SCIENCE, TECHNOLOGY AND SOCIETY IN INDIA: A Sociological Study

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MANOJ KUMAR JENA

CENTRE FOR THE STUDY OF SOCIAL SYSTEMS
SCHOOL OF SOCIAL SCIENCES
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NEW DELHI - 110 067
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जवाहरलाल नेहरू विश्वविद्यालय
JAWAHARLAL NEHRU UNIVERSITY
NEW DELHI 110 067

Centre for the Study of Social Systems
School of Social Sciences

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CERTIFICATE

This is to certify that this dissertation entitled SCIENCE, TECHNOLOGY AND SOCIETY IN INDIA: A Sociological Study submitted by MANOJ KUMAR JENA in partial fulfillment of the requirements for the degree of MASTER OF PHILOSOPHY of the university, is an original work and has not been submitted for the award of any other degrees of this university or any other to the best of our knowledge.

We recommend that this dissertation be placed before the examiners for evaluation.

Renuka Singh

Dr. Renuka Singh

(Supervisor)

Associate Prof.
Centre for the Study
of Social Systems
School of Social Sciences
Jawaharlal Nehru University
New Delhi

Prof. Anand Kumar

(Chairperson)

Chairperson
CSSS/SSS
Jawaharlal Nehru University
New Delhi-110067

Tel. Office : 26704408 • Fax : +91-11-2616-5886, 2619-0411 • Gram : JAYENU • Telex : 031-73167 JNU IN

Dedicated

To

Maa, Bou & Jeje

CONTENTS

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INTRODUCTION

The dawn of civilization started with innovation. Knowledge and science in the long march of human progress became nearly synonymous. **Kautilya's *Arthashastra*** speaks of certain chemical ingredients used against the enemy to have an edge in the warfare, which, of course, is a diabolical dimension of science and technology. It is a well known fact of Indian society that science and technology flourished during the Golden Age of the Gupta period. Science then was the monopoly of the upper classes while the masses were ignorant. There are positive evidences to show that the Indus Valley civilization influenced the European science. As early as the 6th century B.C. there was, in the Indus Valley an emphasis on and an interest in matters that in modern parlance could only be called science. Coinage, mathematics, flood irrigation, psychology, economics, architecture, surgery and herbal medicine are part of the legacy of early Indian civilization. It is however, sad to note that there was a long spell of darkness. It was during the British rule that the Indian society was once more exposed to science and technology and modern thought.

Since the 18th Century, there has been an explosion in scientific inventions and discoveries. The seeds of civilization like the philosophies, the religions, the logic, mathematics, sciences, and arts yielded by the East were buried into oblivion and for a while there was a vacuum but the West successfully planted and watered them to fruitition in the form of science and technology. Today science and technology have not only become vehicles of growth but also act as potential instruments for social transformation. Science and Technology means

'Power' and 'Power' is knowledge. The idiom of power means control of people too. The class of people that had a visible control over the State ultimately possessed and controlled this new source of power. It is the case even today. It is now widely recognized that science is not value-free and technology is not neutral. So, conscious efforts have to be made to make masses the masters of science and technology rather than making them subservient to it to face its ravaging consequences.

The United Nations Conference on Science and Technology for Development (UNCSTD) held at Vienna in 1979 had recognized that science and technology are essential for socio-economic and cultural development. The development ought to have an indigenous character to ensure reduction of dependency and vulnerability in the case of developing countries and that development must be expeditious if the aspirations of the people for meeting even the basic requirements of life were to be fulfilled.

India is known for its unity in diversity. It has diverse social, cultural, economic, ideological and religious and ethnic communities that have different languages, living conditions and food habits. Inter and intra-caste and regional differences in terms of needs, expectations and aspirations are far and wide. The progress of the nation is basically conditioned by the improvements that we can bring about in the quality of life of our rural masses who form nearly 75 per cent of the population. In other words, rural development is sine qua non for the effective application of science and technology for development.

Pandit Jawahar Lal Nehru, the first Prime Minster of India, had perceived that the main thrust of development of our country should be

through science and technology. The moment we speak of science and technology, our imagination flies to high technology (hi-tech) but it is not so. The real science is one which reaches the common man and works for his betterment. In January 1951 in his speech at the Indian Institute of Sciences, Bangalore, Jawahar Lal Nehru had mentioned that he was constantly thinking not so much of pure research as of the application of research to the problems of human society. His anxiety was that technology, which serves as the bridge between scientific research and the needs of society must reach the masses, so that their living standards could rise. He further said, "May science flourish in India and remove many ills that our people suffer from." The Science Policy Resolution (1958), the Technology Policy Statement (1983) and the Science Technology Policy 2003 of the Government of India envisaged a definite role of science and technology in a big way in the making of future India and in shaping an egalitarian society. The Central as well as the State governments invested huge sums of money in establishing the basic infrastructure for scientific research and science education at different levels throughout the country.

Defining Science and Technology

Science is the systematic quest for verifiable knowledge and dependable, orderly sequences, which has been secured through scientific investigation, a method of study where by a body of verified knowledge is discovered. And technology is the use of scientific discoveries to solve practical problem.[1]

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[1] Horton P.B. and Hunt C. L. Hunt 1984. *Sociology*: McGraw Hill Book Company Singapore, pg. 308.

In very simple way we can explain that, science is a way of thinking and experimenting and technology is its offspring. It is a challenge that attracts creative minds. Science and technology are created by the efforts of people for the society. Thus science has power, from a material stand-point, to solve many of the problems of human race. Science can help us to solve our future difficulties, but the important solution lies with the attitudes of the people themselves. The betterment of mankind and, infact, the survival of mankind in the future, depends not on science and technology but on the people who apply science to human affairs.[2]

The basic question is: for whom is this science and technology? It should be for the society, that has to solve the problems and address the issues relating to society. Its true that science and technology have greater effect upon our social relations. We can state that science and technology in society are very much interrelated and we can call it sociology of sciences. Sociology of science defines the nature of scientific ideas and describes their relations to other kinds of ideas (e.g., ideological, philosophical, aesthetic religions etc). The sociology of science is interested both in fundamental scientific ideas themselves and in the application of these fundamental ideas or of more empirical ideas, to technology. The study of technology uses both historical and contemporary data.

Science exercises a significant influence on the pattern of human thinking and gullibility. The fundamental disciplines in science of

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[2] Nangla B.K. 'Science Technology and Society' in Prasad R. (ed.) (1995), *Science, Technology and Quality of Life*, Y.K. Publisher Agra, pg. 107.

reason, of observation, classification, verification, and scrutiny, which constitutes the scientific method, have impercebility influenced the pattern of human thinking for the educated lot. There is a growing tendency for a scientific temper and rational attitude. Man is more and more inclined to enquire into the what and why and how of events and concepts before he makes up his mind to accept or reject. This effect, though vary subtle, has far reaching consequences in man's approach and adherence to age-old values of life. They say that the way to Post-modern man's heart lies through his head. Science and technology with the use of precision-instruments and complicated equipments, such as electronic microscope, mobile phone, advanced super computer and many meters and troves and electronic devices, have considerably extended the frontiers of human knowledge. In particular technocrats are the real rulers of the Global society. Major sea change in the area of world wide network of communication and quick transportation have enabled communities from distant land to know each other, come closer, and to see and study different patterns of living, observing varieties of customs and traditions.

Science Technology and Society

Science and technology is an important factor of social change that has been debated for a long time now by the social scientist. In the contemporary world, science and more precisely its off -shoot, technology, has assumed an important dimension in changing the strategies and social change modalities world over. Technological change, it is argued, has became more visible and stronger than other factor of social change. The all pervasive power of technology is well

recognized. It is not only changing the mode of production but also individual behavior, cultural modes, social relations, societal structure and even international diplomacy.

Culture, economy, polity and technology (CEPT) have been interwoven in the historical past. Technology has been viewed as part of culture; the material aspect of culture is related to tools and technology. CEPT may be interwoven today but not in a complimentary sense as was perhaps the case in the yester-years. Technology has built its own empire. Not only that it is too powerful by itself it is now an important source of power for the power elite in most societies.[3]

Science and technology has been monopolized by a few enlightened, politically and economically powerful groups, and countries, thus alienating themselves from the needs and necessities of the masses.[4] All invention made to make life easy for 'people' the 'masses', has ultimately degenerated into "class-based" conveniences and comforts. It applies to most of the technologies. This may, perhaps, make intellectuals probe into the pattern of ownership of technology-means of production-production of goods, and service information. It is thus important to understand the economic structure and political system in which technology operates as an instrument of change. Capitalism, for example, is bound to monopolise technology for profits and power and contemporary multi-national corporate capitalism has no qualms about miseries of the people and nations whatsoever.

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3 Prasad Rajeshwar, (ed) (1995), *Science Technology and Quality of Life* Y.K. Publisher Agra, pg. xv.

4 Prasad Rajeshwar, (ed), op. cit., pg. xv.

In our own society the tribal population, women, the scheduled castes, particularly untouchables, the fisherman, the marginalized farmers and other traditional occupational groups, e.g. the artisans, and the rural masses are all part of the modern semi-sophisticated techno-economic and sciento-rational society but they are all alienated and marginalized parts that automatically form the exploited lot in our society. Where the life of tiny minority elite group has become more luxurious, more comfortable, more fortified by the modern technology, the big chunk of masses however, still languishes in poverty, unemployment, homelessness, hunger, ignorance and silent obedience to hierarchical authority. Neither qualitatively nor quantitatively, the quality of life of the masses has been improved and made better and respectable for an average Indian. It is usually argued that it is not the technology which is the villain it is the man controlling it who is the real culprit. The argument may be further extended, though in a Marxian frame that "man is shaped by the system", i.e. the system is subservient to superstructure. There is no doubt that science and technology has put tremendous pressure on our social structure but still we fail to address the core issues, for example, the green revolution was responsible for unexpected spurt in agriculture production in India but the distribution and availability of food has been dismal. White revolution phenomenally increased milk production in the country but vast majority of children who belong to weaker section of society still do not get milk. Rural development brought tractors and water pumps to the villages but it has instead made water a commercial commodity in rural areas. Water is now sold much against the cultural value of our society. So it can state that the relationship between science technology and society should be

evaluated as a relationship between two levels of the cultural system, the universal, and historical respectively.

The central issue of sociological analysis of the impact of science and technology is the intriguing problems of the prospect of social development, of changes in the nature and structure of society. It provides subject matter for reflection upon the coming of "new society"; it underlies the advocacy of the advent of "new industrial", "technological" or "technocratic society", "post-industrial society", post traditional or post- modern era, "society of knowledge", learning society, "informal society", 'civilization of services, tertiary society, affluent society, post-capitalist or post-bourgeois society, "planetary society" and global society.[5]

It is also apparent that the internationalization of science and technology and their interrelationship with the ethos and structure of a society, can stimulate, and even ensure, social and national revolution. There are several relevant examples in present day Asia-China, Japan, India and notably Vietnam. Therefore, the social function of science and technology can be appraised for mankind as a whole, irrespective of the inter-societal and historical variations.[6] Nevertheless, science and technology plays a crucial role in upgrading the quality of life. Quality of life has been expressed in different ways, that is "standard of living", "mode of living", "life style" "physical/material aspect of life", 'socio-

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5 Nangla B.K. "Science Technology and Society", *Science Technology and Quality of Life* Prasad R. (ed.) (1995), op.cit., pg. 107.

6 Nangla B.K., op.cit., pg. 107.

economic condition of people, 'spiritual and cultural aspect of life', "social welfare", "societal development" and "human development" etc.[7]

Science and technology provides instrumentalities for more effective dimension of man. The technological society creates a constellations of situations which erode the autonomy, independence and significance of the individual, adding to his feeling of smallness and powerlessness. Technology has made external control of man more effective by introducing some pleasant or euphoric means of control. Mass entertainments and various assortments of material comforts which are a product of technology and high level of living standards unknown in previous stages of civilization, have all combined to dull his mind and increase his passivity.

Technology is instrumental in creating a false consciousness of pleasurable enjoyment which conceals the substantial alienation behind it. It is argued by some critics that the production of instrumental knowledge by science is utilized in the form of instrumental rationality for effective technical rules and procedures, which become established as values in themselves. Max Weber also alluded to the imprisonment of modern man in the "cage" created by the disoriented process of rationalization inevitable in the modern mechanized bureaucratic technical-industrial civilization.[8]

The motive force to technical progress in particular, and human history in general is provided by the goal of humankind which can be

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7 Prasad R. op.cit., pg. ix.

8 Weber Max, 1976, The Protestant Ethic and Spirit of Capitalism (Trans. Talcott Parsons) 2nd edition, George Allen and Unwin.

expressed by four "cardinal values" applicable to all humans, namely, survival, security, prosperity and progress.[9] It is again here that role of technology in development, underdevelopment, national and international interdependencies needs to be examined.

Interaction of Science, Technology and Society

The interaction of science and technology is mutual, viz., science is feeding technology and vice- versa. Technology requires for its growth as has been pointed out earlier, all the information which science has to give.

Technology interacts with science by providing the latter the necessary instruments required to carry out research.

The interaction of science with society is at two levels.

Firstly, science needs resources for its development. This is a major social investment. Secondly, the value engendered by science, as and when and the degree to which they permeate in society, affect it deeply. One of the values is respect for facts. It has become one of the universal human values now.[10]

The interaction of technology with society is more direct and complex. The investment in technology, and through it in the industrial development, brings in new social forces into operations. In this regard it may be worth while to indicate two features. Firstly, an investment in

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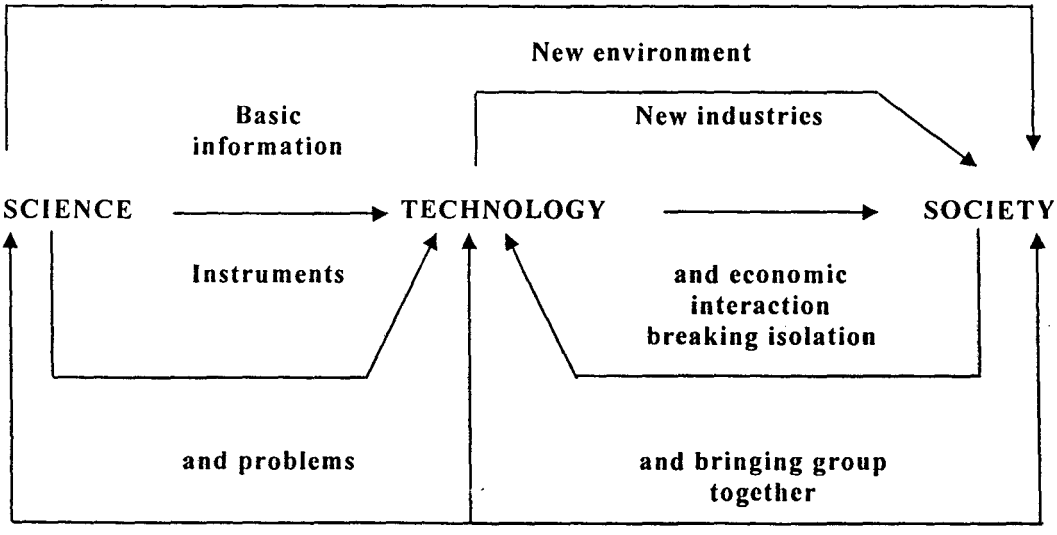
[9] Mukherjee Ramakrishna, 1991, Society, Culture, Development, Sage, New Delhi. pg. 15.

[10] Rahman A. (1972), Trimurti Science, Technology and Society, A Collection of Essays People Publishing House, New Delhi, pg. 9.

a particular technology tends to create a vested interest for its continuation, to the exclusion of newer technology that has shown mankind how to create wealth. The ability of society to create wealth, creates a new dimension and demands from mankind totally new thinking.



Schematic representation of Science Technology and Society

Source: Rahman A. (1972), Trimurti Science, Technology and Society, A Collection of Essays People Publishing House, New Delhi, pg. 12.

Objective

1. To Explore the relationship between science, technology and society at both macro and micro level.

2. To explore development of science and technology in a historical perspective in India particularly and also emphasize the recent development of science and technology after independence.

3. To analyse the role of science and technology for weaker sections, of society, in particular, women, Schedule Caste.

4. To understand how science and technology becomes a major factor of social change.

Methodology

For the present study on "Science, Technology and Society in India", the methodological aspect bears an important aspect so that there are no preconceived value judgements or any personal biases. Our study is based on secondary sources i.e., data has been generated on the basis of extensive literature survey and sources from various books, journals and reports pertaining to the issue of science and society in India.

Relevance of the Study

Science and technology have no doubt influenced the Indian society profoundly. Therefore, it becomes a relevant area of research. So far as the *relevance* of the present study is concerned, science and technology being an integral part of Indian culture, acts as a major force in social evolution. There is an ongoing process of interaction between knowledge and its application. In the contemporary world, this interaction has assumed considerable significance. Though there has been a qualitative change in the problems facing mankind, the social organisation is becoming increasingly complex. Increase in population, demand of science and technology and rising aspirations of various sections of the society which for centuries remained depressed, have been partly the result of the growth of knowledge and consciousness. In this regard, the growing demand for science and technology has further

strengthened the urge to study its development, and its contribution to Indian society. Thus, it becomes imperative to carry out critical sociological studies to understand our own indigenous-culture and its scientific and technological base and its implications for society. So the present study is based on the optimistic belief that science and technology will transform Indian society, break new ground, and inspire many more studies in this area.

However, though the study of science and technology and its to contribution to Indian society is of considerable significance, yet, this area is not devoid of *limitations*.

Limitations of the Study

Science and technology though had a considerable impact on the Indian society but the fruits of science have not been reaped by the masses as the benefits are always appropriated by a particular section of society.

Paucity of time did not permit me to conduct an empirical study which apparently is a major limitation of this study. However, one hopes that this work will be relevant for policy makers and researchers.s

CHAPTER – I

SOCIOLOGY OF SCIENCE, THEORETICAL PERSPECTIVE

Regarding theoretical perspective as Einstein once put it: "It is the theory which decides what we can observe.[1] It means that the theory is the basic building block of any scientific research that may be social science or any pure natural of physical sciences.

This chapter focuses on major and selected theories regarding science and technology and society. Various sociologist and social scientists have given their views regarding science, technology and society.

The sociology of science has two main purposes. The first is to provide instructive and readable material on science as a social phenomena: it has essentially a social character, its socio-historical development, its pattern's of organizations, the social image of science, social influence an the process of discovery and the social responsibilities of science. The second purpose is to contribute to the further development of the sociology of science as a specialized field of study of a great intellectual and practical importance. Few scholars who have seriously cultivated the sociology of science are Robert K. Merton and Talcott Parsons. They are outstanding in their contribution to the sociology as a whole as well as to this particular field.[2]

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1 Quoted in Warner Heizenberg (1971), *Physics and Beyond: Encounters and Conservation,* Free Press, New York, pg. 63.

2 Barber B., Hirseh, W. (1972), *The Sociology of Science*, The Free Press New York, pg.1.

Robert K. Merton

Let us try to look at R.K. Merton's view: "Puritan thesis, as presented in his ***Science, Technology and Society in Seventeenth Century England (1938)***. Although Merton did not explicitly identify the causal influences underlying the rise of modern science, but clearly implied that the dominant set of values prevailing at that time in particular encouraged practical experiment – as distinct from any material factors that were chiefly responsible.

The main influence of Merton's early work proved to be in promoting not the "realistic" but elusive study of science as an integral part of the wider society. It was rather the internal analysis of an "idealized", but accessible, science defined as a more or less independent social subsystem.

In this approach the methodological and cognitive aspects of science are accorded much less prominence than the behavioural norms of people who carry it out. Because it emphasized the internal working of science as a social institutions, for example, the social characteristics of the organization of science and the commitment of scientist to a clearly understood theoretical framework, the appro ach is often referred to as "functionalist". That is it concerns the forces which functions to maintain the status quo of the subsystem of science.

The Ethos of Science

Merton's work is still regarded as the only mature tradition in western academic sociology of science, even though in recent years it has been increasingly attacked. It represents a highly idealized conception of

science in terms of four norms, or institutional imperatives, which are said to govern scientific activity.

The first institutional imperative is that of ***Universalism.*** The purpose of this is to guarantee that new knowledge is evaluated solely interms of objective, impersonal criteria, and that such things as career advancement are determined solely by talent. Universalism is subjected to the most acute strain at the time of international conflict, for it is incompatable with values such as "ethnocentrism" or nationalism. On the other hand, it is fostered by democracy, since it values accomplishment against ascriptive status.

Communism is the second norm intended in the sense that the good of science, its body of public knowledge are subject, not to private, but to common or public ownership. Science accumulates knowledge by means of its extended, co-operative enterprise, its funding being assigned to the whole community. As a result only property rights of the individual scientist are those of recognition and esteem which accrue roughly in proportion to the importance of his work. It is for this reason that disputes over priority of discovery, a recurring phenomena through out the history of science are seen as conforming entirely to the institutional imperatives.[3]

It is the individual duty to communicate his findings among his colleagues, because the most basic institutional goal of science is the extension of knowledge. Merton's third imperative elements of scientific ethos is that of "***disinterestedness***", taken to mean a deep, but detached interest in the working of the world, and interested in what is, simply for

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[3] Richard, S. (ed.) (1987), *Philosophy and Sociology of Science, An Introduction*, Basil Blackwell, Oxford Press, pg. 103.

its own sake. The scientist is expected to make his discoveries available to public scrutiny and there is accordingly, little scope for fraud or irresponsibility. In this important sense the behaviour of scientist is subject to close institutional control. A failure by the individual to conform will be condemned by the wider community, thus enforcing the translation of ***disinterestedness*** into practice no matter what motives may operate unseen.

The final institutional imperative is what Merton calls *organized scepticism*. Clearly it interrelates with the others and, indeed is a crucial part of scientific methodology itself. It is this element which most often brings science into conflict with other social institutions, such as the church or the state, for science "does not preserve the cleavage between the sacred and profane, between that which requires vertical respect that which can be objectively analysed.[4]

Talcott Parsons

Parsons, argues that basic norms of scientific knowledge are perhaps four i.e, empirical validity, logical clarity or precision of the particular proposition, logical consistency of the mutual implications of propositions and generality of the "principles" involved which may perhaps be interpreted to mean range of mutually verified implications.

Parsons, whose interest in science stems from the most general theoretical concerns for sociology as a whole, begins by showing why 'science' of some sort must exit in every society, why there can be no social action without certain of rational empirical knowledge of the

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[4] Richard, S. op.cit., pg. 103.

physical, the biological, and the social worlds.[5] He then defines the basic characteristic of scientific ideas as a structure in their own right and indicates how these several characteristic vary in different societies. The characteristic of systematization and generalization for example are very much greater in 'modern' science than in the science of primitive or ancient civilized societies.

Parsons has described the norms and other elements of the western cultural tradition that have been powerful supports for the development of modern science. He also touched upon the organizational supports for the scientific role, stressing especially the great importance of the university; and he has not neglected some of the problems of the professionalization of the scientific role, what he calls "the communication gap" and the disturbing impact of scientific discoveries on a variety of social, economic and religious vested interest.

Daniel Bell

Daniel Bell argues in his book "Coming of Post-Industrial Society "that there is a radical gap between the present and past, technology has one of the chief focus in the direction of social time, for by introducing a new matric and by enlarging our control over nature, technology has transformed social relationship and our way of looking at the world.

He has listed five ways by which technology brought these transformation.

1. By producing more goods at less cost, technology has been the chief engine of raising the living standards of the world. The achievement

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5 Parsons Talcott , Institutionalization of Scientific Investigation, the *Sociology of Science*,Barber. B. Hirsch (ed) (1962), Free Press New York, pg. 7.

of technology, the late Joseph Schumpter was fond of saying that it brought the price of silk stockings within the reach of every shop girl, as well as of a queen. But technology has not only been the means of raising levels of living, it has been the chief mechanism of reducing inequality within western society. For example, in France, writes Jean Fourastic "The chief justice of the court of Accountants .... earned in 1948 not more than four and a half times as much as his office boy by hour of work, although the difference between these two positions was of the order of 50 to 1 in 1800". The simple reason of this as Fourastic points is the cheapening of goods and the rise of real wages of the working class in western life.

2. Technology has created a new class, hitherto unknown in society, of the engineer and the technician, men who are divorced from the site of work but who constitute a "planning staff" for the operations of the work process.

3. Technology has created a new definition of rationality, a new mode of thought, which emphasizes functional relations and the quantitative. Its criteria of performance are those of efficiency and optimization, that is, a utilization of resources with the least coast and least effort. This new definition of functional rationality has its carry-over a new mode of education, in which the quantitative techniques of engineering and economics now jostle the older modes of speculation, traditions and reason.

4. The revolution in transportation and communication, as a consequence of science and technology, have created new economic interdependencies and new social interaction. New networks of social

relationship have been formed, transcending physical, social and cultural boundaries.

5. Perceptions, of space and time, have been radically altered. The ancients had no concept of "speed" and motion in the way these are perceived today: nor was there a synoptic conception of height the view from the air-which provides a different standard of assessing a landscape of a cityscape. It is in art, especially in painting, that such a radical change of sensibility has taken place.[6]

Karl Marx and Max Weber

In the field of sociology of science, the approach was closely associated with the names of Karl Marx and Max Weber, and it sprang from an earlier and broader intellectual tradition which now refers to as the sociology of knowledge, a discipline that explored the influence of social forces upon the origins and development of ideas. In general Marx's view was that the system of ideas identified with a particular society was most powerfully influenced by societies' economic base, that is by the prevailing economic conditions of life. Thus it was an individual positioning, the class structure, for example, which largely determined in ideas and beliefs. Weber on the other hand, while not discounting the importance of purely material factors, argued that ideas themselves also have an important function in society. It was for the reason that he examined the general world outlook and value system of Protestantism in

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[6] Bell Daniel (1974), *Coming Post- Industrial Society*, A Venture in Social Forecasting, Arnold India, pp.188-189.

respect of its impact on the development of capitalist economics in Europe.[7]

Thomas S. Kuhn

T.S. Kuhn's book the '***Structure of Scientific Revolutions***' has been acclaimed as a major intellectual landmark. Kuhn's view of science thinks in terms of communities of scientists rather than of individuals. Kuhn's indoctrination confines what Kuhn calls a "paradigm". According to Kuhn it is the paradigm which represents the structured whole of a given science and which also guides the research activities of its community. This is because the paradigm represents the totality of the background information. The work of the community is linked by Kuhn to "puzzle-solving" and the sum of this activity constitutes his "normal science". Normal science that works within the paradigm and does not question its authority is a highly cumulative process.[8]

Kuhn's work has provided a new and subtler insight into the internal process of science which accounts both for its stability and its growth.

The British sociologist M.J. Mulkey argues that growth in science occurs as a result of the spread of a paradigm's influence from the area in which it was formulated into other areas. He also adds that the actual process by which new ideas are generated is closely tied up with the "cross-fertilization of ideas". As evidence of this, he points to the

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7 Richard, Stewart, (1987), *Philosophy and Sociology of Science, An Introduction*, Oxford. pg. 102.

8 Richards, S. op.cit., pg. 107.

contrasting structure and functional organizations of the French and German Service in the nineteenth century.[9]

Karl Popper

Karl Popper is known for the method of falsification. The most influential advocate of this conception of scientific methodology has been Karl Popper. His views were first published in 1934 in the Logic of Scientific Discovery (translated into English, 1959) but his more famous book ***Conjectures and Refutations*** (1963), encapsulates the essentials of his "***Method of Falsification***". Hypothesis are to be developed and attempts made to falsify them through empirical research. In Popper's own words, there is no more rational procedure than the method of trial and error of Conjectures and Refutation; of boldy proposing theories; of trying out best to show that these are erroneous; and of accepting them tentatively if our critical efforts are unsuccessful.[10]

Paul Feyerabend

Paul Feyerabend in his book ***Against Method Outline of An Anarchistic Theory of Knowledge (1975)***, Paul Feyerabend points an "irrationalist" picture of science, denies that there is, or ever has been, an objective scientific method and claims that if any progress is discernible in science it is the result of scientists having broken every conceivable rule of rationality.[11]

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9 Richards, S. op.cit., pg. 107.
10 Richards, S. op.cit., pg. 52.
11 Richards, S. op.cit., pg. 69.

Sex, Science and Society

Overwhelmingly, the "great" scientist of history have been men until relatively recent times. The causes underlying this state of affairs were seldom sought. There were powerful were the cultural and ideological pressures on women to conform to the norm of feminine docility and domestic servitude. With the rise of feminist movements however, and the consequent widening of women's expectations to areas beyond the home and family, the traditional stereotypes and their social consequences have increasingly been challenged. Sociologist have made detailed investigations of the nature and extent of sexist discrimination generally, and by now there is a good deal of information specifically relating to science. Together with scholarly literature, it must be said that there has also been a rapid growth in the abundance of articles written by committed feminists.

At any rate, it is because the strength of feeling generated on such contentions issues as sex discrimination is seldom related directly to the quality of supporting evidence. We are fortunate in having an article and a book written by the respected American scholar, Jonathan Cole. The first "Women in American Science" (1975) was written with his equally distinguished compatriot, Harriet Zuckerman, and concerns the so-called triple penalty traditionally paid by women in their attempt to penetrate the scientific establishment. By this, the latter had in mind that first, the cultural barriers which defines science, as an inappropriate career for women; second, the dismissive attitudes often adopted by male scientists to those women who have managed to enter the profession attitudes which damn them as in-capable of creative work; and third, the actual discrimination in term of organizational barriers in the allocation of

scientific opportunities and rewards. In Cole's book, ***Fair Science*** (1979), current beliefs about the treatment of women in science are examined further. The book's ambiguous title nicely encapsulates its analysis of the position of women in a community which prides itself on operating entirely equitable criteria of recognition.

The investigation suggested that the position of women in science might be determined by a combination of two potential factors, "social and self-selection'. Social selection refers to discrimination against women by the institutions that employ scientists. This of course is just the sort of prejudice that feminist fear and expect, but the evidence shows, at least in modern America, such discrimination in largely illusory. Science, it seems, is substantially meritocratic. Improvements have undoubtedly occurred for female scientists in recent years which have gone hand in hand with the liberalization of public attitudes, particularly those concerning careers for married women. In simple statistical terms, for instance, the percentage of science-doctorates gained by females in United States rose from 11 in 1969 to 23 in 1976.[12] The feminist movement has been a major force in this advance destroying many of the myths about women, creating a wider consciousness of their equal rights, and demanding affirmative and legislative action.

Proto-Science, Para-Science and Pseudo-Science

It must be obvious that the problem of demarcation is now a great deal more complex than it was a generation ago. At least, this must be so if we are persuaded that science is influenced by social forces in much the same way as other areas of organized knowledge. But while the

[12] Richards, S. op.cit., pg. 175.

traditional criteria of demarcation may now seem inadequate, we still tend to act as if we know intuitively what science and non-science really are. For instance, few people would hesitate in making the distinction between the following pair of subjects. Astronomy and Astrology; chemistry and alchemy; neurology and phrenology, even though closer examination might convince most of them that substantial areas of awkward grey area exists between the clearly black and white.

Although it would be convenient to concentrate solely upon the distinction between science and non-science, as tended to be the pattern in the past, the title of this section indicates that the problem is now be dealt by the use of several other terms, as if they each has precise and agreed meanings. An important point to make here is that the form "non-science" is often used in a relatively neutral sense to describe the study of literature, metaphysics or theology, subject which do not claim to be scientific and are not defensive about it.

The other terms, however are more clearly normative, even though they still mostly refer to kinds of activities that fall within the category of non-science. Thus "pseudoscience" clearly implies the burden of the false pretender; we generally understand it to refer to an activity and a set of beliefs that claim to be genuinely scientific, but are not recognized as such by the scientific establishment. The term "para-science" is more complex for it is used to describe quite a wide spectrum of activities. For example, the "para-medical" sciences are simply those ancillary to clinical practice; in this particular case they are recognized to be genuinely scientific and indispensable as the basis of modern medicine, they are still some how subservient to the great profession itself (which ironically, could be said to incorporate many elements that are clearly

"non-scientific"). At the other extreme "paranormal" phenomena in general such as clairvoyance and telepathy, fall within the highly controversial area of "parapsychology" which is dismissed by the majority of scientist as simply pseudoscience, yet gaining the guarded support of a minority. Finally, the notion of "proto-science" seem unambiguous as it refers to disciplines with the potential for genuine scientific status, but which for the present are in the state only of becoming.[13]

In the next chapter we will analyze the impact of science and technology in the Indian society and highlight the historical perspective along with the recent developments.

[13] Richards, S. op.cit., pg. 223.

CHAPTER - II

SCIENCE TECHNOLOGY AND SOCIETY IN INDIA

Historical Tradition of Science and Technology in India

Science basically means search of Truth, our sages and seers were great seekers of truth. In their search they not only accomplished remarkable feats in the realm of philosophy, religion, ethics, art, culture but they also contributed significantly to the development of science and technology. When we think of the early periods of Indian history what immediately comes to our minds is the total tradition of science which was the product of outstanding contribution of men like *Aryabhatta, Varahmihura, Charaka, Susrata, Vagabhatta* and *Bhaskara.* In the field of mathematics it was India who gave the "ZERO" to the world. The Arabic numericals, which went from the Arab to the western world, were, in fact invented by Indians. They are known as "Hindsa" in Arabic, meaning "from India". In the field of Astronomy, India had remarkable achievements to her credit. People in Ancient India were known to have computed the exact timings of the Solar and Lunar eclipses. They had calculated very fine and accurate calendars. In the field of medicine India had developed the science of surgery. The diagnostic and pathological aspects of medicine also were highly developed. Similarly, strides had been made in the field of chemistry and metallurgy. The use of different kind of metals and alloys was known to the ancient men of India, a specific example in this regard is the, Iron pillar of Gupta period presently situated in Mehrauli at Delhi.

It indicates their intense knowledge of science and metallurgical technology.[1]

During the medieval period also there was considerable scientific activity in India. Architecture, engineering and industry, particularly in the textile industry were highly developed. It would be wrong to say, as some people have commented, that India had no industrial base in the earlier periods. In fact India had highly developed industries. The muslin cloth which was produced at different centers in India was vary popular during the medieval ages among Europe.

Tremendous contribution was made in the field of geometry, geography, chemistry and metallurgy. New plants were raised and experiments were conducted in the field of animal and plant breeding. By this time India had also begun to exchange scientific knowledge with central and West Asia, and had established trade links with the Arab and other countries of the world, including several European countries. [2]

One example of the quality and the popularity of the Indian goods in the western market is that of Britain. Even after the industrial revolution it had to pass legislation to protect her own nascent industries against spread of Indian goods in her market. The weaving of wrought silk and printed and dyed calico from India, Persia, and China was prohibited by an Act on Parliament, and a penalty of £200 was imposed on anyone having or selling them. Britain knew very well that British goods could not compete with the creative crafts of India. British

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1 Heptulla N. (1986) *India's Progress in Science and Technology, Continuity and Change*, Oxford and IBH Publishing, New Delhi, pg. 1.

2 Rahman A. and Acharya, K.T. (1969), *The Thing called Science and an Introductory essays, in Science Perspective*, Rahman A. and Acharya K.T. (ed) Bombay Academic Books pp. 27-28.

goods were thrust upon India with no duty being paid on them and the manufacturers operating through political channels so as to keep down and ultimately eliminate the competitors with whom they could not compete on terms of quality. As a result of this protection British industry flourished. Britain was also competing with other European countries that wanted to capture the Indian market for their goods. Due to the mass production technology they were producing more than what was required for their use and they were keen to find markets for their goods outside their own countries. So they dumped all their good in the Indian market. It was this search for a market by the European world which ultimately let Britain to colonize India.[3]

Thus one can even say that the Indian economy, which was highly developed due to the application of science and technology, was one of the main attraction for Europeans mercantilists to come and establish trade here. After the industrial revolution in Europe, India lagged behind. The kind of mass production technology which developed through machines and mills in the western world in the wake of the industrial revolution could no be implemented in India. It is however, difficult to find any definite answer as to why India with such a fine background of science, suffered acute stagnation in the field of science and technology during this period.[4] There could be one possible answer that the political and economic factors presented such matrix that it was perhaps not possible to develop the kind of science which has flourished in the earlier days and at the same time it was difficult to develop the

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3 Heptulla, N. (1985), *The Indian National Congress and Science*, New Delhi AICC (I) Publication, pg. 2.

4 Heptulla, N., 1986, op.cit., pg. 3.

new technology which could compete with the technology of the western world.

Origins of Modern Science and Technology

The sixteenth century world history saw the disruption of western Christianity and the rise of modern science. It was an age of fragmentation. Nothing was settled, though much was opposed – new worlds and new ideas. In science, Copernicus and Vesalius may be chosen as the representative figures: they typify the new cosmology and the scientific emphasis on direct observation. Giordano Bruno was the martyr; though the cause for which he suffered was not that of science, but that of free imaginative speculation. His death in the year 1600 ushered in the first century of modern science in the straight sense of the term .Modern science and technology was born in Europe, but its home is the whole world.

Growth of modern Science and Technology during the eighteenth century led to many technological inventions, which finally led to the industrial Revolution. This industrial revolution transformed Europe specifically Britain from a predominantly rural agrarian society to an increasingly urban one based on manufacturing and industry. The science and technology were the major catalysts behind industrial revolution and transforming it to a global society.

Modern Science and Technology in India

Science in its modern form was certainly the gift of the West to India.[5] The colonization of India by England changed the future course of scientific development. As a result of technological renaissance in Europe the so-called western science began to have an impact on the growth of science in India as well.

Although India had very strong traditions of science, the introduction of western science was definitely not an extension of the earlier traditions. Rather western science was totally alien to the people of India. Western science relied much on experimentation which, for many reasons, had hitherto played an insignificant role in the growth of Indian science.

Western science which was introduced to India largely by the British as a fully developed system had hardly anything to do with the Indian traditions of science, yet its introduction was not opposed by the people as vehemently as various other measures introduced by British. For example, when the British wanted to introduce social reforms, they had to face stiff opposition. In 1876 in the course of a visit to India, a British statesman was informed by a Pandit that ghosts were less evident with the advent of rail travel. There is a belief among Hindus that if a person dies without his last rites being performed, he become a ghost. It appears that communication had become so rapid that hardly anyone died on the way while on a long journey, to be deprived of the last rites; hence there were fewer ghosts. Another British statesman maintained

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[5] Aiyagari Rao, V. and P.J. Policy Formulation in Science and Technology In: Policy Making in Government (ed) Madan K.D. (1982), et. al. Publication Division, Ministry of Information and Broadcasting, New Delhi, pg. 448.

that railways and steamers enhanced the popularity of pilgrimage among Hindus, and increased the solidarity among Muslims.[6]

The growth of science in India under the British, however, was not systematic. Institutions were established mainly to furnish data that was required by the British from time to time for various operations facilitating colonial exploitation.[7] British wanted to know about India's natural wealth, the fauna and the flora. They wanted to collect the climatic and geographical data of the country. For this purpose they established scientific departments like the Botanical Survey of India (1899), the Geological Survey of India (1851), the Indian Marine Survey Department (1874), and the Indian Coastal Survey (1875). They also setup observations at Madras, Calcutta and Bombay.[8]

The Asiatic society founded by William Jones came into being in 1784. The society also helped in the promotion of investigations of scientific nature and the range of these investigations naturally widened as result of commercial, political and scientific stimuli. Although all these surveys and the data collection work were done mainly to promote British colonial interests, they also promoted unintentionally western science in India and the progress of science in the western world did influence the minds of some of Indians. Greatly influenced by the promotion of science in the west Sir Mahendra Lal Sircar founded the Indian Association for the cultivation of science in 1876, through public endowment. This organization aimed at attracting talented youth to conduct advance research and enhance the status of science in India to

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6 Gosling, David L. (1976), *Science and Religion in India,* C.L.S. Madrass, pg.18.

7 Heptulla, N, (1985), *The Indian National Congress and Science*, New Delhi AICC (I) Publication, pg. 9.

8 Heptulla N., op.cit., pg. 5.

the level of science as obtained in Europe. The Association Promoted the scientific movement in a big way great scientist like J.C. Bose, P.C. Roy, C.V. Raman and K.S. Krishnan were associated with this organization at one time or other. The Indian science congress was inaugurated in 1914, the Indian Academy of Science in 1934 and the National Institute of Science in 1935. In January 1944, for the first time in its history of 281 years, the Royal society held its meeting outside England.

The western science and technology affected social relations as well. The scientific institutions and societies were definitely the product of new thinking aimed at promoting science in India.

In 1904 the University Act came into being. It allowed the existing Indian Universities to organize teaching and research instead of being merely affiliated teaching bodies. 1909 provision was made for Post-graduate teaching and research at the Calcutta University. Sir Ashutosh Mukherjee, who was himself a mathematician started the university college of science at Calcutta in 1916. In 1917 an engineering college was set up at Banaras Hindu University. This college undoubtedly, was the product of the upsurge for national education.

The Indian scientists contribution was immense; J.K. Bose, studied molecular phenomena, P.C. Ray analyzed a number of rare Indian minerals to discover in them some of the missing elements in Mendileef's periodic table. C.V. Raman was awarded the Nobel Prize for Raman's effect, Meghnah Shah contribution to the field of astrophysics; S.N. Bose's collaboration with Einstein led to what known as the Bose-Einstein Equatic. D.N. Wadia worked in the field of geology, Birbal Sahni in palebotany, P.C. Mahalonobis in statistics; and

S.S. Bhatnagar, in Chemistry. Homi. J. Bhabha later became the chief architect of independent India's nuclear programme and Vikram Sarabhai contributed to the development of space research programme. Apart from the individual contributions of these scientists, the greatest contribution of these persons was in the field of teaching and guiding research. Many of them set up scientific institutes. This gave further impetus to scientific activity in India. The Indian Institute of science was founded in Bangalore in 1911 at the initiative of and from the funds provided by J.N. Tate and J.C. Bose founded the Bose Research Institute in Calcutta 1917.[9]

The out break of the second world war in 1939 brought about a radical change in the pattern of scientific and technological research in India. The colonial government in India had her links severed from British due to the war. This made it essential for the colonial government to development of local resources, meet the demands of war and strive to became industrially self- sufficient to meet the challenges posed by conditions of war. It was therefore, necessary to establish a Central Research Organization and this was eventually followed by the establishment of the council of scientific and Industrial Research (CSIR) in 1942 as an autonomous society. As part of the post-war reconstruction plan, the government invited Professor A.V. Hill of the Royal Society who visited India during late 1943 and early 1944. Professor Hill prepared a report that identified various problems confronting research in India. In this time India's freedom movement was at its peak. Indian National Congress also played crucial role for the development of science and technology.

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[9] Heptulla, N., op.cit., pg. 7.

Science and Indian National Congress

Indian National Congress has played a significant role in promoting science and technology in Indian Society.

In the resolution adopted in 1892, the Congress regarded technical education as one of the most essential branches of education.[10] The *Swadeshi* Movement launched by the Congress in 1905 was aimed at promoting indigenous technology industries. *Swadeshi* was not only an economic doctrine; it was in fact attitude of life.

Mohandas Karamchand Gandhi entered into the Indian political scene, which he dominated from 1920 onward. He explored the field of *Swadeshi* in search of programme to build a new India. Gandhiji was searching for an instrument which could promote Indian technology; a kind of technology which did not believe in mass production but in production for the masses. His search ultimately led him to discover the '*charkha*'. He said he saw the wheel in 1908 but he realized its potential much latter and in 1921 the wheel found a place in the Congress programme.[11] Gandhiji always emphasized the development of indigenous technology and promote local science.

Subhash Chandra Bose clearly said in the meeting of industries ministries that India had to use science and scientific personnel for national reconstruction. He felt that there were basically two types of development. One was the slow and gradual industrialization as had been the case of Britain and the other was forced March, as was the story in Russia. For India he believed, the pace for development had to

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[10] Zaidi, A.M. and Shaheda, S.G. (1970), The Encyclopedia of India's National Congress (Vol. 1 1885-1990), S. Chand and Co. Ltd., New Delhi, pg. 227.

[11] *Young India*, September 20, 1928, pg. 27.

be forced March. He categorically stated, "India is still the pre-industrial state of evolution. No industrial advancement is possible until we pass through the throes of an industrial revolution. The industrial revolution is an evil, it is a necessary evil. We can only try our best to mitigate the ills that have attended its advent in other countries".[12] At the same time Nehru was more visionary regarding the development of science and technology.

Nehru and Science and Technology

Jawaharlal Nehru who had a major say in the affairs of the Congress was himself impressed by the achievement of science. He took active interest in the progress and promotion of science in the country.

Nehru had great faith in the scientific method. The letter which he wrote from jail to his daughter Indira Gandhi clearly bears the imprint of his scientific analysis.

For the progress of science in India he wanted the Indian masses to develop a scientific temper. In 1938 at the National Academy of Science Nehru said,

"Science has brought about all these mighty changes, and not all of them have been for the good of humanity. But the most vital and hopeful of the changes that it has brought about has been the development of scientific and outlook of man". Nehru wanted a scientific temper to be acquired not only by the Indian masses but by scientist themselves. Unless they acquired the scientific temper they could not be any scientific progress. A scientist had to see the problem

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[12] Mitra, Nripendra Nath, The Indian Annual Register (Vol. II: July – December 1938), Calcutta, pp. 288-290.

of the common man. A scientific discoveries take account the human fall. He had to help the planners and administrators in solving the problem of poverty and ignorance.[13]

The marvellous growth of science in India witnessed after independence was due to the efforts of Nehru who had always identified himself with the cause of science and technological workers. After independence when Nehru became the Prime Minster he also looked after the science portfolio. In 1951 India became the first country in the world to have created a ministry on Natural Resources and Scientific Research.

Nehru shared the general ideas about science which socialist scientists like Haldane, Blackett, Bernal and others had been formulating and advocating since the second world war. Science and technology were the key to the problems faced by the society, problems of hunger, poverty, unemployment, health and housing. In addition science had a broader role to play in liberalizing the human intellect and giving new dimensions to human thought and feeling. Nehru even went a step further in advocating that scientific values and outlook should be a part and parcel of society. He coined the phrase: "the scientific temper" to describe this outlook and the self-judiciousness of the scientific process.[14]

How were these ideas to be applied to the situation in India, where large masses of people were illiterate and superstitious, where even those who were educated remained ambivalent and where the base

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[13] Malhotra, P.L. (ed) (1985), *Nehru: An Anthropology for Young Readers*, NCERT New Delhi, pp. 192-194.

[14] Rahman A. (1972), *Trimurti, Science, Technology and Society, A Collection of Essays*, People Publishing House, New Delhi.pg. 79.

for science was narrow and limited and the task facing the country immense? Nehru consistently tried to follow certain basic approaches:

Firstly, through the government he tried to extend the base of science by creating agencies for science and technology, establishing institutions for education and research and giving large support to existing institutions. In the field of education, the creation of the institutes of technology could be mentioned.

Secondly, he tried to involve scientific thinking and methodology in the governmental structure and the decision-making machinery.

Thirdly, through his personal participation, as head of different agencies, in various committees, scientific meetings and conferences, he endeavored to inject science and technology into the social context and at the same time reminded scientists and technologists of social goals and objectives.

Lastly, he emphasized, again and again, the value of science in everyday life and the need for developing the scientific temper.[15]

Development of Science and Technology in the Indian Scenario

The Govt. of India has been consistently laying emphasis on the development of science and technology as a major instrument for achieving national goals of self-reliance and socio-economic development. The Scientific Policy Resolution as adopted by Parliament on March 4, 1958 laid stress on Government responsibility to secure for

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[15] Rahman A., op.cit., pg. 80.

the people, the befits from acquisition of scientific knowledge and practical application of research or the policy application of research. The policy of the Govt. is to encourage individuals and collective initiative for dissemination of knowledge and faster programmes to train scientific personnel to fulfill country's needs in the diverse fields of agriculture, Industry, Defense, Education, Space, Information-technology, Oceanography etc. A number of new agencies and departments such as the Department of Environment, Department of Ocean Development, Department of Non-Conventional Energy Sources, Department of Biotechnology and Department of Science and Technology etc. had already been set-up to deal with newly emerging areas of knowledge and translate the technological power of socio-economic power of mass. There was immense development that had occurred in the following areas.

Agriculture Research: The contribution in scientific and technology research have induced a phenomenal transformation in Indian agriculture from subsistence type into commercial farming. India occupies a premier position amongst the oilseed producing countries of the world. Research efforts have been intensified to bring out crop varieties tolerant to drought conditions, resistant to pests and diseases and responsive to the use of higher doses of fertilizers. The growing resilience of Indian agriculture, its capacity to withstand droughts and natural calamities and the near attainment of the goal of food self-sufficiency by the country are the tributes to the untiring efforts of the agricultural scientists as well as millions of farmers who have willingly and enthusiastically transformed this new agricultural technology from the laboratories to the farms and fields. But for the development of new varieties of H.Y.V. seeds, crop protection measures, improved farming

practices, better water management etc., the kind of green revolution that the country has witnessed over the past few years, could have not been possible. Science and technology was the real powerful catalyst to change the socio-economic profile of masses through green revolution.

Industrial Research: Over the years a strong science and technology infrastructure base has been established in our country. This covers a chain of national laboratories, specialized centres, various research and development and academic institutions, training centres etc., which continuously provide expertise, technically trained man power and technological support to industry. The Council of Scientific and Industrial Research with its network of laboratories and research institution is a major instrument of scientific and industrial research under state auspices and supports research in universities and other centers of learning, which will help to create bridge between the technology and the common people.

Tele-communications: It is a critical part of infrastructure and one that is becoming important, given the trend of globalization and the shift to a knowledge-based economy. Telecommunication has become especially important in recent years because of the enormous growth of information technology and its potential impact on rest of the economy. India is perceived to have a special comparative advantage in information technology or in IT enabled services, both of which depend critically on high quality telecommunication infrastructure. Now telecommunication has immense potential to enhance economic capacity and better connectivity from government to people.

Tenth Plan also emphasized telecommunication policy. It provides the IT and related sectors with world-class telecommunications

at reasonable rates. India has joined a select club of six advanced countries with the Pune-based Centre for Development of Advanced Computing (C-DAC) developing the country's first super computer "*Param*". The indigenously build 64-NODEC supercomputer is capable of reaching peak-power of 100 megaflops. Param promises the creating of a seamless computing platform for supercomputing at an affordable price in the international context.[16] Param has a wide array of applications-oil reservoir modeling for enhanced oil recovery, seismic data processing for drilling oil wells, satellite image processing for resource exploration and disaster management, geographical information, system for cartography and mapping, weather forecasting for agriculture and for various uses in space research.

Nuclear Research: India recognized the importance of atomic energy quite early and the Atomic Energy Commission was wet up in August 1948 to look after atomic energy activities in the country. The functions of the Atomic Energy Commission are:

1. To organize research in atomic energy for peaceful purposes.
2. To train atomic scientists in the country.
3. To promote nuclear research in commission's own laboratories as well as in universities and research institutions in India.
4. To undertake prospecting of atomic minerals in India to extract minerals for use on industrial scale.

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[16] Siddiqui A., Development of Science and Technology, *Yojana*, Feb. 2003, pg. 17.

India today is the seventh country in the world and the first developing nation to have the distinction of mastering fast breeder technology. Some of the landmarks in nuclear research are as follows:

May 11, 1998 – India goes nuclear and lays claim to join the P-5 groups as nuclear power. Oct 29, 1996-Kamioni (Kalpakkam mini), a 30 K.W. research reactor which uses man made uranium as fuel attains critically.

June 10, 1996 – India ranks 11th among the nuclear power stations that are operating world-wide.

Space Research: The Indian Space Research Organization (ISRO) is responsible for the planning, execution and management of space research activities. The ISRO, which has its headquarters in Bangalore, provides rockets and laboratories facilities to scientists belonging to different organizations in India for conducing approved space experiments. The major establishments of ISRO are:

The Vikram Sarabhai Space Centre at Thiruvananthapuram, ISRO Satellite centre at Bangalore,SHAR Centre at Sri Hari Kota in AP, the Space Application Centre (SAC) at Ahmedabad, the Auxiliary Propulsion System unit at Bangalore and Thiruvananthapuram and the Development and Educational Communication unit at Ahmedabad.

The Indian Remote Sensing Satellites have helped in extensive mapping of our natural resources and the voluminous data generated through these are used in a variety of fields. Even the developed

countries including the U.S. have started to buy the data collected by IRS.[17]

Another major growing technology area in information technology (II) India is right now one of the leading countries in the world. The IT sector has immense potential for growth.

Information Technology in India

The information technology is a recent and comprehensive phenomenon, which describes the whole range of process for generation, storage, transmission, retrieval and processing of information. Macmillan Dictionary of information technology defines information technology as" the acquisition, processing, storage and dissemination of vocal, pictorial, textual and numerical information by a micro-electronics based combination of computing and telecommunications".[18] The information technology have a convergence of three strands of technologies viz. computer, microelectronics and communications. It is important to bear in mind that information technology is not just concerned with new pieces of equipment but with much broader spectrum of information activities. The information technology encompasses such different things as book, print, reprography, telephone network, broadcasting and computers. The major components of the information technology are computer technology, communication technology and reprographic and micrographic technologies. The information technologies that can be profitably used in transfer of all aspect technologies are: Satellite communication, Geographic

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[17] Siddiqui A., op.cit., pg. 18.

[18] Dhaka, B.L., Mann J.S., "Information Technology, An Emerging Approach in Transfer of Technology", *Krukshetra*, December, 2002, pg. 18.

information system (GIS), computer network, video, radio and reprography.

Satellite Communication

The word communication originates from the world "Communis" which means common. From the definition given by different authors of communication, it could be concluded that communication is a process of social interaction, which means that in a communication situation two or more individuals situation two or more individuals interact. They try to tangibly influence the ideas, attitudes, knowledge and hence, the behaviour of each other. Communication is the process of exchange of information, knowledge, ideas or feelings taking place between or feelings taking place between two individuals. In a face to face situation, communication is not a mere exchange of information but something beyond it. Because, in such a situation along with the information one passes the gestures, expression, languages, the manner of expression and all these combined together, create a sort of impact on both. Some kind of change occurs as a result of interaction. These changes may be visible in the end behavioural dimensions of both communicator and receiver.

It provides for worldwide television and ratio broadcasting information, transmission of telephone and telex, remote sensing and distance education. It provides information related to international market demand, potential to produce certain goods for world market, current and projected market prices to facilitate the policy maker to make policy decisions and to prioritize the production of agricultural crops and animal products. It also provides information on weather conditions, which is very useful for scientists for selecting and

advocating particular production practices and taking necessary corrective measures.

Geographic Information System

Geographic information system (GIS) is very useful in studying agro eco-regions, characterization studies, trends and pattern in agriculture, drought monitoring, crop yield estimates, disease spread and forecasting, runoff and soil loss estimation etc. This system widely can be used in land use analysis, soil type mapping, and watershed planning which facilitates to decide on the type of crop to be raised, planning for moisture conservation and water harvest. The GIS facilitate extension professionals to integrate information from many sources, formulate management plans and evaluate them. The GIS technology helps the extension professionals to have at their disposal information system in which informations are readily accessible, easily combined and modified as per need.

Computer

Use of computer for the policy makers, experts, scientists and extension professionals for quick and accurate transfer of information to potential farmers is getting a new dimension. Through the World-wide Web, the scientist and experts can reach their counterparts anywhere in the world and can acquire variety of information on every aspect of agriculture and allied subjects. Ideas can be exchanged with experts on agriculture and international market trends. The computer network also facilitates coordination of work between different departments and functionaries involved in dissemination of technology. It can also help to exchange ideas, culture etc.

Video

In recent years, video is becoming the most powerful communication medium. It is the most effective audio- visual aid in present times where message can be seen as well as heard simultaneously. Through video, the government can easily communicate the programme and policy to the masses.

Radio

The Radio is also playing vital role in both urban and rural areas. Pocket radio with modem and antenna can perhaps be used by the field functionaries to transmit information quickly and exchange the ideas on agriculture related problems which require immediate solution. It is easily accessible and affordable.

Reprography

Reprographic technologies include photocopying, micro-coping, duplicating and in-plant printing. Reprographic technology has been playing a vital role in dissemination of recorded information. Reprographic technology is accepted as one of the means of document resources in geographically located distant remote places where the extension workers and farmers have not access to modem electronic media. And it can use in remote areas.

Teleconferencing, e-mail, fax and mobile phone are some other potential technologies that could be used in effective transfer and dissemination of all information to the people as per need, availability and suitability of these technologies.

Thus, modern information technology can be used conveniently to satisfy every purpose of our need. It can help to create web of relationship. Through this technology we can exchange culture, tradition, values etc. Now the entire world has converted to a global village. This IT has enormous capacity to enhance the economic and agriculture potential of country.

At last it is believed that science is growing very fast in this country. It has done well during the last fifty-five years and it has shown significant results. So the future of science and especially of information technology is very bright. It will, no doubt be very helpful to us, because we consider this matter not merely as research and advancement in science, not certainly from its military aspect but naturally from the point of view of utilizing the energy derived from it for civil purposes. We are really very hopeful that the development of science will become people- centric. It will take care of the problems of human life and will solve the problems of poverty and under- development.

Science Technology Policy Statement 1983[19]

Government of India's Technology Policy Statement (TPS 1983) spelt out the need to inject technologies to meet the needs of weaker sections of society and backward regions.

- Provide the most gainful and satisfying employment to all strata of society with emphasis on the employment of women and weaker sections society;

[19] Science Technology Policy Statement (1983), Department of Science Technology Government of India, pg. 25.

- Ensure the correct mix between 'mass production technology' and 'production by masses';
- Identify obsolescence of technology in use and arrange for modernization of both equipment and technology;
- Recycle waste material and make full utilisation of by-products.

Science and Technology Policy Statement 2003[20]

- To ensure that the message of science reaches every citizen of India, man and woman, young and old, so that we advance scientific temper, emerge as a progressive and enlightened society, and make it possible for all our people to participate fully in the development of science and technology and its application for human welfare. Indeed, science and technology will be fully integrated with all spheres of national activity.
- To mount a direct and sustained effort on the alleviation of poverty, enhancing livelihood security, removal of hunger and malnutrition, reduction of drudgery and regional imbalances, both rural and urban, and generation of employment, by using scientific and technological capabilities along with our traditional knowledge pool. This will call for the generation and screening of all relevant technologies, their widespread dissemination through networking and support for the vast unorganized sector of our economy.
- To promote the empowerment of women in all science and technology activities and ensure their full and equal participation.

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[20] Science Technology Policy (2003), Department of Science Technology Government of India, pp. 10-13.

- To provide necessary autonomy and freedom of functioning for all academic and R&D institutions so that an ambience for truly creative work is encouraged, while ensuring at the same time that the science and technology enterprise in the country is fully committed to its social responsibilities and commitments.

- To encourage research and innovation in areas of relevance for the economy and society, particularly by promoting close and productive interaction between private and public institutions in science and technology. Sectors such as agriculture (particularly soil and water management, human and animal nutrition, fisheries), water, health, education, industry, energy including renewable energy, communication and transportation would be accorded highest priority. Key leverage technologies such as information technology, biotechnology and materials science and technology would be given special importance.

- To establish an Intellectual Poverty Rights (IPR) regime which maximizes the incentives for the generation and protection intellectual property by all types of inventors. The regime would also provide a strong, supportive and comprehensive policy environment for speedy and effective domestic commercialilstion of such inventions so as to be maximal in the public interest.

- To encouraging research and application for forecasting, prevention and mitigation of natural hazards, particularly floods, cyclones, earthquakes, drought and landslide.

In this chapter the historical roots of science and technology have been traced. It throws light on the gradual development of science and

technology from the ancient period to the modern era. It also focuses on the major scientific developmental areas like industrial research, telecommunication, nuclear research, space research with special emphasis on the information technology in India.

CHAPTER – III

SCIENCE, TECHNOLOGY AND THE WEAKER SECTIONS IN INDIA

The constitution of India has identified weaker sections of the Indian society. Weakest among the weak are Women, Scheduled Caste and Scheduled Tribes. Science and technology (S&T) has played a vital role in the growth and development of modern advanced countries. It is expected that S&T will bring consequential changes in the societies of the Third World also. However, in almost all the countries that constitute the 'Third World' there is "fourth world" too; fourth world constitutes the majority a people living in the hitherto rural areas and tribal regions. 75 per cent population of India lives in the rural and tribal areas. Most of these ruralites are the weaker section of the society and they are illiterate ignorant, poor, half clad and half fed. Only proper intervention through S&T and radical social action taken up by the scientists, social scientist, social worker and social activists can bring about development and happiness to these people. So the present chapter focuses on the role of science and technology in the lives of women and Scheduled Caste.

Science, Technology and Women

Time and again scientific discoveries and inventions coupled with innovative technological developments have opened many patterns of human prosperity. The modern communication systems have also enhanced the development process by disseminating various information and the modern discoveries to the vast multitude of humanity. Besides a section of our population trying to catch up with the development process, another section still lives in darkness unaware of all these developments

and continues to put up with the drudgeries and miseries involved. Majority of this section of the population consists of women constituting almost one-half of human resources. Despite all this, not much effort has been made to remove the age old sufferings of Indian women. The root cause for this agony is the attitude of society towards women gripped by the laws of *Manu* rendering the women invariably dependent on man. Even now this situation is prevailing in so many parts of the country.

After independence, the situation has changed. The status of women in India has steadily gone up. The importance of science and technology for attaining self-reliance and ensuring faster development of the country in various socio-economic sectors has now been realized. Taking into consideration this observation the planning commission has given due importance in the sixth and seventh five year plans and made specific reference to the application of S&T for the benefit of women.[1]

The report of the Planning Commission states, "The question of developmental activities related to women *vis-à-vis* Science & Technology has two aspects. Firstly, there is the contribution by women to the development of Science and Technology. Secondly, one has to consider as to how Science and Technology can contribute to improvement in the lives and states of women generally."[2] In respect of the former aspect, Science teaching in girls' schools and colleges, enrolment of women in engineering, agriculture, veterinary, fisheries and forestry institutions; better personnel policies and the involvement of women in decision making processes: greater attention to training restructuring of the existing courses and introduction of new skills have

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1 John P. Joseph (ed), (1988), *Science, Technology and Development*, DST, New Delhi, pg. 82.

2 John P. Joseph (ed), (1988), op cit., pg. 71.

been recommended. As far as the latter aspect is concerned, application of S&T for the improvement of lives and status of women depends mainly upon the development of simple and efficient technologies suitable for agriculture and for improving the productivity at various potential sectors where women work. As a result of this, more and more women are being exposed to education, health employment, etc, particularly many of them taking up Science as their career and competing with men for equal rights and opportunities. Even though progress has been made for the improvement of the status of women, it will still have to go a long way to make an impact on their overall development because sufficient efforts have not been made to improve their efficiency and productivity in terms of economic gains, better living conditions and drudgery reduction particularly in rural areas. This slow progress towards the development of women can be attributed to their inherent shyness for taking credit for their achievements, inadequate recognition given for their achievement by their counterparts, and lack of opportunities for securing jobs, etc.[3]

Some of the difficulties faced by rural women are those relating to fuel wood collection and its use in the smoke-filled kitchen, fetching of drinking water from distant places and its storage, occupational hazards in reeling of cocoons, shelling of cashewnuts, making *bidis* and coir products, various agricultural operations e.g. transplanting, threshing, harvesting, etc. All these difficulties can be solved by selecting suitable technologies acceptable to the target group. Selection would depend upon – apart from employment generation and drudgery reduction – improvement of health and nutrition and prevention of hazards. Regarding income-generating activities, women could be involved in sericulture,

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[3] John P. Joseph (ed), (1985), op.cit., pg. 84.

post-harvest technologies, in fisheries, cultivation of economically important plants, mushroom cultivation, biodynamic gardening, bee-keeping, rabbit rearing, etc. Cottage and agro based industries such as those related to spinning, weaving, food-processing, candle and soap-making match-making, leather goods are some areas where women can be effectively absorbed.

With growing industrialization, new avenues for employment have opened up for women. With proper training, women can find employment in the electronic industry. They can contribute to the ancillary industries in spite of the dual role they have to play. Women have been a success in instrumentation services, and in today's computer age, they are able to contribute effectively to both the software and hardware aspects of computer technology.

Aptitude for Scientific Creativity

The question that has been raised now again is related to the aptitude of women for science and technology. Till recently, biological differences between the sexes were held responsible for the low participation rates of women in science. This view, however, has been revised and greater emphasis is laid on the sociological factors such as the socialisation process in the family and school to which boys and girls are exposed. For instance, Kelly points out that female socialisation systematically programmes women into developing a set of personality traits which make them passive, dependent and emotional, all of which are opposed to the make attributes like rationality, perseverance and objectivity. Science has generally been presented as a masculine activity right from the nursery stage; e.g. science text books show pictures of boys doing thing while girls watch. We are aware that the socialisation process

discourages women to develop qualities of independence, initiative and conviction which results in women staying away from the field of intellectual creativity. Women somehow have to fit into the traditional conception of femininity. One reason that explains that lower level of intellectual achievement of women as compared to men is the lack of access to higher education owing to structural, ideological or economic factors.[4]

Traditionally, the status of women in the patriarchal society has been of dependence on men, which restricts the expression by the female creative mind. Denied a proper education and limited to the nearer sphere of activities within the family women were perceived as possessing inferior minds. But with the spread of democratic processes throughout the society in the recent past, the situation began to change.[5] Thus, the important point to be noted is that it is historical and socio-cultural conditions that are responsible for keeping women away from the field of science and not their innate deficiency. Many a time psychological reasons of personal inhibitions, lack of motivation or encouragement and lack of recognition contribute in keeping women disinterested in science and technology. For instance Veronica points out that the cultural values transmuted reinforced by the sexual division of the labour in the family often result in self-selective avoidance of scientific occupations by women.[6] Further, historical, traditional, socio-cultural and organisational

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4 Singh Renuka, Science Technology and role of Women, Rahman A. ed., (1995), *Science Technology Development* vol. II. Wiley Eastern Limited, pg. 254.

5 R. Chakravarthy, A. Chawla, G. Mehta, (1988), *Women Scientists at Work – An International Comparative Study of Six Countries* – Scientometrics, pg. 45.

6 Vernoca Stolte, Heiskanen, (1982), The Role and Status of Women Scientific Research Workers in Research Groups in Research in the Interweave of Social Role: Jobs and Families, Vol.3, pg. 82.

factors have had adverse consequences on the progress of women in science and technology.

The Impact of Science and Technology on the Lives of Women

Today, the impact of development on the status of women comes forth as a global concern. Communication revolution combined with mobility has succeeded in producing international preoccupation for which Science and Technology are mainly responsible.

Studies on the effect of change in developing countries have indicated a negative impact on the well-being between productivity and income of men and women. The Committee on the Status of women in India indicates the impact of development on women in the following way:

In agrarian societies the family is the unit of production. The place of work being close to the home, women and children participate in the production process. As the society moves from the traditional agricultural and household industry to organised industry and services, from rural to urban areas, the traditional divisions of labour ceases to operate, and the complementary relationship of the family is substituted by the competitive one between units of labour. The scarcer the jobs, the sharper are the competition. Technological changes in the process of production call for acquisition of new skills and specialisations which are very different from the traditional division of labour. Women, handicapped by

lack of opportunities for acquisition of these skills, find their traditional productive skills unwanted by the new economy.[7]

Hence, changes in the family roles, the phenomenon of female headed households, traditional laws and social customs, statistics on mortality, morbidity, employment and literacy in India have indicated a decline in the status of women in the post-independence era.[8]

Life-Style Changes

Today we are living in a world in which new technologies are upon us. Some economic appetites, aspirations and demands cut across national boundaries in the prevalent world economy. We also find that society and polity are pluralistic which pose challenges that are philosophical, spiritual and political in nature. Last but not the least are the new men of power – the men of knowledge who play a crucial role in the development of societies.

While technologies may have decreased the physical effort of housework, they have not the time involved or lowered the psychic burden on women or even changed the allocation of labour by gender. Thus, technology is viewed not as an independent variable but an intervening one that helps the processes of change. For instance, telephone and television, video and computer technologies are being combined to produce potentially lucrative home-based information service shopping banking, news delivery, library research, fire and burglar alarms, energy monitoring appliance control, travel arrangements, entertainment schedules, ticket reservations electronic mail etc.

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7 Singh R., op.cit., pg. 254.
8 Singh R., op.cit., pg. 254.

Apparently, women are in for paying a heavy price for loss of human contact at the risk of imprisonment in their privatized household. Human interaction and exchange at public places such as markets, schools, laundromats and others is likely to suffer as a home information service may reduce the comfort of shared reality.[9]

The current trend in the developing and developed countries has shown that women are likely to be pushed into the mechanical operation of computers by and large, or otherwise displaced by men who are better trained in this field. Furthermore, the traditional occupation of teaching had drawn many women generally and today the problem of computer education highlights a crisis for them and in schools. Education thus awaits transformation and radical restructuring, a reform of global proportions in all countries where it has challenges in store for women.[10]

In the following section the basic focus is on rural women and technology.

Women as human resource in India constitute about 50% of the population and about 77% of them belong to rural areas. Majority of them comes from small and marginal farmers of landless families. Their main occupation is agriculture and allied activities, involving them either as cultivators or as agricultural laborers. About 60-70% of the labour input is provided by women in production, processing and storage of grain.[11] Farmwomen are characterized by drudgery, occupational hazard, low productivity and low income, which lead to poor diet, poor health and

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9 Singh R., op.cit., pg. 255.

10 Singh R., op.cit., pg.255.

11 Sanghi, N.K., (1990), Crop technologies for farm women identification, application and research gaps in agriculture edited by (C. Prasad and S. Ram) IFWA, Krishi Anusandhan Bhawan, New Delhi.

poverty. As far as efficiency of work is concerned, it is reported that women are more efficient that man, in respect of rice transplanting (16% more) weeding in rice and wheat fields (7-8% more), picking of pearl millet (25% more) and in picking cotton 37% more.[12] Their efficiency in harvesting and processing of tea, coffee and horticultural crops is well established.

1. Technology for increasing productivity

The main reason attributed to the poverty of rural workers are their low productivity, low incomes, poor diets and health. It is at this stage that interventions are needed to increase their productivity by use of appropriate machine. In the first phase, hand tools or simple equipment, which do not require engine power, may be introduced. These may include improved sickles, weeders, manual transplanters, tubular maize sheller, pedel operated threshers, cleaners, graders decorticators etc. In the second phase, group of women may be trained to own and operate power operated machines like tractors (with threshers, reapers) flour mills, dal mills, mills for spices and oils, etc. The ultimate aim of this should be increase in productivity, improvement in better working environment and reduction in drudgery of women workers. Which can help their socio-economic status.

2. Improving work environment

Generally, it is seen that women agricultural workers work barefoot, without any head or body protection against sun and shower. While spraying pesticides they do not cover their nose and mouth.

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[12] Deshpande and Ali, Gender issue in technology development and dissemination, Kurukhetra July 2002, pg.24.

There is a need to educate them about such hazards and also provide them suitable waterproof shoes and hats. It's a preventing measure for them, which can protect them from health hazard.

3. Skills and Education

Low literacy rate in general and particularly in women agricultural workers is a big barrier in their development as it affect the communication from outside world. Increased literacy therefore, may be one of the main objective of any programme related with economic improvements and empowerment of women agricultural workers.

4. Social attitude

There is a need to change the attitude of rural workers towards adopting the mechanization, for example, threshing to crop with the help of a thresher not by rubbing with feet or beating on stone or by stick.

5. Improving skill and understanding

The change in attitude, upgradation of operational skills and understanding of mechanical processes involved in various operations require country wide training network. The network required may be made available through *Krishi Vigyan Kendra*, which are centres of speedy transfer of technology to the doorstep of the agricultural women workers.

6. Improving food quality

Survey conducted in some of the villages of Bhopal district showed that though soybean, which contains 40% protein and 20% oil, the rural people do not use this most economical dietary protein source. Only 13%

rural women are aware of the importance of soybean and its nutritional potential, while 18% use it in the form of *papad/badi* and that too occasionally. Creating awareness about the importance of nutrition and by improving nutritional status of the rural population through the use of economically available soybean protein and imparting nutritional education are major ways to improve the health status and productivity of rural women workers.[13]

7. Income generation activity

Post harvest agriculture offers rural women an opportunity for income generation. Women can go for micro or small-scale food enterprises to have self-employment and income. For rural women to become active in enterprise development, it is necessary to undergo a well-designed training course, which includes multi-faceted inputs to develop skills, knowledge and attitude for running enterprise.[14]

Technological Change: Family, Women and Society

The underdeveloped countries are said to be on the brink of technological change, whereas, advanced industrial countries have gone through a series of technological breaks. In this section, one will attempt to understand the social implications of technological change, in depth and direction especially in the context of the institutions of family in the developing countries.

Sociological analysis usually regards the structural components of societies as being so closely interrelated that a change in any part of the system would have repercussions in all other parts. Family and kinship

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[13] Deshpande and Ali, op.cit., pg. 26.
[14] Deshpande and Ali, op.cit., pg. 26.

organisations are universal structural features of human societies which involve procreation and socialisation and placement of children. A nuclear family comprising of parents and children is usually an identifiable structural unit. It has its variation in the modes of mate selection, multiple unions, the place of residence, the durability of unions, the ways of tracing lineage and the character of internal role relationships. Further, since family always has some economic functions, it is related to new forms of production organizations.[15]

It has been generally believed that industrial and economic changes taking place have affected the family organiazation. Structurally the joint family is breaking down into a nuclear family and socio-culturally, Westernisation is influencing the lifestyles of Indians residing in the urban areas. However, kinship ties are retained with the original joint family that is either located within the city or at a distance in the rural setting. The joint family is found to be more suitable to the agricultural societies but is dysfunctional under the present circumstances in urban centres.[16]

In the urban areas, greater importance is placed in the conjugal bond between the husband and the wife and toward decreasing the demands of consaguine ties, especially those among siblings. Moreover, the emancipation of the son from the dominance of his parents and the woman's desire to overcome her subordinate position constitute the two basic forms of change.[17] Since women who have acquired higher education and achieved economic independence, they are not so formally

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[15] Singh Renuka, (1995), op.cit., pg.263.

[16] Jain S.C. (1985), *Women and Technology*, Introduction, Pg. 85.

[17] Neil J. Smelser;(1966), *Mechanism of Change and Adjustment of Change in Industrialization and Society*, pg. 65.

segregated or dependent on men, age at marriage is rising, divorce and widow remarriage are gaining currency in the urban centres. Today, the parents are concerned more for their children's success and career rather than maintaining family and kinship obligations. Yet, marriage continues to be the test of a family status, and is usually arranged by parents and endogamy gets a serious consideration.[18]

A significant change in the socialisation of children is taking place in the urban nuclear families. The phenomenon of hierarchical socialisation is being replaced by egalitarian socialisation. This has led many women to have access to higher education and find employment in clerical, administrative, media, professional work and take up business as well. Despite modernisation, the grip of caste system continues to have a negative impact on female education and liberal caste associations. Caste as a custom, has not been eradicated despite education, legislation and social reforms. General reform movements led to legal reforms and the elimination of social evils such as the practice of *Sati, Devadasis*, child marriage and ostracized widowhood.[19]

In Renuka Singh is study on the Status of Women in Delhi[20], two hundred women from various social backgrounds were interviewed. This study unfolds a pro-family ideology held by respondents. Family acquires and intrinsic value not only in Indian but Japanese and Chinese society as well, even though, women and ample reasons –social, economic and emotional- to break up their family. Whether women were part of a joint family or a nuclear family, they perceived it as a social reference point.

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18 Mandelbaum D.G. (1970), *Society in India*, University of California Press, pg.105.

19 Singh Renuka, op.cit., pg. 263.

20 Singh Renuka, op.cit., pg. 263.

Family proved to be a protective institution but at the same time, it was not devoid of interpersonal strain. Women often had to accommodate the family's needs or husband's wishes and narcissistic desires. In the lower and middle classes, abuse, battering and extra-marital affairs were tolerated for the sake of children. In the lower class, occasionally, women even abandoned their men if they failed to provide essential things. An intensification of mother/child bond takes place in cases where the husband neglects the wife. In the upper strata, women's need to have a family and take up work was a personal choice. It was strongly influenced by living standards and personal qualifications or interest. Education and skills have increased the desire in women to seek employment and science and technology has provided them with that sort of time and space, but still there were many cases of educated and professional women who renounced their career for the sake of their marriage and family.[21]

Science and Technology and Scheduled Caste in India

In this section an attempt is made to highlight the impact of science and technology, particularly on the life style of the depressed scheduled castes in India. Since this is the largest simple group of people which if left outside the main stream of the country's overall development, it may harm the national interest.

The depressed scheduled castes in India are a special and significant segment of population since centuries. First, scheduled castes (SCs) in India constitute 15.75 percent of India's population; secondly, they have long suffered for several social, political, economic and religious disabilities and assigned lowest status with traditional ban over

[21] Singh Renuka, op.cit., pg.264.

the right to own property. Without freedom to choose an occupation and attend educational institutions, they were historically deprived from holding public posts and denied access to all public places. Therefore, the quality of life of depressed and untouchable castes since ancient times was too bad, full of woes and sorrows. All these castes had a sub-standard level of living. Thirdly, the depressed and SCs are very important and decisive in determining the overall development of Indian society. For no society can be developed or will progress and prosper when a major part of it is left undeveloped.

The Scheduled Castes in India

The term scheduled castes refers to a list of castes prepared in 1935 by the British Government in India. It was provided for in the Government of India Act. During the ancient and medieval periods they were called as *Sudras*, *Panchams*, (Fifth group), *Chandalas* (outcastes) and *Antyajas* (lowest castes). During the British period *'Avarnas'* were first designated as 'Depressed Classes' latter as 'Exterior Castes' and finally as 'Scheduled Castes'. The term Depressed Classes was introduced some time late in the last century in the British official records.[22] Some castes suffering from disabilities were identified in the Census of India, 1901 and designated as 'unclean' castes. However, these castes got identified as depressed classes in various official and non-official reports. To identify the 'Depressed Classes', the term 'Untouchables' was first used by the Maharaja of Baroda even before the Depressed Classes Mission of Bombay in 1990.[23] Later in the 1911, 1931 and 1932 attempts

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22 Issacs, Harold R. (1966), *India's Untouchables*, Bombay, Asia Publishing House, p. 30., Ibid., pg. 40.

23 Galanter, Gore, (1972), *The Abolition of disabilities, unsociability and the law*, J. Michael, pg.50.

were made to redefine terms viz, Depressed Classes, Exterior Castes, Untouchables *etc.* In the 1933, Mahatama Gandhi gave them a name – *Harijan*, which was first coined by saint Narsinha Mehta, meaning children of God, as the most satisfactory name to refer to untouchables. Dr. B.R. Ambedkar opposed the term *Harijan* and proposed the words 'Protestant Hindu or Non-conformist Hindus.'[24] Finally in 1935 as recommended by the Simon Commission, the term 'Scheduled Castes' was adopted by the British Government as a substitute to all other words hitherto, used for identifying the untouchables.[25] In the year 1936 the British Government issued the Government of India Scheduled Castes Orders specifying certain castes and tribes as placed and listed in the respective Schedules in the various provinces of India. This listing took into consideration the social, educational and economic backwardness arising out of the historical context of untouchability. After independence, the Constitution of India has used the term 'Scheduled Castes' but the same has not been specifically defined as such. Article 34 of the Constitution of India reads as follows: "Scheduled Castes means such casts, races to tribes, parts or groups within such castes, races or tribes as are deemed under Article 341 to the Scheduled Castes for the purpose of Constitution of India.'[26]

In the following section we have dealt with the direct relationship between science, technology and societal condition of Scheduled Caste.

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[24] Mahar, ed., *The Untouchables in Contemporary India*, Tucson: University of Arizona Press, pg. 65.

[25] Government of India Act: 1935, Para 2.6, Schedule. I.

[26] *Constitution of India.*

Family-Social Participation and Occupational Change

Science and technology has changed the family pattern, occupational pattern and pattern of social participation of SC population and brought significant changes in their quality of life. Because of technological advancements and resultant industrialization, quick means of transport and communication, migration of rural SC labourers is facilitated to urban areas. It has turned them into industrial labour, thus affecting changes in their status and giving them opportunities to earn in the cities. However, this breaks the joint family system and makes it nuclear. It is argued that nuclear family is a better way of living, as one is more independent and free in comparison to the earlier way of living in a joint family. In the joint family, there are lesser hands to work but more mouths to feed. This shift of SC labourers from rural to urban areas has reduced the problem of hunger to most landless workers. Further, it has reduced untouchability and the extent of atrocities on SCs has, greatly, been reduced in the urban centres. The work situation in the factories, travel in rails and buses etc. has endowed them with equality in most aspects in urban areas. This has been possible due to the advent of new technology.

Further, because of high economic pressure and newer family planning devices which are the result of scientific and technological innovations, the family size of SCs (in urban areas in particular) gets shrunk. The traditional occupation of SCs *i.e.*, weaving, training, leather work, and scavenging have witnessed the impact of science and technology. The hand-made weaving is substituted with products from textile mills, and silk industry, leather industry etc., have become gigantic mechanized industries where more usage of new technologies is being

identified in various forms. The new technology has been introduced in these sectors helping the raise of status or the SC people. The occupation of scavenging has been made comparatively drudgery-free and technically well-equipped. The concept of sewage of drainage system is introduced instead of manual cleaning and carrying garbage as a head load. Sewage system, latrine system, urinals and other scavenging tasks are highly affected by the role of science and technology. The resultant health of Safai Karamcharis, speed of cleaning operation and quality of cleaning etc. have improved to a great extent due to S&T.

Besides this SC people have started establishing new trades, business, occupations and new enterprises.[27] In small percentage, though some forward looking and progressive SC entrepreneurs have emerged due to the development of S&T. Thus, Science and technology has opened new vistas for economic activities for SCs and played the role of catalyst in changing the occupational based castes, their status and life-styles and consequently, the social structure of the Indian society. Further, due to exceedingly high application of science and technology the co-operative movement, improved village industries and tertiary sector of industry of India have got big momentum. Each village and urban center has got a number of small and medium scale co-operative commercial units e.g. milk co-operatives, housing co-operatives, co-operative farming societies, co-operative production units etc. As an outcome of these, SC groups have been able to get memberships in these institutions and, thereby, raise their social participation on resultant impact in the improvement of their quality of life.

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[27] Krishnaiah Chetty, V.B., (1991), *Scheduled Castes and Developmental Programmes in India*, Vohra Publishers and Distributors, Allahabad, India, pg. 70.

Food Pattern

The application of science and technology has changed the agriculture pattern of India because of which Green Revolution, White Revolution, and Operation Flood etc., have materialized. As a result SC people have been able to raise their per-capita consumption of such items. Besides, earlier food patterns were of routing type and restrictive, where choices were very limited both due to poverty, tradition and historicity. Now SC people in rural as well as in urban areas have almost left their traditional food pattern and practices and have adopted upper-caste, reformed and modern practices of food consumption like other sections of the population.[28]

Direct and indirect application of fertilizers, manures and insecticides and pesticides are seen by them, in rural areas, as means of increased production even on tiny pieces of land. Because of inter-cultural exchanges, the upper echelon of SS also uses modern cooking devices like pressure cookers, gas *chulahas* to prepare food items which has helped to save lot of their time, and has made their life more comfortable in comparison to earlier times when such cooking devices were not developed. The role of science and technology is also visualized in the consumption pattern of fuel and lighting among SC people. Firewood in urban areas is now substituted by gas oven; kerosene lamp is substituted by electricity in most of the slums as well as in rural areas. It is fact that a vast majority of them are still beyond the fringes of benefit of S&T.

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[28] Saxena, S.B., Solanki J.D., Impact of Science and Technology on the Quality of Life of Depressed Castes in India, Prasad R. (ed.), (1995), Science, Technology and Quality of Life, Y.K. Publishers Agra, pg. 115.

Clothing Pattern

Clothing has got high face value. It decides *prima facie* quality of life of people. In the past days, SC people were wearing mainly old clothes given by others as charity. New variety of clothes made possible due to S&T and new designs and patterns, have swayed all our urban and rural areas. Previously the SCs were prohibited from wearing new clothes etc. The application of science and technology has brought many changes in the areas of cloth, variety of clothes. These, in turn, have influenced consumption of these items and, thereby, improved the quality of life of people. The legal safeguards, social action combined with S&T have now changed the clothing pattern of the SC population. Old were the days when traditional clothing and dressing were the style of SC people but now, they have adopted new material, designs and clothing style. SC women also have undergone drastic changes in their clothing used. These clothing styles have brought them closer to the wider society and reduced discrimination and identity crisis.

Education Pattern

Today's education is highly influenced by science and technology, and its role is very much evident in the educational patterns. The official statistics confirms that educational level amongst SCs has relatively increased. Apart from formal education, the informal education through Radio, Television etc. has increased the role of science and technology and the impact of educational technology has become evident through educational advancements of SC groups. The sky revolution and telecommunication system have made the rural and the urban SC persons to be able to get a feel of the world trends. The role of science and

technology is also revealed in one of the five mission i.e., National Literacy Mission. New Technology Mission is to give new thrust to technology that is beneficial to the SCs. An emphasis on vocational education that is also predominantly technology-biased will ultimately improve the quality of life. In short, whether it is primary, secondary, college or university, education, being panaecia for all problems of scheduled castes, has been greatly emphasized. The science and technology and modern communication have played very significant role in education and in ultimately raising the quality of life by relatively increasing educational and technological levels of SCs in India.

Health Pattern

The health scenario of India is highly influenced by science and technology. The impact of these is seen on the following areas e.g. public health facilities, community hygiene, etc; Science and Technology has affected changes in *Harijan busties*, community latrined, drainage and the drinking water facilities in *Harijan* localities of urban slums and rural areas. These sectors are taken care of due to new developments and new innovations which provides the SC people a favourable and congenial environment due to which they can raise their quality of life still better.

Science and technology has made medical facilities available to the very door or nearby areas of SC people. The new awareness has made the SC people leave their traditional methods of treatment and move towards advanced medical treatment which has effected their death rates, birth rates as well as infant mortality rates. Due to the development of scientific temper of SC people, they have no comparatively lesser superstitions and traditional beliefs (in urban areas particularly). Science

and technology has embarked new method of recreation for SCs and opened new avenues for excursion and traveling and reduced the urban-rural gap in certain respects.

Science and technology has to play a positive and different role in the lives of people in general and Scheduled Caste in particular. Nevertheless the quality of life among SC people cannot be achieved without the improvement in their socio-economic life and equalization of opportunities.

Role of Department of Science and Technology and Weaker Sections

Department of Science & Technology (DST) has initiated a variety of programmes for the benefit of the poor and weaker sections through the applications of S&T. There we have a focused attention in dealing with the problems of rural poor. A separate division, namely, "Science and Society" has been created well over a decade back to give a fillip to rural development activities through S&T interventions. In our effort, we emphasise a "bottom up" approach rather than the conventional "top down" approach.

Science and Technology (S&T) has established its viability in terms of products, processes, technologies and development models which have tremendous potential in addressing the problems of the poor people. Every community is empowered to pursue its own vision, have its own strategic development plan in an enabling environment with access to all resources required for its effective implementation in realizing its vision. The well-being and dignity of every person, family and community are ensured. Men and women have self-respect, self-confidence and equal

status in all spheres of life. Every person has access to information, technology and resources to realize his/her full potential and the capacity to use it. The economic system produces growth that is equitable, self-reliant, sustainable and respects social and cultural inter-dependencies. The habitat and infrastructure are ecologically sound and based on wise use of natural resources. The governance system at all levels supports people-centred development. It also encourages the convergence of existing and new development initiatives to respond in a holistic way to the community development plans and defined needs. In order to achieve sustainable development, people's participation is the key factor for all S&T interventions so that their involvement in problem/need identification, project formulation, implementation, monitoring and evaluation by social audit, should be ensured.

The following specific programmes are undertaken in the Science and Society Division: Science & Technology Application for Weaker Section (STAWS), Science & Technology Application for Rural Development (STARD), Science & Technology for Women, Tribal Sub-Plan (TSP), Special Component Plan for Schedule Caste (SCP).

However, considering the proceeding chapter it becomes apparent that women have historically been and are presently integrated in economic development worldwide. But women in most countries of the world are the 'invisible' economic base of society and as such are excluded from the mainstream of decision-making and planning, which means that they can be controlled more effectively. The advancement of women is central to the objective of creating national and international environments conducive to constructing science and technology in the public interest. This is the case because women comprise a major

segment of the urban and rural poor and women are focal points of family welfare, not only producing most of the basics to sustain life but also transforming them and delivering them to their point of final consumption. Therefore, the international community should focus its attention on the interrelated dynamics of modernisation, power distribution, scientific and technological progress, and the socio-economic and political participation of women if sexual inequalities are to be redressed. The United Nations conference on science and technology for development has been a significant step in the direction. The subject of the conference afforded many opportunities to raise varies aspects of these issues relating to women. In the current process of restructuring the international economic, social and information order, and the international arrangements thereof, the opportunity should be taken to end the narrow confinements of issues affecting women to social and humanitarian affairs.

Simultaneously, there is a need to address the core issue of the SCs in India as well. These people are really facing inequality in all spheres of life and suppressed and depressed life the Kurds in Middle East and Blacks in the western blocs. Unless and until they are brought into the mainstream of the society, their overall development is not possible. It is a fact that they are neglected and they are always subjugated on grounds of their caste. No doubt, science and technology can bring major sea change in this field, nevertheless it is necessary to change the attitude of *Manuvadi* mindset. We have to support these weaker sections of the Indian society to the optimum level.

CHAPTER - IV

SCIENCE, TECHNOLOGY AND SOCIAL CHANGE IN INDIA

Science and Technology is also recognized as an important factor of social and cultural changes in society. The changes in communication, technology have affected changes in the interrelations of individual and groups, and the advances in the electronic technology and availability of gadgets, like radio and television, have brought in the society qualitative changes in the elements of culture.

The technology change should be understood in sociology in a much wider sense than the meaning usually attributed to it. The term does not simply means machines and scientific instruments. It also implies appropriate attitudes, habits of thought and action. Technology does not work on its own. It is to be worked by man. In this regard G.M. Foster has very aptly said, "Technological development is, indeed, a complex process. It does not simply mean the overt acceptance of material and technical improvements. It implies a cultural, social and psychological process as well.[1]

Technological Culture and Social Change

Ogburn has made an extensive study of the pattern of change in material culture. He refers to two patterns. First, mechanical inventions tend to accumulate, and as a result, the material culture becomes enlarged. Ogburn illustrates this process as follows: "The use of bone is

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[1] G.M. Foster, (1980), *Traditional Cultures and the Impact of Technological Change*, Harper and Brothers, New York, pg. 75.

added to the use of stone. The use of bronze is added to the use of cooper and the use of iron is added to the use of bronze. So that the steam of material culture grows bigger.[2]

Ogburn had studied the process of social change that took place under the impact of technology from three angles:

(i) Dispersion or the multiple effects of a major material invention.

(ii) Convergence or the coming together of several influences of different inventions.

(iii) Spiral or the circular cumulative accelerating process.

i) ***Dispersion:*** Any mechanical invention may have both direct and derivative social effect. Ogburn noted one hundred and fifty social effects of the radio; effects ranging all the way from entertainment, education, diffusion of culture to morning exercises.

Besides this direct effect, a mechanical invention has some derivative effects as well "when an invention has an influence on some institution or custom, the influence does not stop there but is continuous on each influence succeeding the preceding link in the chain". Availability of power, in its turn, is followed by gradual growth of cottage and small scale industries in countryside.

This effect eventually leads, to change in the modes of life, attitudes, and beliefs of the people of these areas.

ii) ***Convergence:*** It should, however be noted that the spread of electric power is not the sole determining cause of the growth of industrial

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[2] Ogburn W.F, (1922), *social change*, New York, pg. 73.

units in rural areas. The industrial policy of the government of India relating to the establishment and growth of 'big' emergence of rural industries as ancillary unites to big industries. Thus, the primary result of an invention is itself only one of many factors producing the secondary derivative influence and so on. This brings us to the concept of convergence or the combination of several influences of different invention. For example the facilities of telephone, quick transportation and expensive accommodation have led people to live far away from their place of work in the heart of city. This lead to the size of city or town getting bigger and bigger, major to metro, metro to million plus mega city. It is therefore, clear that group of inventions may converge together and may jointly have a derivative effect in the same way as a single invention has a derivative effect.

iii) ***Spiral***: So long we have been discussing only the derivative effects, that is, one social change leading to a number of social changes. However sometimes one social change leads to another which, in turn, reinforces the former change. Ogburn characterizes this as "spiral". Gunnar Myrdal calls this process "a circular cumulative accelerating process" because the effects of a change accumulate and the social changes are accelerated for example. The industrial development of India is hampered by lack of capital. The government tries to meet this problems by stimulating and monopolizing people's savings and, at the same time, by drawing upon foreign aid. The industrial development, which is an offshoot of added capital investment, leads to additional employment, greater – income and, finally, to greater accumulation of savings and capital.

Information Technology and Social change

The Information Communication technology has given rise to many positive impacts on our society and its changing aspects of many sultry benefits. Change is a common phenomenon in each and every society. It happens more when they inch closer to any new thoughts, ideas and with new innovations and development. The basic characteristics of a society is to search for something new, superior in nature and beneficial, they try to gain more knowledge about it, thereby increasing the possibilities for arranging it in a way that we ourselves want.

It is argued that different factors lead to a change in society. Yet it is commonly believed that "flow of information" is vital for any social change. Social Scientist agree that no change can take place without flow of information. Communication is very much involved in the change process, and those who have access to communication facilities are in a position to exert a strong influence on the direction the change will take.

We have seen that several changes and the impact of the communication technology tools like Television, Radio and most popularly, the Internet technology, with the proliferation of new technologies, and new innovations, has moved our society in the direction of change. The recent using of Internet technology is already redefining the way we communicate, live, play, work and conduct our business. With the emergence of exchanging information, it has made it possible for individuals to collaborate and interact through this communication technology in a near frictionless information environment and without geographical boundaries. With the change of

time, all the communication technologies have brought a significant change in all round development through the transmission of information. In particular communication technology.

The Communication technology is an extremely powerful instrument in the area of social change. The communication technology such as television, radio and Internet can exert a decisive influence over the direction of social change.

Communication, meaning exchange of messages in-between, is present in almost all communication theories; no change in society can take place without communication. So communication is present in all directed and purposive efforts to bring about change. Communication is one such vital factor that always helps to change and influences the people to bring a change. Communication is indispensable in every attempt to bring about change. We believe, the use of Internet, will strengthen democracy, decentralization of the economic and political system, and bring most of the social reforms. While it will meet the basic needs of the people enhancing information towards the establishment of a united society- "a global village", information and communication will not be a constraint to gather knowledge. IT applications and its communication technology are going to quench the knowledge thrust of all sections of the society either rich or poor.

The state of development in India always captured the forefront areas through the realization of the concept of decentralization of political and economic system. Five decades have passed after independence thereby much epoch-making changes have taken place in our country, in the sphere of economic, political and social development. It has brought about widespread change in the lives of

landless sharecroppers actuated by the government of India at removing poverty, misery and social injustice. Another great aspect of the country is the decentralization of power through Panchayats. India has gone through political Panchayats and hold Panchayat elections at regular intervals. Panchayat played very attractive role in operating of wiping out the rural poverty and which were directly handled by Zilla Parishad and Panchayat Samities. The successful implementation for the land reform programme along with the rise of Panchayat institution has resulted in a remarkable change in the socio-economic scenario of the country. India has made a major breakthrough in agriculture production during this period.

In 1998, state government has made the ideas to accept information technology as part of their policy. Disseminating and empowering the citizens with all sorts of development information was the kernel principle of state policy. Down the years Indian government has already started IT courses in many engineering and polytechnic colleges in the country. IT courses even continued in many colleges in the country. In schools, students have started receiving computer training. The Government has established a new IT department and cabinet ministers were appointed to oversee the task of implementation. To engulf the concept of E-commerce, India has already signed with many software companies and established IT parks in different states and directed all state governments to act in the direction to use the best potential of IT technology. For a quick and face-to-face interaction, the system of video-conferencing was set up at different states and

connected with all Deputy Commissioners' offices in various district of our country.[3]

Technology as a Factor in Social Change

Many social scientists have held that technological invention is the primary factor in explaining social and cultural change. It is fact that the wheel, the pot, the compass, gunpowder, the printing press, the steam engine, the telephone, the motor car, the radio, the aeroplane and now the atom bomb, have certainly brought about many changes in the society. For example, the radio sets out a common standard of speech, and thus brings about uniformity in speech in the various sections of the society. The motor car expands the range of social relationship and reduces the communal character of the neighbourhood. Ogburn even went to the extent of suggesting that the self-starter in the motor car had something to do with emancipation of women in American and Western Europe.[4]

In a broad way we can say that technological developments have brought about many changes in attitudes, beliefs and even in traditions. There is no doubt that the modern factory, the railway carriage, the bus, the restaurant, etc., have brought about changes with respect to caste and class behaviour. People of various castes work side by side in the modern factory. The Brahman cannot complain that his co-worker who comes into close contact with him is a Harijan. Similarly, any person who has the means to purchase a railway ticket, or a bus ticket can come and sit next to you and you cannot complain that a man of lower caste or

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3 Dutta Subrata, Impact of Information Communication Technology on Society, *Yojana* July 2003, pg. 24.

4 Ogbur W.F, (1922), *Social change*, New York, pg. 81.

a man of lower class is your fellow traveller rubbing shoulders with you. It is true that the change with respect to restaurants was not so smooth or easy. The owners of the restaurants as well as the customers tried long to prevent people of other castes and creeds from entering the restaurants and sitting at the same table.

In the Western European countries, mechanization completely destroyed cottage industries and the system of domestic production. However, this is not true in the case of Japan, India and other countries. As a matter of fact the great Indian leader Mahatma Gandhi, was against mechanization and struggled hard to see that the cottage industries are revived. On the other hand, the other great Indian leader, Jawaharlal Nehru, was eager to industrialize the country in order to increase production and eliminate poverty in the land. It may be said that today practically the whole of the Indian society, and certainly the Indian State, is committed to industrialization. It is only a few orthodox Gandhians that are against the programmes of industrialization. Still, no Indian Government can overlook the importance of cottage industries.

One great effect of the progress of technology is the high specialization of the task involved in production. It also leads to exact time-prescribed routines of work. Because of these changes, there is mass production leading to lowering of the costs. Goods are now produced not for the use of a small class of aristocratic customers but for the mass of the people. Consequently, there is a rise in the standard of living and a transformation of the class structure. Even in contemporary India, we are seeing in the midst of poverty some slight improvement in the standard of living of the masses because of mass production. Even villagers and the urban slum-dwellers today own

bicycles, watches and transistor radios etc., which would have been unthinkable before Independence because all these articles had to be imported from the West.

In the Western countries, there has been a profound change in values because of the technological change.[5] Success today is measured in pecuniary terms. It is the multi-millionaire industrialist who commands greatest social prestige. There is stress on achievement. Each man tries to build up his knowledge and skill so that he can go up in the social ladder. There is the desire for speed dominating the whole society. This is responsible for the manufacture of the giant jet planes, which carry one at a speed of 500 to 600 miles per hour. Today, the big cities of India are linked up by jet planes, so that one can go from one city to other within a couple of hours. Another important effect of technology is the desire for novelty and innovation. The manufacturers have vast research units where highly qualified scientists and engineers are constantly working to produce new machines, new fuels, etc. But, the most important change is that men have become more pragmatic in their outlook.

However, we cannot say that such social and cultural changes have taken place in India with the use of machines and techniques of production. The changes are very slow. Another important area in which great technological improvements have taken place and have contributed to significant changes in social life is that of transportation and communication. The road, the railway, and air transport have developed within the country in the last two decades. We have now fast luxury buses connecting the various cities in India. The diesel engines have

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[5] Nordskog, J.E. (ed) 1960, *Social Change* McGraw Hill, pg. 52.

increased the speed as well as capacity of the railway. Still, there is a continuous increase in the demand for speedy transportation. Even within each state, the villages have been brought into the mainstream of national life because of these improvements in transportation. The mass production of bicycles is another important factor. The village people now are purchasing bicycles in large number and are using them for commercial as well as for recreational purposes.

Even more significant are the social effects of the tremendous strides made in the recent decades with respect to media of communication. The circulation of Indian language newspapers has gone up greatly and these are now being purchased in considerable quantity by the rural people. Similarly, there are not only community radio sets in the rural areas, but after the manufacture of the transistors, they have become particularly popular in the urban as well as in the rural areas. We have the unique phenomenon of the mobile cinema tents where the owner moves the cinema equipment from one rural area to another. There is also considerable increase in the number of telephones not only in the big cities but even in the small towns. The press and the radio are reducing the cultural differences between the rural and urban communities.

Another important feature of the improvement in the means of communication and transportation is the strengthening of the political parties in the rural areas and their increasing influence on the people.

We might now consider briefly some of the general directions in which advancement of technology is affecting the society. One of the most impressive features is the attainment of greater efficiency and speed. Because of advanced technology productivity has greatly

increased. This has made the people adjust themselves to the new tempo of life.[6] Another important feature is the greater mobility in the population. On the one hand, villagers are losing their attachment of their villages, and are moving in large numbers tot the cities in quest of a better life and greater excitement. There is also the other aspect of mobility with regard to occupation. Because of the introduction of technology into India, people of various castes are giving up their traditional occupations and are taking to work in the factories and the offices – commercial as well as government. This has also meant the possibility of vertical mobility so that a person can now aspire to take up an occupation with higher status than what he could ever have thought of in the pre-technological days.

Another consequence of advanced technology which we are witnessing even in a developing economy like that of India's is a higher standard of living for a larger number of people and greater leisure. It is true that the mass of the people in India are yet living in hovels. Even so, we can see improvement in the standard of living because factory workers as well as office workers now put on better clothes and purchase at least a watch and a bicycle for themselves, if not a transistor-radio.

Advancing technology has also meant a more elaborate social organization. The urban society of India today is much more complicated than it was at the beginning of the present century. The corollary of this new concentration of economic and political power in certain sections of the society which were relatively poor and powerless a few decades back. In fact, this new access to economic and political

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[6] Nordskog J.E. (ed), op.cit., pg. 64.

power of the weaker sections of the previous decades has become a serious threat to the wealth and power of the more advanced castes and communities. Political changes as well as economic changes based on the advancement of technology made the Muslims of India lose their power as well as their wealth towards the end of the eighteenth century and the beginning of the nineteenth century. Similarly, with the advancement in technology the government is having greater power regarding the starting of new factories. In every country, it is found that the government is becoming more and more powerful because they have to regulate economic life as a consequence of technological improvements. We may now consider briefly some of the reasons why the introduction of new technology has not brought rapid social changes in India.[7]

Introduction of new methods, even if they are efficient and economic, will not automatically lead to their acceptance by the society. Unless they are accepted and adopted, social change cannot take place. There are several reasons why innovations are accepted by any society readily. Even the West European societies have resisted certain innovations. We have one very outstanding example. India accepted the decimal system for coinage, weights and measures, etc., since 1957 but it is only recently that Great Britain accepted this innovation. The new coins came out of the mint the U.K. only in 1969. In a society consisting of people at the tribal level as well as the peasant level and in a society dominated by kinship, joint family, and caste system, it is not strange that innovations in technology are not automatically accepted. Indian people were exposed to the British influence during the eighteenth and

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[7] Kupppuswamy B., (1996), *Social Change*, Konark Publication Delhi, pg. 103.

nineteenth centuries just when Great Britain was undergoing an industrial revolution. It is indeed one of the strange incidents in human history that India was not affected by these world-shaking changes which were taking place in England at that time, except that the British, in their own interests, introduced railways, post and telegraphs, telephones, etc., for strategic and commercial purposes. But the people at large were really not affected by these changes. Even the introduction of the textile mills as early as 1854 affected only the basic cottage industries – spinning and weaving. They did not have any large impact on the society as a whole.[8] It is true that it was not in the political and economic interests of the British to promote corresponding industrial revolution in a colonial country and it is also a fact that India is a vast land of villages and mass illiteracy. Even today after 50 years of independence and after Ninth Five Year Plans, India continues to be an agricultural country. The vast rural population, besides being illiterate, is engaged even today in the traditional forms of agriculture and industry. It is only in certain pockets that the signs of an agricultural revolution are appearing. One wonders whether this slow change is due to the traditional tolerance of the Indian people.

The most important aspect of technology is that a man thinks rationally and objectively about things and events. Technology can change only when a man thinks that it is possible to improve the way in which one is doing. If, on the other hand, a man thinks that what he is now doing is the only way of doing it or, even worse, that it is the best way of doing it, then innovation is impossible. It is only when a man is in search of a better way of doing things with less effort, less cost and

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[8] Gandhi M.K., (1958), *Hind Swaraj*, Navajivan Ahamedabad, pg. 31.

greater efficiency that it is possible for him to apply his mind to the way in which he is doing and there is hope of finding out more efficient techniques and the use of other raw materials.

Social Effects of Technology

Whether technology plays an increasingly dominant role in shaping our current way of life is beyond question. Our mode of life and thought and all our social institutions are influenced profoundly by mechanization. Modern civilization could not have developed in the absence of its technological base.

By destroying the domestic system of production, modern industrialism had radically changed the family organization. Technology has placed man's work, except in agricultural, wholly away from the homestead and has removed nearly all woman's economic duties, except cooking, house cleaning, sewing and laundering. It has therefore, been possible for women to come away from home to the factory and the office and have their independent earning. The women have thus new social life in this new environment Technology has affected man's idea, attitudes, beliefs, and philosophies. Scientific discoveries and inventions have changed the attitude of men and women towards many rituals, creeds, and religions practices. Space exploration may change these ideas more radically in the near future. It is held that modern man and women are less serious, more inclined towards superficial excitements, and that wealth is esteemed more than cultural or intellectual attainment. The qualities that assure quick material success in life are prized highly and men have grown pragmatic is their philosophies. They refuse to accept any thing on trust. Every idea, concept or belief is tested by reason and experience before it is found acceptable. In other word

functional utility rather than abstract value, dominates man's thinking in the modern world.

Improvement in transportation has led to the disintegration of the neighbourhood and to the growth of town and cities. There is moreover the undermining of local folkways and the increasing dominance of urban ways over those of the country.

Change in Social Structure and Science and Technology

To identify social change, one has to look at what has happened in the traditional structure of Indian society and its institution like caste, the Hindu join family, marriage, status of women, untouchability, ceremonials and customs, and religion. The extent to which Indian traditional society has altered and the nature of the alteration that has taken place would be the most significant aspect of the social change that science and technology and their application have brought about in India.

Caste and Science and Technology

Caste has been the strongest and most traditional from of social group in India, not so much in terms of the original four-fold Varna system, harking back to the Purushasukta, but in terms of the numerous castes and sub-castes that have formed through many permutations and combinations on the basis of language, region, and local peculiarities. And caste has sustained itself not only because of its base in heredity but, also, because of the internal ties it promotes amongst its members through marriage and kinship. The continued strength of the caste system, also, has rested on its social codes, food habits and taboos

residential proximity, occupational links and identities, and rituals and religious practices.

The change effected by the application of science and technology by way of industrialization, mechanization, urbanization, demand for new skills and provision for facilities to obtain the same without restrictions based on caste or heredity, the propinquity created by the new methods of transport, the mobility created by the changing economic system and the extending spheres of Government, the skepticism generated for the traditional religious sanction for caste restriction by the new education, the new influences created by films and the literature of skepticism and protest of the masses, and the wooing of the traditionally lower castes by politicians who had to find their activity in a political system based on adult franchise and periodic elections – all these had their inevitable impact on the working of the caste system in India. The new industrial occupations and service professions, the new towns and cities the new transport system, the new educational centers and the operation of new political forces all brought proximity and propinquity among members of different castes, diluted, if not eliminated their isolation and exclusiveness, and built up new social relations that broke old caste barriers.

The new group that has emerged, cutting across caste barriers, marrying outside the caste and even language-group and region, cultivating a western style of living, and forming a new all-India elite based on education, occupation economic opportunities and Government services. Some members of this group have taken full advantage of the mobility created by modern science and technology to establish their outposts even in foreign countries (though, largely, confined to English-

speaking areas). While the group has not solidified itself into a caste, as it is not based on heredity, nor has any allegedly religious sanction, it is unlikely to do any serious damage to the caste system, as many of its members take full advantage of their original caste affiliations to better their own interests. In the vary long run, however, this new group may help to undermine the caste system, as the gap between its profession and practice is bound to have its effect on the members of the caste systems it tries to exploit, and as its younger generation gets gradually by its profession as against practice it may assume leadership for a genuine assault on the caste system.

The impact of science and technology on the economy and on the material conditions of life and work in this country has not succeeded in shaking the strength of the caste system and to the extent it has failed to effect a major social change that would have brought India in line with other countries which have experienced the impact.

Family and Science, Technology

The position, however, is different in regard to some of the other traditional institutions in Indian society. The Hindu joint family for example, has failed to withstand the impact of the operational effects of science and technology. New industrial processes, changing forms of economic activity, increasing mobility of qualified or displaced individuals in search of better opportunities, transfers on service that are affecting increasingly large numbers of the technical, professional and administrative classes in both the public sector and the larger units in the private sector, and the increasing assertion for autonomous family life on the part of younger generations – all these are leading to a rapid breakup of the joint family and its replacement by the nuclear family.

This is, of course, more true of the urban areas, in the rural areas the joint nature of the agricultural occupations still tends to sustain the joint family system.

The most conspicuous change that has taken place in traditional institutions has been in the status of women in India. Undoubtedly, the religion gave high status to women in India and its goddesses have more worshippers than gods. But in all things that matter in this material world, women in India have always been treated as inferior beings, deprived of both status and opportunities. That position has now undergone a radical change. A women's right to ancestral property has been accepted. She now has the right to monogamy, divorce and maintenance. Educational facilities for women have been extended in large measure; her equality in status with man has been recognized by law and the constitution and women are now playing an active role in all areas of national activity including the political and the economic. Domestic drudgery has also been reduced by the direct impact of science and technology on energy and gadgets for use in domestic work, thus releasing opportunities for women's activity outside the domestic sphere. True, all this has so far been largely confined to the more educated section and upper echelons of Indian society. But the phenomenon is conspicuously visible and it is bound to set a trend that in due course and in the long run, will give women in India a status and a position approximating to that of their sisters in the western world.

The problem of Scheduled Castes is the problem of poverty; and the problem of poverty can only be solved by a politico-economic system that uses science and technology, not only for increasing production but, also, for increasing employment and individual labour

productivity, and at the same time restructures property relations and investment pattern in such a way as to reduce disparities in income and wealth and improve the quality of life for the masses of the people. Such a system is democratic socialism, and caste has no place in a socialist society.[9]

The impact of science and technology that has made for social change in India are in the realm of national identity an cultural development. Thus, industrialization, urbanization, commercialization and extension of educational facilities have led to a considerably larger measures of mobility and internal migration than in the past. And today we find a greater diversification of language, regional origin, religion and caste amongst our people who share work and residence than at any time previously in Indian history. While this is more applicable to the big cities and towns, it is not entirely absent in rural areas. The social change that this has brought about is of a mixed character. On the one hand, it has made for a sharper interaction between diverse social groups and given a new reality to the concept of Indianness. On the other hand, it has also given a new life to linguistic, regional and communal groupings, giving the country an uneasy balance between national identity and particularistic identities in Indian political and social life.

However, if the political and scientific forces effectively operate their professed postures on development they will undoubtedly strengthen the chances of a major breakthrough in the realm of social change in India.

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[9] Rao V.K.R.V. Science and Social Change, Rahman A. Choudhaury P.N. (ed) (1980), *Science and Society*, Centre for R&D Management CSIR New Delhi, pg. 82.

CONCLUSION

Science and Technology have profoundly influenced the course of human civilization. Science has provided us remarkable insights into the world we live in. Particularly striking is the rapidity with which science and technology is moving ahead. Science is becoming increasingly inter- and multi-disciplinary, and calls for multi-institutional, and in several cases, multi-country participation.

Science and technology have been an integral part of Indian civilization over the past several millennia.

In the present study of science, technology and society in India we have specifically focused on sociology of science. The theoretical perspective, which deals with the social character of science, we have focuses on the ideas of R.K. Merton, Talcott Parson, Daniel Bell, Karl Marx, Max Weber, Thomas, S. Kuhn Karl Popper, Paul Feyerabend.

The chapter on science, technology and society in India throws light on the development of science and technology from ancient period to the contemporary era. One has also looked at the various scientific policies.

The chapter on science, technology and weaker sections analyses the role of science and technology in enhancing the status of women and uplilfting the scheduled castes in India. Included also is the role of the

department of science and technology in uplifting the SCs is also analysed in this chapter.

Finally the role of science and technology is also considered important in generating social and cultural changes in society. Therefore, technology as a factor of social change the social effect of technology and the change in social structure through technology is analyzed in greater detail in the last chapter.

In the concluding part it can be said that historically, from ancient to medieval times there was a continuity of the development of science and technology. Development of modern science in India has been a catalyst in the process of creating a socio-scientific temper. After independence, there has been massive growth in the area of science and technology. In the wake of industrialization, science and technology has enormously changed the socio-economic profile of Indian masses. Technological onslaught has brought about change in the life style of the Indian masses. The social organization, social institutions and social structure of the Indian society is directly and indirectly affected by science and technology. These social institutions and organizations like family marriage, kinship, caste, race, and ethnicity has undergone changes. Technological invention has created a new form of relationship between man and machine and that relationship helped to mobilize the man's intellectual, physical and psychological capacity. The rational scientific temper has eroded the taboos, stigmas and blind faiths of

society like untouchability, child marriage, gender discrimination, notion of patriarchy etc. Today, every aspect of human values is judged by scientific rationality rather than ethnocentric bias.

Science and technology has definitely played a positive role in the areas of improvement of literacy, occupational upgradation and educating rural masses. The constructive use of mass media is obviously commendable in communicating useful information and relevant knowledge, as well as changing the outmoded outlook of the people by instilling in the fighting spirit and equalitarian goals. There is no doubt that science and technology has played a vital role in enhancing the status of women and improving the quality of life of Scheduled Castes. Nevertheless, the present orientation of science and technology has not been able to benefit all the masses.

It is a grim fact that the benefit of science and technology has not percolated down to the masses. The benefits on the other hand are always appropriated by the elites of the society while the weaker sections of the society are deprived of it. Moreover, the backward and weaker sections of society are ignorant of the policies, programmes and its implementation.

Hence, any technology prescription should in principle be pro-poor, pro-nature, pro-employment, i.e., technology should be need based self reliant, people centred, employment generating, eco friendly and culture specific.

It is imperative to consider the following factors in adopting science and technology for the purpose of development. Firstly science and technology should be compatible with the local culture and economic conditions. Secondly, the tools and process should be accessible to people. Thirdly, it should be ecologically and environmentally sound. Fourthly, it should improve gender relations. Fifthly, it should encourage participation of local community.

The authority of science thus, lies in its social responsibility. As a social scientist, one will be concerned very much on the role of science and technology in constructing social reality.

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