing of Hiroshima and Nagasaki in World War II has led to era sins and sorrows produced by science and technology. Achievements of the science dominated the twentieth century with the start of a debate whether science is our master or slave. The decade from 1895-1905 is often called a miracle decade. The scientific developments of this period were the culmination of centuries of thought. Brief mention of this discoveries and invention is given for physical sciences: aeroplane, astro-physics, electronics, atomic physics, radio activity, relativity, x ray tube and vacuum tube. Biological science: biometrics, bacteria, microscope, virus.

The miracle decade witnessed the establishment of philanthropic foundations like Carnegie foundation, industrial research laboratories. Nobel prizes in medicine, chemistry, physics and physiology were established and were first awarded in 1901, this had a powerful effect on scientific achievements. Just before the miracle decade, scientific and industrial progress to have come to stand still.

In 1905 a clerk in Swiss patent office, Albert Einstein published a paper on '"Special theory of Relativity" and higher physics was born. The most remarkable team of husband and wife is of Pierre Curie (1859-1906) and Marie Curie (1867-1934) for the discovery of radium; they received Nobel Prize in 1903 along with Becquerel on radioactivity. Marie Curie received another Nobel Prize in1911 on her work on radium. She died in1934 of pernicious anaemia. She was the eventual victim of the radioactive bodies she and her husband had discovered. This proved how dangerous these radioactive substances are when they are not shielded.

Role of Science and Technology in World War I and II

Before World War I 1914-18, the education of military men always was to teach them how to fight the last war over again and not how to fight the next one. Their education material was a three volume treatise by Karl von Clausewitz on war which was based on Napoleonic times. But the advances in science and technology applied to ordnance, explosives communication and transportation caused the old ideas to be fearfully outdated. The use of submarines had upset the cherished tradition of war. All explosive contained nitrogen. The new process, known as Haber's process to provide nitrogen in usable form was discovered. Chemists played an important role n chemical warfare by using dreadful poison gas.

The World War II represented the triumph of applied science, technology, engineering and industrial know-how and an age of atomic weapons with atomic bombs began. It was a scientist war and more particularly a physicist's war. In World War II the victory fell not on the side of strongest battalions but on the side of best scientist and engineers. Atomic bomb cut the war short and saved millions of causalities but it did not win the war. Scientist worked ceaselessly to perfect offense and defence warfare, their efforts bore fruits in the form of super tanks, magnetic mines, jet and rocket bombs, radars sea crafts, submarines snorkels etc.

In the United States scientist were organised under a government agency OSRD Office of Scientific Research and Development it was a part of War Production Board. Other nations too organised their scientists for war, the British established Scientific Advisory Committee to the British War cabinet, and Canada established National Research Council, the efforts of scientists and engineers transformed into war machines and weapons. War production became the biggest business with special emphasis on crucial war material like steel, aluminium, rubber and petroleum . World War II took millions of lives but it also taught men how to save lives , DDT, insect killing chemicals, antibiotics and penicillin developed in the war proved to be effective against malaria and typhus fever. An expected outcome of World War II was population explosion throughout the world. The techniques of preventing medicine such as spraying on DDT and Inoculation against communicable diseases and anti malarial drugs were also the cause of population explosion. Now the big question of producing more food for more population arose. And science of agriculture was developed to solve World food problem.

Perils of Atomic Age

It is often said that atomic age began in 1945 when atomic explosions took place in Hiroshima and Nagasaki in August 1945. The public at large came to realise how harmful these radiations are. Before this only a small number of scientists and technicians were particularly concerned about radiation hazards. The deadly radiation emitted by the atomic bomb proved fatal immediately for thousands of people. As weeks passed by thousands of in habitants of Hiroshima and Nagasaki sickened and many of them died, they were victims of atomic bomb disease. After more than a decade of dropping of the bomb, people showed delayed symptoms of radiation damage penetrating radiation had become a problem that concerned not only few but the all mankind. The atomic bomb was the chief peril that confronted man in the atomic age. International commission on radiological protection has been set up to recommend safe exposure limits for professional people working with radiations. Roentgen is the unit. The people who received less than 100 roentgens of radiation were not sickened by exposure. This is a rough yardstick for estimating how many people will survive in future war after an atomic attack. The wisp of the bomb cloud that formed over Hiroshima after the explosion on 6th August 1945 floated around the world and were detected over the United States also.

After the atomic bomb explodes there are three types of fallout: local, troposphere and Stratospheric. Local fallout occurs within hours after the blast and comes to Earth within i distance of several hundred miles from the bomb site. Troposphere fallout has a wider distribution, it may take place over a period of several weeks, radioactive fragments travel thousands of miles. Stratospheric fallout occurs, the radioactive particles push into the stratosphere above the Earth surface and the fragments remain suspended for very long periods of time and fall to earth very gradually, this fallout is global in extent.

Uncertainty in Science

Science in nineteenth century appeared to be materialistic; scientists had cast of ties with philosophy. In the twentieth century the situation changed with Einstein's epoch making theory of relativity followed by the principle of uncertainty. Modern science does not speak with certainty. Its tone has become tentative, relative and uncertain. The field of higher physics was born. Physicists have to believe in impossible, invisible and uncertain. They had to perform hypothetical experiments and philosophical enquiry to solve the scientific problems. The serious problems of uncertainty in science were highlighted by German physicist Werner Heisenberg in the form of uncertainty principle.

We have come to realise the true limitations of science and have led us to the question: what is the Absolute Truth?

Control of electrons, the invisible negatively charged particles led to the development of electronics which revolutionised our livings in every corner of the world. The journey started with the electronic tubes followed by transistors, LSI, VLSI etc. Invention of transistor earned the Nobel Prize in physics in 1956 for Bardeen, Brattain and their co-workers. During first half of the 20th century, electronic circuits used large, power hungry and unreliable vacuum tubes. In 1947 John Bardeen and Wharton Brattain built first junction point contact transistor. Frank Wanless described the first logic gates using mosfets in 1963. The Gaudin Moore observed in 1965 that plotting of the number of transistors that can be most easily fabricated on a chip. The incredible growth of electronics has come from miniaturisation of transistors and improvement in the manufacturing processes. As transistors become smaller, they become faster, dissipate less power and are cheaper to manufacture. This synergy has revolutionised not only electronics but also society at large. The twenty-first century is going to be the decade of nano technology.

Purpose of this paper is to highlight for the twenty first century living beings that they should not forget how differently people live before they learnt how to harness the power and set the forces of nature to work. Quest for knowledge and history of science shall continue to remain fundamental human right for any individual born on this planet. There should not be any racial, regional, social, cultural, language barriers. Moral and ethical values should centre on humanity. Burning issues like global warming, it is not bound by any regional, cultural or social barrier. It is bond to affect whites and blacks, rich and poor. This is not a regional or national issue, but this has been a universal issue. If all the countries of the world continue to release green house gases this will lead to permanent changes and the whole planet would be affected.

Action plan 2010 science for all

1. Promoting scientific temperament in the poorest of the poor in the developing nations.
2. Promoting and nurturing women in science popularization.
3. Science for sustainable development and formulate planes to tackle some of the large problems which the world is facing today.
4. Contributions made by science to the world economy in the areas of electronics, nano-materials, computer and IT and health are ongoing and need to be appreciated. Many contributions have benefited people in developed nation more than those in the developing nations.
5. Science popularising should focus on energy and environment, health and economic development.
6. Develop and formulate an action plan for future, initiate new mechanisms of cooperation to carry out the action plan.
7. Knowledge should be free and accessible to all without copyright.
8. Storytelling and puppet shows to impart scientific knowledge to the illiterate.
9. Screen interactive CDs on environment space universe ecology etc.
10. Organise science and book exhibitions.
11. Use over head projector and slide shows to promote kitchen gardening, horticulture, fish production, organic farming bee keeping, solar cooking, water shed models to rural poor.
12. Create awareness amongst rural poor students about eradication HIV /AIDS , smoking
13. Retired scientists, teachers, professors and executives from MNCs may be invited to share their thoughts, feeling and their life journey, success and failure stories among generations.
14. Media persons to be encouraged and provided some subsidy to produce films on renowned scientists like Aristotle, Pythagoras, Einstein, and Newton etc.
15. Street play and songs, public movies, may be used to create awareness on public hygiene, sanitation, rain water harvesting, disaster management.
16. Awareness camps for removal of superstitious beliefs.
17. Industry –institute interaction as a part of science education curriculum.
18. Scientific knowledge should reach the poorest of the poor in the remotest corner of the world.
19. Principle of non-violence, peace, simplicity and universal cooperation is to be transferred to future generations along with scientific knowledge right from childhood.
20. Efficient management of time and resources available to every individual born on this earth is to be taught.

Acknowledgement

Author wishes to express deep gratitude towards Principle Secretary Dept. Of training and Technical Education, Govt. of NCT of Delhi for providing the financial support to present this paper.

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