INTRODUCTION

If you can’t explain what you’re doing and why you’re doing it to any intelligent layman, that really means that you don’t understand it yourself.

— Allan Bromley
ABOUT THE CHAPTER

This chapter gives the background of the study. It introduces the title of the thesis and explains the importance of science by giving examples. The chapter illustrates the attempts made by common people in the past leading to development of science and technology. The chapter also highlights the reading habits of common people and students for bringing out the fact that interesting and easily understood information are generally preferred for reading. The chapter narrates some of the examples of scientific development in agriculture sector, updates earlier heritage of traditional medicines, advantages and disadvantages, limitations of science, importance of scientific discoveries, rendering of scientific discoveries, the need of scientific discoveries in simple prose, scientific discoveries and common readers, importance of the topic, scientific discoveries as defined by the researcher, common publication used for scientific discoveries, listings of few popular journals, language of scientific discoveries, contribution to the body of knowledge and limitations of the study.
1.1. INTRODUCTION

1.1.1. Background of Study:

Scientific information is available in various forms, such as the popular science articles, books, monographs, blogs, newspapers, e-journals, classrooms, websites, films, television, CDs, internet etc. But, the scientific research knowledge and the scientific topic on which research is carried out or on which research has been completed in other words monographs or research findings are generally found in scholarly journals like Acta Crystallographica, American Journal of Physics, Biophysical Journal, Journal of Astrophysics & Astronomy, Journal of Materials Chemistry, Journal of Mathematical Physics, Journal of Molecular Biology, Journal of Nano Science & Nano Technology, etc. These are often referred and accessed by research communities. The information or knowledge from these are assumed to be meant for the expert or for readers exposed to a sufficiently high level of scientific understanding. Though some of the information found in these contain suggestions for a wider range of readership, like masses or common people, but the same is not readily understandable to them. Thus, as a transfer of communication to those aspiring to improve their overall scientific base, a different level of writing which is simple, easily understood is necessary.

The thesis uses the terms such as public, common man, common people, ignorant, masses, common readers, interchangeably, the terms such as scientists and researchers, journalists, scholars, research scholars, professionals and reporters are used interchangeably, the terms scholarly journal, technical journal, scientific journal are used interchangeably. The term research article (RA), scientific discovery (SD), research paper are used interchangeably.

Liver diseases kill lakhs of people in India. Hepatitis B is responsible for millions of chronic carriers which are at high risk due to sufferings from damaged liver and cancer. Tamir Rashid and his team created liver cells in the lab using reprogrammed cells from human skin, this is an important and useful discovery to lakhs of people who have suffered from liver cells. The researchers have used these cells to generate liver cells which could imitate the broad range of liver diseases in the patients from where the skin cells were taken. Using this technique they
created healthy liver cells from the control group. This made the diseased liver cell available making way for new treatment of liver diseases that killed lakhs of people every year.

The popular science publishing article by S. Kyvik gives an overview of the scope of popular science publishing and the contributions to public arguments compared to the scientific publishing among the faculty members at Norwegian Universities. The point that Kyvik raises is that faculty publish few articles for common people than publish for their specialist (so called scholarly or professional) colleagues. The efforts are taken to reach out to masses through various available media’s such as the television news channels, documentary, seminars, workshops, conferences etc. many a times, this method of science dissemination is used by the science communicators for establishing a connection to the general audience.

Communicating science through writing is not an easy task. Science writers and specialised science communicators are few as compared to scientists and engineers. It may be considered that in media, news announcers possess skill in reading out the science written by a science reporter. The grooming up of a good science reporter though, still remains a challenging task. Writing science for a non science audience needs expert training. They need to learn the language and the appropriate nomenclatures of scientific terms. In scientific writing, every day word’s, may be used in a specific way. While teaching report writing to students, it is important to provide them with models describing the issue that needs to be covered in writing. This is because many students may not be able to absorb the scientific style. First year students have written an article on perceptions of writing difficulties in science. This details the difficulties faced by students while writing science. Keeping this difficulty in mind the study addresses the suggestion for an easy to read abstract that could be named as ‘abstract for common readers’ (ACR) or ‘abstract for publicity’. This can be made possible by making a provision to modify the present format of the journal article by adding ACR to the existing format.

1.1.2. Attempts of common people towards science and technology:
Communication has come into existence since stone-age. People used to draw pictures and write on walls or scribble on mud. Because of their dependency to kill and eat they had made instruments from stone and barks. It has been noticed that people were tool dependent. Bow, arrow and axe were made with the help of a sharp stone and a tough stick was used for killing animals for food or defence and for shelter purpose by making a shed etc. The tendency of being curious and adapting to new methods for a better living was being explored by common people. The tendency for betterment compelled common people to think rationally and make use of technologies unknowingly, driven by science. In the past roughly 2.5 million years ago, common people were curious and were inspired in designing different kinds of tools from stones and barks. Today the same people are inspired and curious for information on science and technology related topics. The technology of science constantly moves with demand from people. For example few decades ago humans were discovering bulbs, telephones, electricity, etc. while today they are discovering genes, clones, robots, etc. Such discoveries lead to a livelihood that is easier, efficient, effective and comfortable.

The reading habits of majority of the people including students are such that they are interested to read topics that they easily understand. They do not attempt to read information from sources other than the usually available newspapers, curricula books, office manuals etc. Some of the housewives are found to read magazines, story books, recipe books etc. while some of the managers may read management related books. Hence, most of the common people are not found to read journals. The ones who read journals are the professionals, research scientists or scholars who are occupied in discovering topics related to their subjects of specialisation. A physicists may not like to read an article from a mathematicians journal nor a biologists may wish to read a materials journal only if it pertains to developing a new technology related to a bio-material topic like bio-nano materials, gold particles etc. Skinner through his book reports the observation of the reading habits of Indian managers. He says, Science is a willingness to accept facts even though they are unfulfilled. Experiments do not always give results as expected, they may fall but facts remain. Edison in his lab had tried hundreds of different materials for using as a filament but could not succeed. After experimenting most of the materials, he finally tried using the tungsten wire as a filament and this worked. The discovery that sugar for diabetes patient can be replaced by an artificial sweetener using saccharin was
found by chemist Constantin Fahlberg simply by way of an accident. This shows that discoveries also happen accidentally.

1.1.3. Major Steps / Milestones:

India’s excellence for science and technology is well known from its world wide variety of products like textiles, spices, etc. The recent Haldi ghati movement led by Dr. Mashelkar, former Director General, CSIR, proved to the world that turmeric was an ancient herb used by Indians in cooking, healing of wounds etc. and used commonly by Indians and therefore cannot be patented. He later fought patenting against basmati rice, thus protecting the tradition of Indians. As far as technology of India goes, the R&D laboratories and industries have licensed several patents based on modern knowledge in the US, Europe, Germany and other countries.

India is advancing by leaps and bounds. A newspaper covered the recent opening of the 99th Indian Science Congress held at KIIT University, Bhubaneshwar, between 3-7 Jan, 2012. Hon’ble Prime Minister, Dr. Manmohan Singh during his inauguration speech informed the scientific community to contribute their knowledge and wisdom for nation’s critical problems like Sustainable Agriculture, Water, Energy Efficiency, Solar Energy and Forestry. He said that industries should increase their contribution to the R&D expenditure. There should be interaction between public private partnerships, publicly owned Science and Technology institutions and the industry. Prime Minister also emphasized the importance of exploring traditional knowledge systems in areas of agriculture, architecture, handicrafts and textiles by emphasizing on common people to understand the method and concept of sustainable development and green growth.

The diversity of century old irrigation systems have been modified continuously and presently are serving a large majority of farmers from the Himalayan kuhls. Earlier these farmers would run for kilometres to fetch water from the tankas, kundis or sarovars of Rajasthan. Today they are provided with harvested rainwater throughout the year. This help has thus come from both the rural and urban communities. Agriculturists across the world are turning to organic cultivation whereas the Indian farmers have practiced organic cultivation for centuries. They are updating their practices by adapting appropriate technologies for the betterment of cultivation of crops. The farmers and the non literates from the Rajasthan deserts are found to make use of
scrap aeroplane tyres for reuse to form wheels taken from a camel cart. In Ranchi, district of Jharkand, wheels from a discarded bicycle are being popularly used as pulleys for lifting the earth while excavating the wells. More examples on the traditional knowledge are found in the technologies used today like the wootz steel technology adapted from China, the horizontal wells i.e. the surangams of Kerala came from the qanats of Iran. The Indian Science and Technology author, in the 18th Century appreciates the fact that these traditions still exist in large parts of the country.

Though old traditions are boom to the technology of today, some of the old technologies have been replaced for the betterment and efficient use by man. For example an earthen pot earlier made by a pottery maker has limited applications whereas technology replaced plastic pots have wider applications and are also cheaper and long lasting. Bartending of grains is replaced by money. Earlier, waterproof leather chappals made out of extracts from nuts and wax of Honnekai trees these days these trees have become extinct. Every period has two traditions, a people’s tradition that is constantly adapting and an elite tradition derived from people’s knowledge. This tradition derived from people’s knowledge gets redundant. Modern scientists and technologists analyse the past and generally try to innovate or modify the available technology for betterment of society. Attention is moving backwards to our natural resources, herbal remedies are in vogue. Traditional plants and natural habitats are being explored to bring out a green technology. Sacred groves and virgin forests are being considered and an open protest to tree pruning is being carried out. Rain water harvesting in societies, fields etc. are developed. The last two decades have evolved in several experiments to show that success lies in forming open and transparent community organisations like Gram Sabhas for empowering decision making by the community. These organisations are expected to ensure equal distribution of benefits from projects. Contributions from scientists and technologists can help facilitate the projects.

1.1.4. Advantages and Disadvantages:

The study brings out five important elements that go with the advantage of scientific knowledge upgradation in the common people in terms of i) encouragement to read scientific journals ii) to know the kind of research that is being carried out by the researchers iii) to generate ideas from the research iv) to communicate with the author of the publication and update him / her of the
requirement that is needed for research v) the scientist or research scholar might think twice before taking up research if the results are not benefitted to the common people vi) research will be society driven vii) common people will get deeply involved in scientific thinking viii) a scientific temperament will be created amongst the masses ix) scientists will be satisfied to know if their research has reaped benefits to the society at large x) more and more researchers will move away from non-societal technologies will get motivated to work towards societal technologies and much more.

Some of the disadvantages that scientist anticipate is that research and development is a slow process and by sharing their ideas and plans the common people may expect technologies overnight which is difficult and hence scientist may not get support from common people. The scientists also feel that unlike cultural and art activity, few people may be interested in research activities. Scientists also fear that they may not be able to make the people understand their research. Science communicators may tend to misinterpret their research causing harm to the image of scientists and science. In a rare case, discovery after publishing may not work and if it fails then people will not come forward to support the failure instead make issues to harm and criticise the efforts that go in to building research and technology. Society should give the understanding to Scientist that if they fail in their efforts, their failure may prove as a knowledge that could be used in another research application. Society should understand that research does not lead to products the very next day and should refrain from misleading information. Many times media presents false claims which scientists do not claim and therefore causes defamation to the scientist or researcher.

1.1.5 Limitations of Science:

Science is important and more important is that it gets communicated to the people in the right way. It is a known fact that there is a limitation to human thoughts and therefore there is a limitation to the knowledge about science. If science is not supported then it is assumed that there is a limitation to science. It is closely observed amongst literate people that inspite of their literacy, they are still scientifically illiterate. They do not understand science in the right perspective. They are not satisfied with the scientific reason and therefore try to bring in blind beliefs or assume that what they think is right.
There will always be a limitation to knowledge of science because it is always insufficient knowledge. The more science is known, the more curiosity science creates. Also scientific knowledge is inadequate with regard to public debates, politics of science, getting grants and ethics. If there is a limit to knowledge then, people are deprived of their rights in the area where knowledge is acquired. For example, through newspapers or news channels if it had been declared that the price of wheat has been reduced by rupees four, and people who do not know this pay more in ignorance. Another simple example could be, while buying a television consisting of 30 channels for an amount, after purchasing the customer realizes that he has been cheated because that is the standard number of channels given by all the companies in the market with more features and less price. Some of them accept that they have been cheated while others try to seek consumer rights.

Hence, science even when thoroughly popularized will be effective only when its receivers read about the latest developments and try to understand it. There are limitations in communicating science to layman and children. For example if some questions such as roses have a particular fragrance, whereas a jasmine has a different fragrance than rose, this can be decided by the nose. Since the nose is the sense organ that is responsible for the smell, it is true that when everybody smells the rose and when one of them smells the rose, it is the same smell that is being discussed. Questions such as a person is bad or good cannot be measured in scientific terms nor does it have any equipment that can truly measure. The most popular of all examples is the weather prediction. Scientists are working to get the right prediction of monsoon, cyclone, hurricanes, floods etc. The argument is the right type of tools and knowledge for analyzing these kinds of forecasts. These questions can be supported by scientific thinking but without the involvement of scientific proofs.

1.1.6. Importance of Scientific Discoveries:

Researchers or Scientists or for that matter scholars are like explorers looking for something new that could bring along with it new ideas on which technology could be built in. The topic of discovery thus dominates the imagination of researchers as well as students having science in their studies. Augustine Brannigan in his book, ‘The Social Basis of Scientific Discoveries’, presents a note from N. R. Hanson that says, ‘discovery is what science is all about’. Science is
that culture which makes an uncovering of nature its central focus. In the first chapter, ‘the topic of discovery and the concept of nature’ Brannigan has given several examples that one could relate with science and the unwrapping of science from the past scientific discoveries noted from Einstein, Galileo, Socrates, Archimedes, Alfred Russell Wallace etc. questions such as what comprises of a scientific discovery, how are these discoveries recognized and how and when do they happen concerned the scientists and the philosophers. In his book, Brannigan provides an examination of some of the important alternatives and theories which have been developed to explain the discoveries and innovations in science. The two types of theories called as the mentalistic theory in which he describes how ideas come to mind and the other environment or culture theory which describes how ideas grow. He has also illustrated few important scientific cases.

Discoveries are important whether they are scientific or non-scientific. Julian Ayrs quoted, ‘the road less travelled is usually the best one to take’ and an American poet Robert Lee Frost, on ‘the road not taken’, also known as, ‘the road less travelled’. The last two lines of the poem, ‘I took the one less traveled by, And that has made all the difference’. Through his poem the poet Robert Frost informs the readers to take the path that has not been taken before. In other words one should know the unknown. Discovering science is wonderful when one begins to move on a path that is unexplored. On an unexplored path, one might discover something that may not have been imagined. Thus science is directly related to discovery and vice versa.

Rescher Nicholas, in his article analyses importance of scientific discovery through its problem finding techniques, scientifically reasoned questions and answers. The results of these may vary in terms of its seriousness. The more serious findings may form figures in a book, while the smaller ones form the footnotes. What are important are not the numbers but the findings and the magnitude of their importance largely. Science is important and without the difference between the important and the unimportant, it would be difficult to teach, understand or even practice science effectively. Scientific importance is an important index of quality and forms a significant context of understanding. Efforts are made to negotiate between keeping the more important and meaningful result than mere keeping numbers that has no value. Science is therefore, an
important enterprise that aims at the description and the explanation of natural observation and therefore it cannot be treated casually.

An example of Michael Fred Phelps, world famous American swimmer is that he who won 16 Olympic medals, consisting of six gold and two bronze at Athens in 2004, eight gold at Beijing in 2008. His international titles and record breaking performances earned him the World Swimmer of the Year Award six times and American Swimmer of the Year Award eight times. He was found wearing the LZR Racer made swim suit. During summer Phelps suit started shrinking. He then preferred, less permeable, more buoyant material suits and when controversy increased that he won because of his suit, it was decided that from the next event onwards, swimsuits made of less permeable, more buoyant material were to be worn by all.

The technology used in the swimmers suit is similar when observed on a lotus flower. When water falls on the lotus flower, it slides from the petals, it does not stick to the flower, this is because the lotus flow is hydrophobic in nature that means in simple prose that water is repelled from its surface and does not stick to it. This nature of the flower is studied for making applications like the swim suit of Michael Felps that was made using artificial hydrophobic swim suit. More applications of this technology are found in self - cleaning coatings that are designed by technologists or chemists and applications that can be applied with general super-hydrophobic applications involving water-repellent and stainless coatings, self-cleaning and antifouling surface designs, and laboratory-on-a-chip devices etc. The discovery of science is more like a scientific truth that revolves around the discovery in an idealistic manner. Thus scientists or the scholars learn from science found in nature.

1.1.7. Rendering Scientific Discoveries:

For application purposes, more often scientific discoveries are rendered. There are plenty of examples where such a rendering rooted from a science discovery has been applied. The examples are found in abundance in areas such as medicines, therapeutics, life saving gadgets, methods adapted for treatment, all process such as the biological, physical, chemical are modified to suit the adaptability of a particular application.
Advancement in technology and restrictions in use of real world samples from animals has forced the scientists to create real life models which are built for experimental purposes. For example, systems biology is a subject that undergoes reality test more often for specific findings. Therefore, scientists have prepared a real virtual model of a heart and performed all kinds of experiments on it. Testing of drugs, measuring its effect, noting the occurrence of any damage, applying treatment methods etc. turn out convenient on a virtual model. Thus, virtual models are a hot topic of leading biologists, pharmacists, medical practitioners. In order to achieve a study like this, one has to build an entire virtual human for researchers to play with. Since human bodies are made up of cells the best way to build a model body would be to construct a general purpose virtual cell that can be reprogrammed into being any one of the 220 or so specialized sorts of cell of which the human body is built. A collaboration organized by the European Science Foundation was hoping to do this through a project named Blue Cell. To carry out systems biology thus, tracking for data would be an extraordinary task and may turn out to be a driver of the future developments in computer industry. Technology or for that matter scientific rendering have created virtual models that are as efficient as real humans.

Biologists are building software models that behave like parts of living organisms and are using this concept to understand biological processes. This approach is also being used by pharmaceutical industry. Around forty percent of the compounds tested by the drug companies are found to cause disturbances in the normal heart rate called arrhythmia. Drugs such as Vioxx (anti-inflammatory) and Avandia (diabetes) have been found to increase heart disease resulting in reduced share in the market.

The pharmaceutical company has thus taken help from the creator of the beating heart model, Dr. Denis Noble who is part of a consortium that involves four drug firms namely the Roche, Novartis, GlaxoSmithKline and AstraZeneca. This consortium is aiming at discovering new drugs that may affect the heart. Virtual drugs are introduced into the model and the changes they cause, (like in real wherein the drugs have been applied to a real heart) are monitored by researchers. The changes observed affect the flow of blood and electrical activity based on which
the application of drugs can be managed for increasing the benefit or reducing the harm caused. Systems biology thus speeds up the drug-testing process.

e-Therapeutics, Newcastle Tyne a company that claims to have developed world’s fastest drug-profiling system by using databases of thousands of interactions between components of a cell which would normally take two years is done in two weeks time for assessing the effects of a new compound by using conventional research methods. Moreover, the company has been looking for drugs known to have damaging effects. This would enable one to assess alternate therapies such as herbs and clinical nutrition (which seeks to control diseases through the use of particular foodstuffs). These remedies are often dismissed as unscientific as they have a magnitude of effects on the body that are hard to quantify. Studying multiple effects is precisely what models like the virtual heart are able to do.

Mice are better understood as Men in biological terms. A team in Netherlands is using a computer model of mouse physiology to investigate the effects of a high-fat diet, by monitoring the concentration of various components of the blood.

SU BioMedicine, Zeist whose team found that the active ingredient of a particular concoction (mixture) of Chinese herbal medicine has the same effect on blood composition as the anti-obesity drug Rimonabant. It is hoped therefore that systems biology studies like these will eventually trace out the pathways the herbs are affecting. Such models may also help to pin down the causes of diseases that arise from the interplay of genetic and environmental factors.

Dr. Andrew Ahn, Harvard Medical School who cited the example of diabetes for which the standard clinical test is a measure of the level of glucose in the blood, suggested that to understand diabetes completely would be to track glucose levels, against other factors such as diet, sleeping habits and psychological health and for doing this he proposed to employ a systems biology model. In other words, to achieve a study like this, one has to build an entire virtual human for researchers to play with.
To carry out systems biology thus, tracking for data would be an extraordinary task and may turn out to be a driver of the future developments in computer industry. Dr. Noble is in negotiation with Fujitsu, a Japanese computer firm that is developing a machine capable of performing some ten thousand trillion calculations per second, the world’s fastest computer costing to about a billion dollars. This is a little more than dollar six million paid for the fictional bionic man, Steve Austin. It is only about a quarter of what the Human Genome Project costs.

A report from the BBC, a research team from UK’s Aberystwyth University, has created a robot that can independently conduct and analyze scientific experiments. The robot is named Adam, is said to have actually made a scientific discovery by identifying the role of several genes in yeast cells, and is able to plan further experiments to test its own hypotheses. Ross King from the department of computer science at Aberystwyth University, and team leader informed BBC news that he envisaged a future when human scientists' time would be "freed up to do more advanced experiments". Ross Kind and his team is working on a more advanced robot scientist called Eve, which is designed to screen new drugs and is said to be more advanced.

1.1.8. Need of Scientific Discoveries in Simple Prose:

A scientific discovery in simple prose is the need of the hour. Tons of efforts have gone into popularising science and communicating science for public understanding. These efforts are aiming at bringing people, science technology, scientists and industries under one common platform. For the popularisation of discoveries information is required to be covered in all magazines, media, and similar broadcasting sources. When compared to the number of research scholars around the globe with the amount of research funding from government and industry budgets, the number of discoveries in simple prose are not found in line with its investment. Due to this there is a gap between the common people and the research work of scientists resulting in technology updates. The gap between the common people’s knowledge and the existing knowledge of technology updates should reduce and this can happen if at least the applicable part of science reported is in simplified and easy to read format.

When scholars write science discoveries, analysis and interpretations, it is mostly hard to read. One feels that it is not only difficult to get the facts and complex science for common people’s
readability, but Gopen and Swan in their article have demonstrated a number of ways this can be presented in the most simplified manner. They have demonstrated a number of rhetorical principles that produce clarity in communication. Improving the quality of writing actually improves the quality of thought as stated by Gopen and Swan. They comment on their article that ‘if the reader is to grasp what the writer means, the writer must understand what the reader needs’. The general format of a research article is made up of an introduction, methodology or experimental methods, results and discussion. These sections are confusing for a non-scientists or common readers. The experimental data and analysis are mind boggling. The readers typically have an urge to get to the main theme of the research and find out if there is any new knowledge or an innovation to the overall idea hidden in the article. Many times the non-scholarly readers are bored with the figures and analysis, readers read with certain definite expectations and look for it in particular places, if this is not satisfied, then they prefer to read the conclusion and if that is not enough, they drop the idea of going through the article.

The below excerpts are taken directly in its original form from the article Gopen and Swan who have clarified the passage in quotes and italics as an example to depict scientific writing in simple prose.

‘The smallest of the URF's (URFA6L), a 207-nucleotide (nt) reading frame overlapping out of phase the NH₂-terminal portion of the adenosinetriphosphatase (ATPase) subunit 6 gene has been identified as the animal equivalent of the recently discovered yeast H⁺-ATPase subunit 8 gene. The functional significance of the other URF's has been, on the contrary, elusive. Recently, however, immunoprecipitation experiments with antibodies to purified, rotenone-sensitive NADH-ubiquinone oxido-reductase [hereafter referred to as respiratory chain NADH dehydrogenase or complex I] from bovine heart, as well as enzyme fractionation studies, have indicated that six human URF's (that is, URF1, URF2, URF3, URF4, URF4L, and URF5, hereafter referred to as ND1, ND2, ND3, ND4, ND4L, and ND5) encode subunits of complex I. This is a large complex that also contains many subunits synthesized in the cytoplasm’.

Most of the people felt that the above passage contained technical terms while some felt that to understand the passage needed specialized background knowledge.
Below is a passage again the original from the article, with the difficult words temporarily removed.

‘The smallest of the URF’s, and [A], has been identified as a [B] subunit 8 gene. The functional significance of the other URF’s has been, on the contrary, elusive. Recently, however, [C] experiments, as well as [D] studies, have indicated that six human URF’s [1-6] encode subunits of Complex I. This is a large complex that also contains many subunits synthesized in the cytoplasm’.

The above passage appears simple and still needs to be simplified further. In other words personal style of a writer matters most while presenting the research article on any written material like a news item, book chapter, manuals, etc.

1.1.9. Scientific Discoveries and Common Readers:

Scientific discoveries are directly related to common readers. Discoveries are meant for common people who can use, rely, depend and update themselves of the technology advances in science and technology. All of the scientific discoveries may not directly make a difference to the livelihood of common people, these may catalyse processes, design new machinery, upgrade present systems, invite new methods, schemes etc for benefitting better performance to the common people. Writers are found in almost all areas of work whether it is business magazines, academics, lawyers, scientific institutions, policy makers, advocates, lawyers, press reporters etc. The important element in the midst of information technologies is associated with the new economy the intellectual capitalism and left behind the legend of material capitalism. This new thought of intellectual capitalism brings in assured system of market with a combination of a new set of technical and institutional innovations that would provide reliable knowledge assets thereby protecting the intellectual property holders right from the advances of digital information technologies .

An example that directly benefits common people is illustrated as follows. Recently a new electronic display technology has come up which can be used on beer cans and clothes. This device represents a thin film of plastic that allows electricity to pass through it and generates
solar power. Organic light emitting devices (OLED) is thin and flexible and therefore it is used for electronic display screens. Applications of OLED could be used to change colour of clothes, put a display on beer cans, etc. OLED is found to be more efficient than the usual light bulb. The same technology is found reliable on mobile phones and MP3 players but not reliable on computer screens and large televisions.

1.1.10. Importance of Topic:

The topic of ‘Rendering of Scientific Discovery in Simple Prose’ means presenting the available discoveries related to the area of science in a manner that is simplified for reader’s readability. Academicians, researchers, scholars, scientific community try to explore for finding out something that previously existed but was not known, and the discovery to know the unknown still continues. To let people know the unknown is important, common people understand content which is non complex, presentable and written or communicated using simple language. The topic of this study attempts to make discoveries written by publishers in high impact journals that go well with discovering or making attempts to make discoveries written by scientist in simple prose for popularity amongst students and common people.

Every scholar writes its research findings and publishes them in journals preferably in journals having high impact factor. The recordings of these findings or published articles are simple to the researcher but equally complex to the non-researchers and non-scientists. Hence, communicating the complex knowledge into simple prose is essential and for this rendering of that knowledge or RA should be carried out.

Nowadays, articles are written in magazines and are also available in non scientific journals. These are read by scientists as well as non scientists. But, the most noteworthy fact here is that non-scientific articles and journal information are less in number, compared to the combined information from all the known scholarly journals. The number if not equal at least should increase to a larger extent and when this happens, a true scientific temper and an upscale of scientific knowledge will be imbibed in the minds of people. The benefits of such knowledge
pool will result in a revolutionary change and will directly affect the important factors of the nation like economy, policies, literacy, mindset, thoughts, standard of living, unity amongst people, political environment, inflation etc. and these will also touch upon corrosive factors like pollution, fuel, energy etc. The topic of this study when carefully analysed will bring in a complete wave of turbulence that will benefit people.

1.1.11. Types of Scientific discoveries as defined by scholars:

Scientific discoveries are classified into different types by different scholars. As such, there is no standard type of scientific discoveries. Keiichi Noe in his article on ‘the Structure of Scientific Discovery: From a Philosophical Point of View’ remarks that there are two types of discoveries the factual and conceptual discovery. According to him, factual discovery occurs during the period of ‘normal science’ as termed in Kuhnian while conceptual discovery for him, emerges as an opportunity of ‘scientific revolution’ the time of a paradigm shift. He feels that scientific discoveries in general use imagination and reasoning. Discovery by the author is described as an act of becoming aware of something that existed but not known.

Scientific discovery has three sides as stated by Pat Langley in his article on ‘three facets of scientific discovery’. These are glauber, bacon and dalton. Scientific discovery is a complex process. GLAUBER – forms classes of objects based on regularities in qualitative data, and states abstract laws based on it. BACON – ‘includes techniques for finding numerical laws for formulating intrinsic properties and for noting the common divisors’. DALTON – ‘formulates molecular models that account for observed reactions, taking advantage of theoretical assumptions to direct its search if they are available. These sides relate to chemical discoveries but they can be applied to other domains as well’. According to Langley, a complete theory of the scientific process must not only account for different types of discovery but it must also account for interactions between the sides.

1.1.12. Scientific discoveries as defined by the researcher:
As such there can be no boundaries to put scientific discoveries into types other than very broad areas of research for example: materials, nanomaterials, polymers, engineering, medical, biomedical, synthesis, bioengineering, stem cells, animal testing, DNA, agricultural, organic etc. etc. Popular information on scientific discoveries is available online, yet there are many more available in the scholarly journals. Few examples of latest popular scientific discoveries directly related to common people are given as follows.

1. AbioCor Artificial Heart was developed by Abiomed, Inc. lead by a group of surgeons. They managed to implant this artificial heart in a patient who suffered from heart failure. Though artificial hearts were developed and used in humans before, AbioCor has proved to be more technically advanced in which a patient need not suffer from having tubes or lines running through skin. The AbioCor is implanted within the body which has a battery pack that can be charged by wearing a belt.

2. Bio-Artificial Liver was developed by Dr. Kenneth Matsumura. He has come up with a totally new concept that uses liver cells collected from animals and not by developing a number of tools to carry out specific liver functions. This artificial liver is composed of both the biological and manufactured parts. The blood of the user circulates through the device and a unique synthetic membrane differentiates it from the animal cells. The membrane prevents the rejection of cells and permits the cells to detoxify, acting exactly like a natural liver.

3. Camera Pill – detects early signs of cancer. The device was developed to capture colour images in restricted spaces. Esophageal cancer, a fast growing cancer in United States is detected at an early stage. This pill is convenient to take as it is cheap, small and one can stay away from sedates and anaesthesia which otherwise would have been a torture to the patient.

1.1.13. Common Publication Used for Scientific Discoveries:

Scientist usually connect with each other either through common research (co-authoring), or when they read about other researchers or scientists through journal publications or online available data sources like Springer, MEDLINE (biomedical research), Los Alamos e-Print Archive (physics), and NCSTRL (computer science) etc. Scientists also connect through networks that are formed by way of conference, workshops, seminars, libraries etc. Social
networks contain both empirical and theoretical study due to their natural interest in patterns of human interaction that leads to the spread of information and disease.

The common publications where scientific discoveries are printed are found in print and online databases available by publishers of repute. The difference in the status of these publications is due to their impact factors. The journals which consist of scientific discoveries are mostly termed as scholarly journals, are technical in nature. It means most of the content is filled with results, experiments, analysis etc. The content consists of mostly the study performed by the research scholar for discovery something that was existing but unknown to people.

Science and engineering research will result in more productive scientific data over the next decade. The data will be a success only if it will be easily accessible and will have the ability to integrate and analyse. Vigorous data organisation and methods of publication are essential to enable the discovery of data and analysis of science by researchers. A new method consisting of point observations called the standard observation data model is used for publishing research datasets. This can be made use for environmental and water resources data along with web services for data transmission to consumers. The components from this model reduce the syntactic and semantic heterogeneity in the assembled data within a national network of environmental observatory test beds. The data publication system is also utilised to create a federated network of consistent research data from a set of geographically decentralized databases.

1.1.14. List of Some of the Popular Journals directly from Internet

General and multidisciplinary science
- Nature
- Philosophical Transactions of the Royal Society
- PLoS ONE
- Proceedings of the National Academy of Sciences
- Proceedings of the Royal Society
- Science
- Basic & physical sciences

Astronomy and astrophysics
For a more comprehensive list, see List of scientific journals in astronomy.
• AIAA Journal from the American Institute of Aeronautics and Astronautics
• Astronomy and Astrophysics
• Astronomical Journal
• Astrophysical Journal
• Monthly Notices of the Royal Astronomical Society
• Publications of the Astronomical Society of the Pacific
• Chemistry
• Journal of the American Chemical Society
• Angewandte Chemie
• Chemical Communications
• Chemical Reviews
• Accounts of Chemical Research
• Chemistry - A European Journal
• Chemistry Letters
• Bulletin of the Chemical Society of Japan
• Helvetica Chimica Acta
• Canadian Journal of Chemistry

Physics
For a more comprehensive list, see List of scientific journals in physics.
• Acta Crystallographica-- parts A, B
• Advances in Physics
• American Journal of Physics
• Journal of Physics - parts A-D, G
• Nature Physics
• New Journal of Physics
• Physical Review - parts A-E and Physical Review Letters
• Reports on Progress in Physics
• Philosophical Transactions of the Royal Society

Biology
For a more comprehensive list, see List of scientific journals in biology.
• American Naturalist
• Biological Reviews
• BioEssays
• Biophysical Journal
• Cell
• Journal of Cell Biology
• International Journal of Biological Sciences
• Journal of Theoretical Biology
• Journal of Molecular Biology
• PLoS Biology

Genetics
• Genetica
• Genetics
• Heredity
• Journal of Genetics
• Theoretical and Applied Genetics

And so on ……

1.1.15. Language of Scientific Discoveries:

Language of scientific discoveries has moved from its earlier vernacular languages to its most popular language as English. In the past, out of 25 literature Nobel prize winners, it was found that 9 wrote their major work in English language while other 16 Nobel Laureates used their native language for writing the work. These were later translated into English language for an international recognition and also for the attention of the Swedish Nobel Prize committee. It is found that Most Nobel laureates from the area of Physics, Chemistry, and Physiology or Medicine write in English. The language English is considered as the lingua franca of science, the international community and also the Karolinska Institute. Many scientists in Africa, Asia, Latin America and Europe still publish articles in their mother tongue. The shortcomings of articles written in languages other than English are ignored due to lesser visibility and not readily accessible to the international scientific community. To overcome this problem, the articles are encouraged to be published in English language.
It is also observed that articles published in bilingual languages are also difficult to understand and process. The international indexes need to address these differently and therefore a different set of presentation and metadata is required for linking and citing bilingual articles. Larger effort from editors, authors, index providers is required. Also support is required from national research agencies that develop articles in local languages. For this, research, visibility from both national and international is required.

The English language from the scientific journals is termed as the technical language by common readers and science communicators. This technical English language that is used in the scientific discoveries or journals, are very well understood by the researchers and scholars, unlike common readers. Common readers prefer an easy way to read research written in simple prose for better clarity and understandability.

1.2. STATEMENT OF THE PROBLEM

The source for popular science information are magazines, newspapers, popular science websites, print media, science channels like discovery, animal planet etc. The not so popular scientific information that comes directly from researchers is not so common and it does not cover sources as stated above. The broader aspects of scientific knowledge if not the complete detailed research, should be available to common readers for their understanding. The scholarly journal is meant for a specific audience and is read by the scholars, theses facilitators, scientists, professors, examiners etc. Because of this, the overall knowledge base of a community as a whole tends to remain at a relatively low level. In a world where knowledge is building up at an exponential rate, is a serious concern. Many facts cannot be estimated or understood completely because they are not discussed, or people ignore them because much of it exceeds their understanding. A typical reader is interested in reading what he is able to understand. This is so because ultimately the motivating force for reading in the common group of people is not “knowledge for the sake of knowledge,” but, directly or indirectly, the benefits of reading get built up on the person as a whole. He would prefer to avoid reading complex material than spend unnecessary time in understanding it.
For example, popular science when goggled from internet informs the reader of various ranges of topics on science. For example, information like a silkworm moth has eleven brains; or another example such as, apart from humans the only animal that cries is the elephant or maybe, each domestic cow emits about 105 pounds of methane a year; liver is the only organ in the human body that can be partially removed and donated because of its ability to re-grow over several months, and so forth. Similarly, the information ‘In India sheep breeds are mostly raised for meat production rather than wool. Shepherds income is directly related to the number of lambs produced by each ewe (ewe - A female sheep, especially when full grown.). The prolificacy gene $FecB$ from the only highly prolific Indian breed, Garole, was introduced into the Deccani breed of Maharashtra using a direct DNA test for detection of the gene. The project work was undertaken by CSIR-NCL, led by Dr. Vidya Gupta and Dr. Chanda Nimbkar at NARI who have demonstrated that ewes carrying the $FecB$ gene produce about 5 extra lambs per 10 ewes compared to ewes that do not have the $FecB$ gene’. This information is useful to common readers and this must also reach them.

On analysis it was found that an article on this was published in a newspaper by reporters@sakatherald.com on 20th October, 2007. The Hindu reported the award for this work in their newspaper on Sunday, Dec 21, 2008, under the main heading, ‘Shanti Swaroop awards presented’ followed by, ‘New Delhi: Prime Minister Manmohan Singh on Saturday presented the prestigious Shanti Swaroop awards to 21 young scientists from different academic and research institutions for the years 2007 and 2008’. Publicising research in the laboratory is important for updating the knowledge of masses thus giving way to creating a certain kind of scientific temperament in the minds of the people.

It does not matter if science or mathematics is discovered by man or an art is crafted by man, it matters a lot, if the information is extracted in an organised manner for the benefit of people. The thought that available information must reach people, has put some of the best thinkers to think over centuries of time. If science has always existed and man just discovered it, it looks like science is now discovering man! It is well known that technology is a form of science and man has become fully dependent on technology. Communication is fast growing through online mediums on the Internet, like chatting, etc. that helps one to connect with unknown people. It has
thus become necessary to remain updated in many of the fast growing and more useful branches of science. Communication gadgets like phones, messages, videoconferences are common but science in the lab has yet to become a common man’s tool. The research will focus on the information available in the research publications published in journals by taking into consideration some of the research papers published by scientists from the leading Council of Scientific and Industrial Research’s (CSIR) National Chemical Laboratory (NCL), Pune. It will explore some of the published abstracts that may have a direct impact on the people in terms of knowledge and technology development.

In other words, Scientists face challenges in communicating their specialized topic to non-experts who can be termed as layman or who have expertise but in another area. More often it becomes easier for a scientist to deliver a lecture with it’s equally intellect audience but all the more difficult to follow simple rules for addressing or communicating to non science audience. Similarly, it is easier for a scientist or a research scholar to write his work and publish in journals since these are scrutinized by experts. Therefore, more often a science communicator is recruited to fill this gap. Some of the science communicators are skilled to communicate, whereas others need training.

The primary channels for non-experts are mass media, museums, science centres, activities in schools organizing science festivals and by using mediums like internet, online chats, blogs, face book, twitter etc. Though some of the researchers may feel it unimportant but many of the scientists feel it important to communicate science.

It is well-known that we have been progressing well in the area of science and technology. The comparison of awareness of science in the prehistoric period and its development till-date is no doubt an upward curve leading to the enhancement of science communication. Development of science and communication of science therefore go hand in hand. As we date back to pre-historic times, the stone-age era practitioners communicated with each other using stone carvings. They were found to draw designs and pictures on the stones and walls for communicating their thoughts. Some of these pictograms designed by them are still found today. The first newspaper published during that era was the Calcutta General Advertiser also known as the Hicky's Bengal
Gazette written by James Augustus Hicky in the year 1780. The Bengal Journal, Calcutta Gazette, the Madras Courier, the Oriental Magazine and the Indian Gazette are names of some of the newspapers that emerged during that time. Advancing technology has today provided us with internet, satellites, video conferencing across countries.

The study addresses the problems caused to common readers due to unavailability of scientific knowledge written in lucid form found in the scholarly journals.

1.3. OBJECTIVES

1. To find out the popularity and importance of popularising scientific article / discovery amongst college students of Pune.
2. To undertake an experiment to convert information relevant to common people from ten scientific research abstracts in simple prose to state that abstracts is informative and can be understood if written in simple prose.
3. To popularise science amongst school students of Pune by conducting a workshop that would aim to impart excitement about chemistry, a branch of science.
4. To find out if scientists are interested to popularise science.

1.4. LIMITATIONS OF STUDY

The study involves a concept that is common across the globe. Hence the popularisation is focussed only on the knowledge popularisation from the content of publication which is presently limited to scholars, scientists, academicians etc. An attempt through the study is aimed at finding out the crux of knowledge from the research that a researcher had undertaken to find out if that knowledge has reached the common masses and if so, the sources used or not used to do so.

The study focussed on ten publications that had a direct or indirect impact on the common issues that were of relevance to the common people. This is because there are more than millions of researchers across the globe and more than thousands of scholarly journals. The research has
focussed more on the idea to tap the popularity than to lose its focus on the number of publications available and catered to.

1.5. CONTRIBUTION TO BODY OF KNOWLEDGE

The study aims at simplifying the outcome of research available in scientific journals and making them available for common people. The study brings attention on those scientific articles which have direct or indirect applications to common people and insists that they should read these for the following reasons:

1. Become aware of the results of research
2. Would be curious to know if the ongoing research has any immediate benefits to them
3. Would be able to relate their problems with the available technologies
4. Would be able to suggest their problems so that researchers can come up with technologies that may be beneficial to common people
5. Societal technologies would increase
6. Would play a positive role in developing the economy of the country
7. Scientific Culture would be built amongst the common people
8. Would create scientific thoughts in the minds of people
9. Would play a significant positive role in curbing superstitions
10. Researchers will be encouraged to write in a simple manner or would be interested in interacting with media like, newspapers, television, by way of interview, etc. to inform the common readers of their significant work. Their work would get recognition and more ideas would come from common people. This would no doubt help them try out technologies beneficial to people and will not want to waste their time in trying out something that is not useful.

11. Lack of literacy is the main reason for the backwardness of any nation. Similarly illiteracy in the area of science and technology would further push the country to be more backward. Scientific research publications in simple prose would certainly take the common people in a long way in creating their knowledge which would certainly help the country to develop. Therefore present research work would motivate the written researchers as well as publishers to bring the results of scientific researchers in simple prose manner for the knowledge and use of common people.

12. The next chapter, chapter II presents the previous review of literature.