UNIT 1 SCIENCE AS A HUMAN ENDEAVOUR

Structure

1.1 INTRODUCTION

Science is a human endeavour. Human beings, from prehistoric times, attempted to control nature for their own welfare. For this, they had to observe and understand nature. Out of such an understanding, they found the means to make nature yield goods according to their needs. While this understanding led to useful applications, it also opened up further questions and avenues of enquiry, enriching the stock of knowledge. And this, in turn, led to improved techniques for satisfying their needs.

This process of understanding nature and using that understanding to control nature, is what may be called "science". The process is certainly not without ups and downs. The story of the ups and downs in science, as it grew in society, is very interesting. As we have said earlier, in this block we shall relate this story. But surely, by now, you may be wondering why you should know the history of science. And, for that matter, you may ask, what do we mean by the **'history'** of science? Will it mean memorising a lot of dates, names and places? Well, in the first unit we'll provide you with the answers to these questions. We will also discuss, in brief, some aspects of science in the present-day society.

The roots of science, as we know it today, lie in the life of primitive human beings. Therefore, in the next unit, we shall start the story of science right from the beginning, that is, from the dawn of human society. We shall see how the transition from a primitive society to an agricultural society had led to the birth of science and how it grew in the ancient world.

Objectives

After studying this unit you should be able to :

- explain why one should be aware of the history of science,
- explain what is meant by the history of science,
- describe some aspects of science in the present-day society.

1.2 LINKING PAST WITH PRESENT

The history of human civilisation shows that the progress of science has not always been steady. There were tremendous advances in mathematics in India about 2000 years ago, and in medicine about 2500 years ago. But, no comparable developments have taken place here in the last 2000 years. When sophisticated calculations and observations were being made in India in ancient times, Europe generally was in the primitive stage. On the other hand, while India was being ruled and exploited by the British, there was a flowering of the

Industrial Revolution in Europe. The picture is complex, but we cannot deny that science and human affairs are closely connected and together they give rise to, what we call, human civilisation.

Today, many questions related to life and happiness, like the following, worry us.

i) How is it that, in spite of the development of science and technology in our country, the vast majority of our people do not even have clean drinking water, basic health care, or the simplest facilities for education? Why is it that only a tiny minority enjoys the fruits of science and technology? While the latest techniques of surgery are available to a tiny minority, most people do not get even basic medical care. Why are essential medicines so expensive in our country?

ii) How is it that our science and technology is not as advanced as that in the West or in the socialist countries? In spite of glorious beginnings thousands of years ago, why have we fallen so far behind?

iii) How is it that a group of countries in the West have advanced and sophisticated machines, excellent health care, and good standards of living, while we do not have these?

iv) Is it true, as some in our country now say, and some of the colonisers have said in the past, that science and India have nothing to do with each other? Our culture, they say, is purely spiritual : science brings misery and spirit solace. Hence, we should concern ourselves mainly with scriptures and not with test tubes. Does this correspond with reality? Can we really do without science?

v) While science has brought enormous benefits to human beings, it has also been used as a means of destruction. For example, today an important question facing us is how to control and eliminate the threat of total destruction which a nuclear war may cause. How to establish a world where the relations between nations and people will be peaceful?

You could think of several more such questions. All such questions arise because, consciously or unconsciously, we have come to accept science as a part of our lives, and cherish the hope that it will bring us a better life. While we cherish the hope, we find impediments which either distort the true purpose of science, or divert the fruits of science for a small minority of our people.

1.2.1 Why Search the Past

How do we answer these questions which are of vital interest to us?

One approach is that characterised by the famous statement of Henry Ford, "History is bunk". According to this approach, all the earlier knowledge that is useful is absorbed in the present state of knowledge. What has been left out are only the mistakes, about which we should not bother. But this approach does not answer the basic questions. For example, let us take the last question that we have posed in the previous section. To understand why science is being misused to produce more and more deadly weapons, it is not good enough to blame the scientists who are at present engaged in defence research. Instead, we have to look at history in order to see how knowledge, including scientific knowledge, has been used to further the narrow interests of dominating groups. Whether in tribal life, or in agricultural societies, or in industrialised countries, competition for economic domination has led to destructive use of science. Although new discoveries enriched science, they too were employed, in course of time, for expanding empires, winning markets and controlling natural resources. And this has always benefited very small sections of people or only a few countries.

Henry Ford was a famous American innovator and industrialist who pioneered large-scale industrial manufacture of automobiles.

The same approach is applicable to all the other questions listed above. *It can be easily seen that none of the questions which arise out of the intimate interaction of science with our lives or with society in general, can be answered without due reference to history of science.* Thus, in order to draw full benefits from science, we have to understand how science is related to social and economic factors.

Science is the means by which the whole of our civilisation is rapidly being transformed. In the past, science grew steadily and imperceptibly. But now science is progressing by leaps and bounds, for all to see. The fabric of our civilisation has changed enormously in our own life times and is changing more and more rapidly from year to year. To understand how this is taking place, it is not sufficient to know what science is doing now. It is also essential to

be aware of how it came to be what it is; how it has responded in the past to the successive forms of society, and how, in its turn, it has served to mould them. In science, more than in any other human institution, it is necessary to search the past in order to understand the present and to control the future. In other words, we have to know the history of science. But then, what is the history of science? We will shortly answer this question. But before going further, you may like to try the following SAQ!

SAQ 1

State whether the following statements are true or false. Write either T or F in the boxes provided.

a) The correct approach, to answer the important questions we face today, is to ignore all that has been done in the past.

b) We have to refer to the history of science if we want to understand the matters which are today intimately connected with science and with our lives.

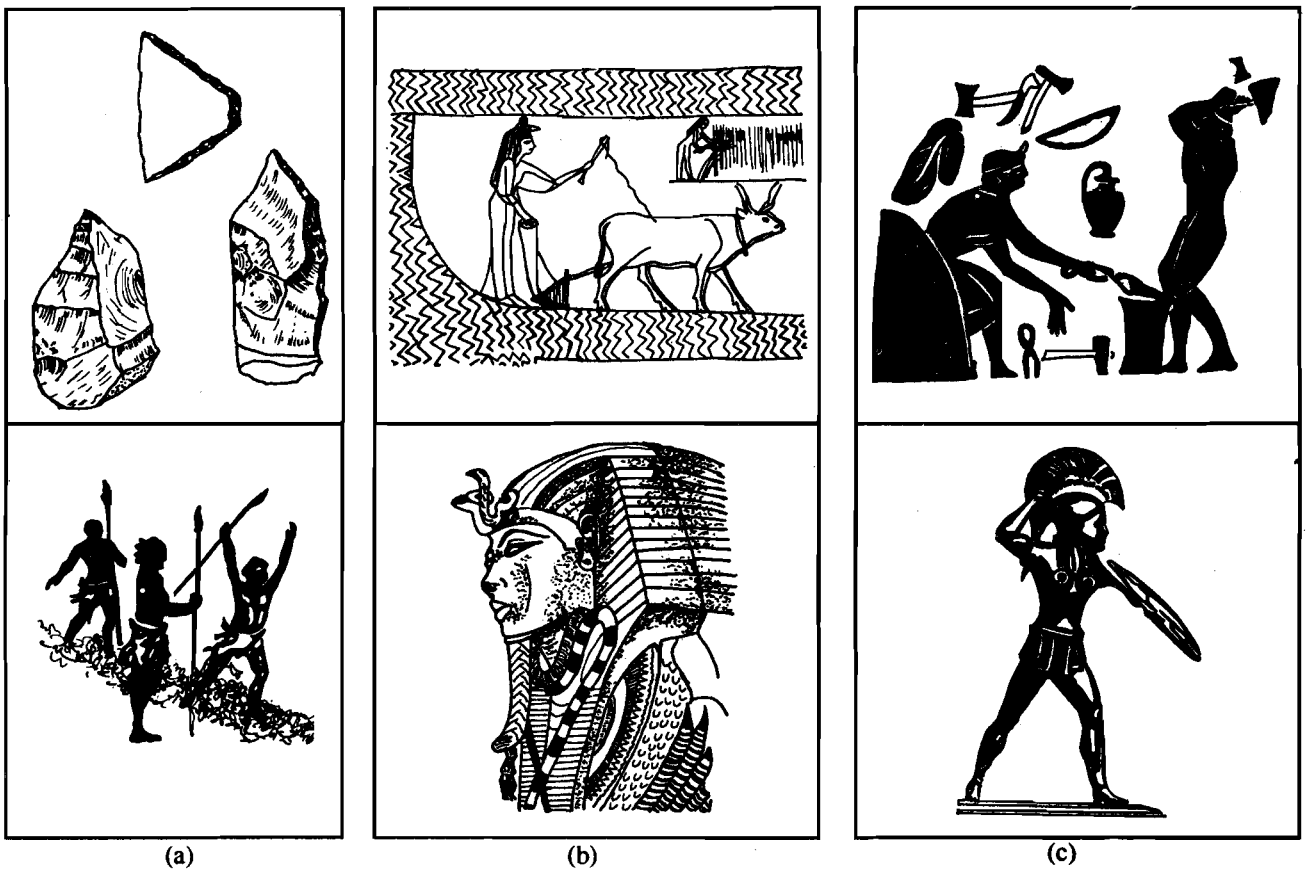
c) It is not necessary to concern ourselves with any of the issues related with science and society.

d) To understand how science has helped in transforming our civilisation, we must know about the interactions between science and society in the past.

e) If we want to understand the present and control the future for the good of all, we will have to search the past.

1.2.2 What is History of Science

The history of science is not a chronological description of events of scientific discovery. It is a story of an ongoing process of the interaction of science and society. It begins in the primitive human society and threads its way through different ages which have seen different forms of society, upto the modern times (Fig. 1.1). It is a story of how social



(a) (b) (c)

Fig. 1.1: Three societies belonging to different epochs—the Stone Age, the Bronze Age and the Iron Age. (a) Primitive human beings depended on food gathering and hunting for their survival and mainly used stone tools: some Stone Age tools; primitive human beings; (b) the Bronze Age is marked by the practice of agriculture and the use of bronze tools: sowing of crops using ox-drawn plough and reaping with a sickle; an Egyptian Pharaoh Tutenkhamen, fourteenth century B.C.; (c) the Iron Age is marked by the discovery of iron and its widespread use for making tools and implements. It was also a period of constant war between societies: a slave working in a black-smith's shop; a hoplite—an infantryman of the warring Greek states.

and economic pressures arising out of a given form of society necessitate particular inventions and innovations. These innovations are gradually used and absorbed by dominant social forces to stabilise their domination. The stability eventually leads to social stagnation. In the period of stability, new ideas in science and technology do arise. These ideas may be ahead of their times, and it may not be possible to put all of them into practice, in the prevailing socio-economic conditions. Later on, new social groups and forces take shape, often out of the frustrated and exploited sections of the society. These new groups press for full utilisation of the new ideas, inventions and discoveries. Out of such demands and struggles arises a new society, with new forces as the dominant section. The process is not an endless circle, as with each phase science takes society to a qualitatively higher phase. Each higher phase has more complex problems and social relations, creating even more complex and difficult problems for science to solve.

While the above picture has a rough universal validity, the actual story has interesting variations. For example, stagnation in a given geographical area or society does not always lead to radical changes in the same area or society. New ideas are sometimes transmitted through human interaction, due to trade and other means of communication, to other geographical locations. There, the society may be more conducive to a rapid change. Again, in a given society, successive changes may be rapid in a particular epoch (period of time). In a different epoch, in the same locality, changes may be extremely slow. You may wonder why it is so. To understand this, we have to understand the specific social, cultural and economic conditions of a given society. We also have to understand the world situation in which such a society functions.

It is in this perspective that we are going to study the history of science. Science, as it is today, is not a product of disinterested search for truth by a few gifted individuals. Nor is it a monument where one brick is simply placed on top of the other to gain magnificence. *The history of science is a story of human life. It is a story of human striving in all its failings, frailties and strengths. It is a story of the interaction of science with other forces in society such as economics, politics, psychology, culture and social organisation* (Fig. 1.2). Only through such a study of the past can we understand the present so as to control the future for the welfare of mankind.

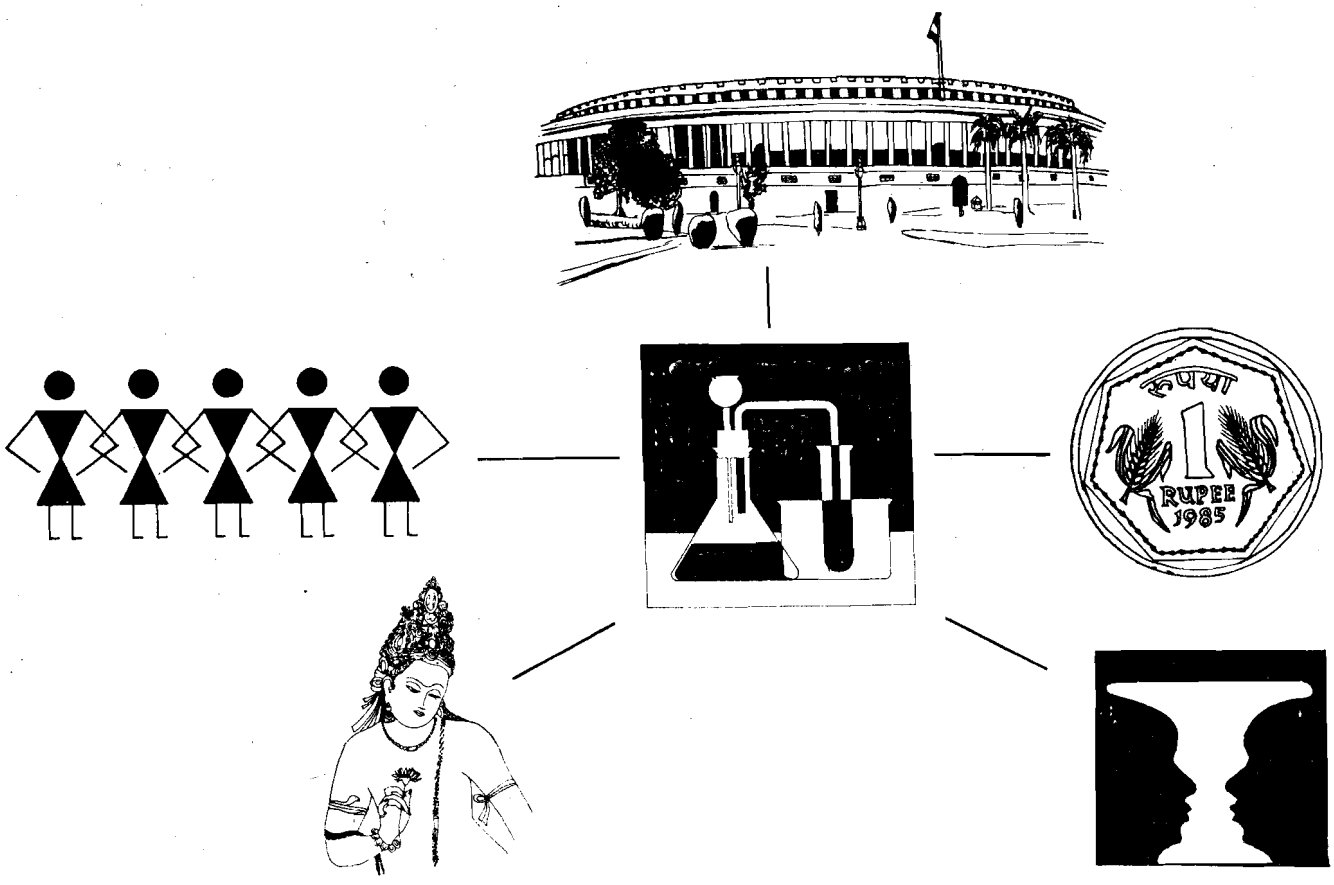


Fig. 1.2: Science interacts with politics, economics, psychology, culture and social organisation.

SAQ 2

Some statements, indicating how science and society interact, are given below. Fill up the blank spaces in these statements using the words given below.

a) Necessity is the mother of invention, means that scientific ..... are caused by the ..... needs in a given society.

b) The dominant social groups use the inventions to ..... or extend their ..... in the society.

c) Stable and ..... position of the dominant groups may lead to stagnation in society and ..... in science.

d) ..... ideas may sometimes be far ahead of social need, and, therefore, they can't be used, or they may require social and economic ..... before they can be used.

e) Sections of society which are ..... will not have a ..... interest in allowing science to stagnate.

dominated, strengthen, vested, new, secure, domination, inventions, stagnation, socio-economic, changes.

1.3 SOME ASPECTS OF SCIENCE

When we look at science today, it appears as an organised and specialised human activity. This character of science is, however, not more than 300 years old. Before that, science was a part of the general culture, often indistinguishable from other areas of knowledge. As you will see in the following units, in the olden days, a philosopher, an artisan, a priest, or a magician could at the same time be a scientist. However, today, science is a multifaceted activity. It has its own body of knowledge, organisation, experts, tasks and methods. It is important that we discuss these aspects before briefly going into the history of science.

1.3.1 The Institution of Science

Science, in the modern times, is a collective and organised activity, in which hundreds of thousands of men and women are actively involved. They work with apparatus, which appears strange and even mysterious to a layman. They perform complex calculations and speak a language which the common people find difficult to understand. Scientists are generally thought of as a set apart in society. *The large and diverse scientific activity, which is well organised, gives science the nature of an "institution"*. In Fig. 1.3, we show you some of the activities in which scientists are involved.

While the influence of science on our daily lives has grown, it has not become easily understandable to most of us. These days, scientists limit themselves more and more to narrow areas of specialised activity. What is more, the specialisation is so narrow that often one section of the scientific community fails to understand the other. For example, scientists specialising in the study of insects may not know much about other areas of life sciences such as the study of worms, snakes or monkeys.

Specialisation in science means a deep study of a limited range of questions or phenomena. Thus, it may help in rapid solution of some problems. However, too narrow a specialisation often leads to loss of broad scientific understanding. It inhibits the scientist's ability to see the relation of one set of questions to another set, thus hampering the growth of knowledge. Specialisation also leads to the use of special terms and phrases or what may be called jargon. This prevents common people from understanding science and using it for their benefit in everyday life. Very often it leads to stagnation and decay of scientific activity.

When we think of science as a social institution, then the objectives of science are, in a general sense, social objectives. The general economic and ideological atmosphere of society determines the broad motivation for scientific activity. And the specific areas of social life, such as trade or "markets", industrial development, agriculture, natural resources, health etc., set definite problems for science to solve. Unfortunately, military activity has also been one of the major social goals for science throughout history. Such goals do not lead to human welfare and, in fact, pervert scientific activity. Most scientists in modern time have taken a position against such a perversion of their work. The stand taken by scientists all over the world against using space to instal deadly weapons is an example of this.

Fig. 1.3: The institution of science may be used to solve the problems of a society or to satisfy individual curiosity. (a) Blast off of rocket ASLV (Augmented Satellite Launch Vehicle); (b) control room to monitor the launching of ASLV; (c) an agricultural scientist explaining the advantages of a new wheat variety to farmers; (d) late Vikram Sarabhai, former head of the Indian Space Research Organisation (ISRO), inspecting plans with fellow scientists; (e) scientist handling sophisticated apparatus at Bhabha Atomic Research Centre, Trombay, Bombay; (f) tiny electronic devices being assembled.

Thus, science, as an institution, is used to solve specific problems in different areas, within the broad framework of existing social conditions. The fruits of scientific labour can be used for human good or they may be misused. It depends upon the historical epoch and the interests of dominant groups in a particular society. For instance, science, in a society based on private profit, would lead to production of goods which can be sold for profit rather than those which are really needed. And if weapons can be a source of profit, in such a society weapons will be produced rather than medicine for the ailing. All of us and scientists, in particular, need to be continuously aware of this.

In the final analysis, it is we, the common people, who are the ultimate judges of the meaning and value of science. Therefore, science should not be kept as a mystery in the hands of a few. The scope of science and its working as an institution has to be understood by all of us. Only then will we be able to demand that science be linked with our needs and be used for common welfare.

SAQ 3

In the following sets of statements, tick the correct ones and cross the wrong ones :

a) Science is a social institution. This means that,
   i) scientific activity is carried out in a large number of huge buildings throughout the world. ☐
   ii) scientific activity is carried out by a large number of people bound together in an organised way. ☐

b) Narrow specialisation in science implies,
   i) an in-depth study of a specific problem in a given area. ☐
   ii) that the specialist is able to acquire a broad understanding of several inter-related questions from different areas. ☐
   iii) using a readily understandable language to express scientific ideas. ☐
   iv) that the ordinary people are unable to understand and use scientific knowledge for their betterment. ☐

1.3.2 The Method of Science

We have seen above that science is a social institution, in which a large number of people, all over the world, are involved in an organised way. They carry out certain tasks in society, such as extending the frontiers of knowledge or applying science to solve practical problems. The methods and the practices that they follow can be broadly described as the **"method of science".** The methods of exploring and enlarging scientific knowledge are continuously evolving through a complex interplay of mental and practical activity. Science cannot be given a purely intellectual character. For, removing it from the din and dust of practical life, and from physical and manual work, distorts science in the long run.

The method of science is made up of a number of operations, some mental, some manual. **Observation** and **experiment** are essential for science. Now, everyone, whether a scientist or not, observes things and phenomena. But, to a scientist, the important question is what to observe and how to observe it. Scientists also have to make sure that observations are, as far as possible, independent of their sentiments and wishes.

You will study a more detailed description of the method of science in Unit 8 of this course.

However, systematic observation alone does not tell us "why things are as they are". Based on previous knowledge or observations, a speculative framework or a **hypothesis** is generally built to answer the question 'why'. Experiments are set up to prove the first hypothesis, or to find under what conditions the idea is valid. This leads to formulation of more reliable laws and theories which, of course, are not considered unchangeable. Each law is valid within certain boundaries or conditions. Application of laws to real life brings out these limitations, and leads to new hypotheses, further experiments and better laws.

Strategy of Science

So far we have talked of using the method of science to solve problems and to ensure that the solutions are satisfactory. But, how do problems arise? Why should a problem be solved? *In a broad sense, economic and social necessities pose problems to be solved.* For example, the need to cure common diseases, or to produce food for all in a given climate and soil are some such problems. In a capitalist society, the desire to sell a product may also pose problems. *For an individual scientist, however, the problem he solves is often a logical extension of the work of an earlier scientific worker. It is also to be noted that important advances in science are made by people who are just curious and who want to resolve the so called mysteries of nature.* Some of the great scientists of the past like Newton, Darwin and Einstein belong to this category.

SAQ 4

a) Using the words given below, fill up the blanks in the following statements describing the strategy of science :

The problems to be solved with the help of science arise due to the general social and ..... necessities. The need to provide ..... or to provide ..... to all are some such problems in our times. Problems may also arise due to an individual's ..... about the mysteries of the..... Problems solved by an ..... scientist may often be an extension of the work done by ..... scientists.

housing, universe, earlier, individual, drinking water, economic, curiosity.

b) In Fig. 1.4 we have shown the individual components of the method of science. From what you have read earlier, connect them in their logical sequence by drawing an arrow from one box to the other. We have shown the first link in this loop.

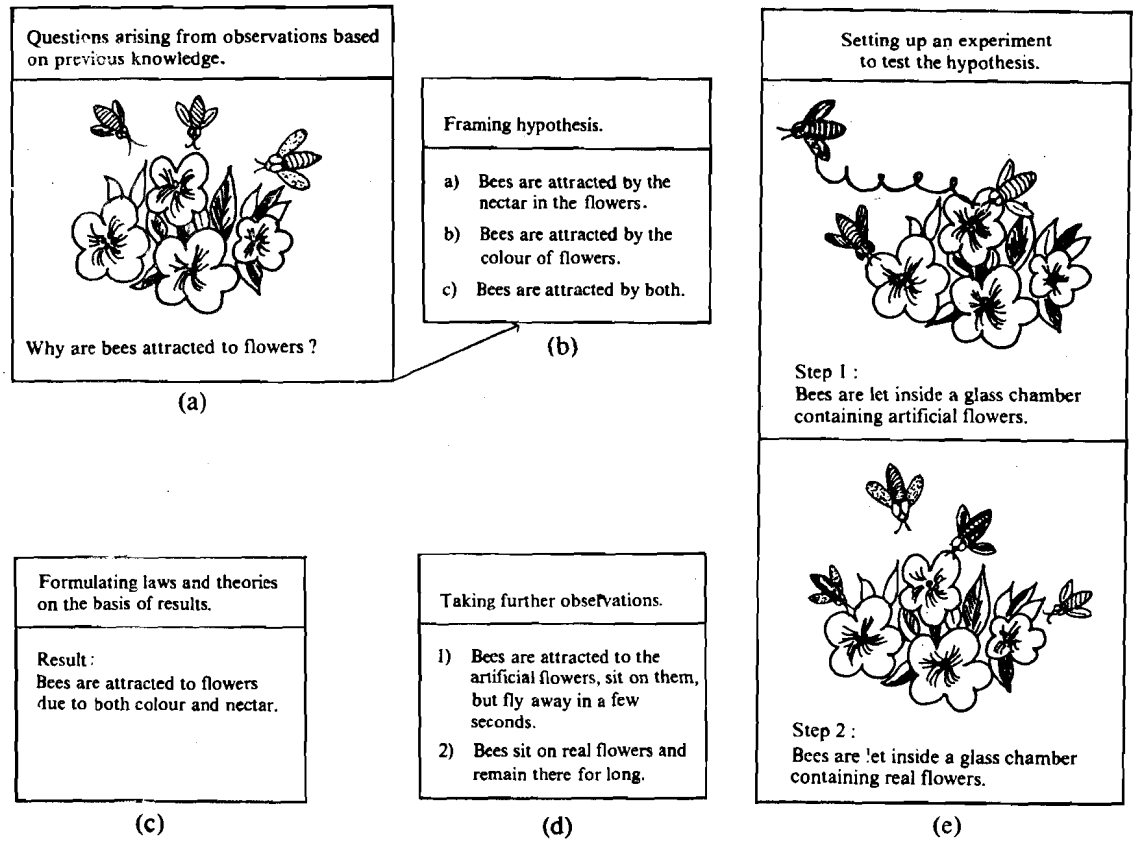


Fig. 1.4 : The Method of Science illustrated with an example.

1.3.3 The Tradition of Science

One aspect of scientific endeavour makes it different from all other aspects of social achievement. This is that *scientific endeavour, at any point of time, depends on the existence of previous knowledge*. Without the stock of previous knowledge, the methods of the scientist would not be able to achieve much. Further, to be called scientists, scientific workers have to add to previous knowledge. Scientists constantly strive to change the accepted truth. In this sense, they uniquely differ from other professionals such as lawyers, priests and administrators who mainly interpret and use previous knowledge.

Science is cumulative, that is, science at any time is the total result of all that science has been up to that date. Further, an individual scientist's contribution, howsoever great, is absorbed into the body of scientific knowledge. The individual character of a scientist's work is lost in the general history of science and knowledge. In art and music, the works of past masters are always appreciated and sought after. *In science, it is only the current state of knowledge which is of the utmost importance as the past is fused into the present.* For instance, we still listen to and appreciate the music of great maestros like Ustad Bade Ghulām Ali Khan or Ustad Fayyaz Khan. Prints and reproductions of Leonardo da Vinci's famous painting, 'Mona Lisa', are bought by art lovers all over the world. The works of Shakespeare and Kalidasa are read even today. But, not many people feel the need to read Newton's Principia Mathematica or Einstein's famous papers in original. What is important, in science, is the form in which those ideas are used today.

Art and religion appeal to personal faith and sentiment. In contrast, scientific activity always strives to reduce the personal or subjective component and build as objective a basis as possible. *Results of science can always be checked, verified and repeated by anybody anywhere.* This gives science a "universal" character.

The truth of science lies in its application. The final test of validity lies in testing scientific knowledge in real life, in controlling nature towards some chosen ends.

SAQ 5

Which features listed in the column 2 below, correspond to the scientific knowledge and which to the other aspects of social life such as law, religion, art, music etc., given in column 1. List them under suitable headings. For example, scientific knowledge as well as law is based on reason.

1	2
a) Scientific Knowledge	i) Non-involvement of personal feelings and views.
(ii),	ii) Based on reason.
Other aspects such as	iii) Great works of the past are sought after.
b) Law	iv) Using and interpreting previous knowledge only.
(ii),	v) Open to change.
c) Religion	vi) The individual's work is absorbed in the general tradition.
	vii) Creating new knowledge.
d) Art and music	viii) Results can be verified by anyone anywhere.
	ix) Personal faith and beliefs matter a lot.

1.3.4 The Social Function of Science

All the features discussed so far describe the character of science—as an institution, as a method and as a growing and ever-changing body of knowledge. By themselves they do not answer many questions. For instance, what is the major function of science today? How does science influence the way a society develops? What social factors help or impede the growth of science in any society? We will now examine these questions.

Science and the Means of Production

Science has always played a crucial role in production. The history of humankind, is principally, the history of how human beings have attempted to control and transform nature for their own use. In this, different tools and means of production have played a crucial role (Fig. 1.5). We call the major historical epochs by the corresponding principal means of production: Stone Age, Bronze Age, and Iron Age. In the last few centuries, the means of production have become very complex and, therefore, one now refers to the Industrial Age, Atomic or Space Age etc. on a very different basis.

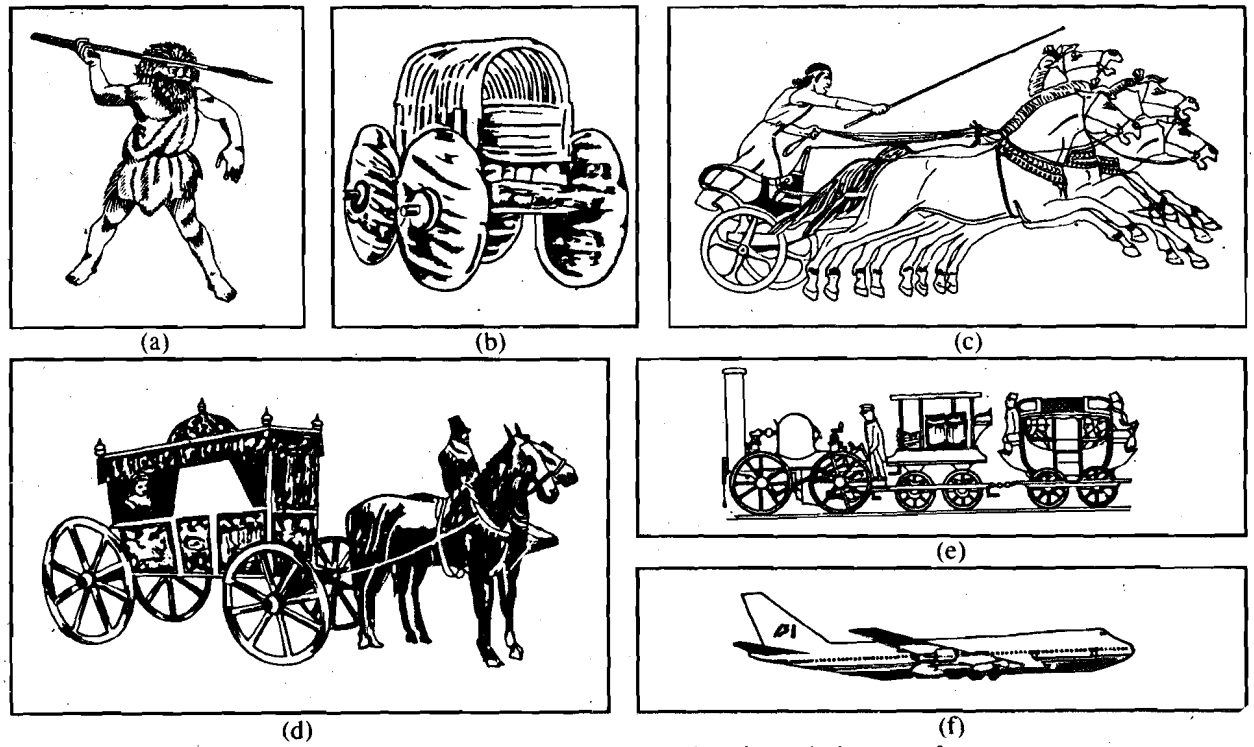


Fig. 1.5: Developments in science and technology have brought about tremendous changes in the means of production, that is, in the land, transport, resources, and the tools, machines and methods for making goods of use. Here we show the changes in transport from primitive to modern times.

Early man strived to extract and fashion materials so that they could be used as tools to satisfy his prime needs. Techniques were, thus, discovered. You will see, in the later units of this block, how technique, and later science, arose in society to satisfy human needs.

Science flowered in different countries at different times. *Generally, science thrived whenever a society had organised itself to increase the production of goods and to create a degree of satisfaction in its members.* The development of science led to a further increase in production. However, in a given form of social organisation, the range and level of production have a limit, both in quality and quantity. Therefore, in this process, whenever a saturation in production was reached, science stagnated. The unequal sharing of the produce led to the emergence of a dominant class who wanted to keep things as they were. This was another impediment in the growth of science.

However, societies which were more receptive to new ideas forged ahead, and science flourished there. And, as you will see in the later units, *the most fruitful periods of scientific advance were also those in which practice and theory could be combined, either in individual scientists, or in groups where practitioners of medicine, artisans and technicians mixed on equal terms with learned men.*

The growth of science not only increases production but also leads to an improvement in the methods of production. And when methods of production evolve and develop to a new stage, societies transform. For example, when agriculture was the prime means of production, human habitations were scattered over large rural areas with their own lifestyles. But, when factory-based production became common, industrial towns grew up, because a large number of people were working in one place, with a life very different from the rural life.

In this process of change, societies may even break up. Social classes come into conflict in this process and create new social organisations. In Europe, at a certain stage of development, the big landlords who jealously guarded their territories, and the merchants and tradesmen who wanted free passage through such territories, as also common laws for large geographical areas, came into conflict. A few centuries ago, science and industry developed together so that the growth of science and the improvement in the methods of production were intimately related. In the present stage, science has grown to such a point that it leads to the development of industry.

Science and Ideas

We have said above, that the practical application of science leads to its growth. But, the advance of science depends on something more than just the practical aspect. *An equally essential part of science is theory and concepts, which have played an important role in its advance.* The theoretical framework links together the practical achievements in science and gives them an intellectual unity. As we shall see later, major advances in science occurred when a particular theory was proved or disproved. However, in science, theory is intimately linked with practice. It has often happened that an important theory became very formal and came to be used mechanically, without any fresh ideas or new approaches. Then a new contact with practical experience brought forth its limitations. And it had to be modified or rejected, leading to another major advance in science.

We have also seen that the level of practical application of science in a society depends on the prevailing social conditions. For example, there are scientific methods to prevent births and control population, but social conditions in many countries do not allow such an application of science. Or, in agriculture, mechanisation could increase productivity. But, in the regions where farmers have small pieces of land, mechanisation is not possible.

Similarly, *the theories of science are also influenced by the general intellectual atmosphere in the society in which scientists work.* It often happens that a theory which fits into the general intellectual atmosphere and so is accepted universally, impedes further scientific advance. New theories based on newly discovered facts may be radically different from the existing ones. Therefore, they come into conflict with the prevailing ideas and social thought. This conflict has, in the past, even resulted in the persecution of scientists. For instance, in the seventeenth century, Galileo used a telescope to see and to show others that the moons of the planet Jupiter, revolved around it. This was very much like what he was proposing : that the earth revolved around the sun. He could also show that there were hills and valleys on the surface of the moon. But these ideas were against the prevailing concepts that the sun revolved around the earth and that God had created the perfectly spherical moon. This new theory when published, led to the trial of Galileo.

Nevertheless, history shows us that barring a few exceptions, new ideas in science overcame opposition and came to be accepted in due course of time. This not only led to great leaps in science but also moulded the intellectual thinking in general.

SAQ 6

a) State, in three or four lines, two ways in which the growth of science influences the production process in a society . Give your answer in the space provided.

.....

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.....

b) Use the words given below to fill up the blanks in the following statements about science and ideas.

Ideas and ..... also play an important part in the growth of science.

Proving or ..... a theory of science has led to major advances in science.

The theories are influenced by the general ..... atmosphere of the society.

New theories radically ..... from the existing ones may come up.

Initially, they are not accepted because they may not agree with the .....

theories and the prevailing social ideas. However, their acceptance leads to great .....

..... in science. It also influences the social attitudes and ..... as

well as the intellectual ....., in general.

thinking, disproving, advances, different, intellectual, existing, concepts, beliefs

Thus, the progress of science depends, to a large extent, on a continuous tradition of scientific thought influenced by the prevailing social thought. But, this tradition should be continually broken and remade in the light of new experience from the world around us.

Let us now sum up what we have studied, in this section, about various aspects of science as it has come to be in the world today.

- We have seen that science is a social institution.
- There is a method of science which is used to solve problems arising either out of social and economic needs or individual curiosity.
- Science has a cumulative tradition of knowledge. The stock of previous knowledge forms the basis for new knowledge, with the previous knowledge merging into the new knowledge.
- Science has several functions in a given society. It plays a major role in the maintenance and development of production processes.
- Science is influenced by the prevailing social thought. And, in turn, radical changes in scientific ideas influence the general attitudes and beliefs in society.
- In science, theory and practice are intimately related. Hence, science progresses rapidly in societies and in conditions, where practitioners and thinkers mix and interact. Theory without practice is as barren as practice without theory.

What is common to all these aspects is that we are seeing science in the context of the society. We are regarding science as a natural part of the common tradition of mankind. The growth and change of this great tradition cannot be seen without science. At the same time, science cannot be understood without duly examining its part in this tradition. It is in this perspective that we will follow, in brief, the whole course of science from its first appearance to the present day. As the story of science unfolds, the apparently abstract ideas that you have studied in this section, will become clearer and easier for you to understand.

1.4 SUMMARY

In this unit, we have tried to view the development of science and technology as an integral part of human endeavour. So far we have learnt that,

- if we wish to answer questions arising from the interaction of our lives with science and technology, we have to refer to the history of science. It is also necessary to know the

history of science if we want to understand the character of science and technology in the present-day society and wish to exercise a conscious control on their future development;

- the history of science is not merely a description of the works of important scientists, or the dates of important scientific events that have to be mechanically memorised. It is a story of human life. It is a story of how science grew as an integral part of society; how developments in science led to a change in the material conditions of the society. The changed material conditions led to a change in the social conditions giving rise to a higher phase in society. And the higher phase created more complex and difficult problems for science to solve. In this way, the growth of science is intimately connected with the development of society;
- science, in the present-day society, can be seen as a social institution having its own methods and tradition, and an evergrowing body of knowledge. Theory and practice are intimately linked in the growth of science;
- in a given society, science influences the means of production. It not only increases production but also improves the methods of production in the society;
- the ideas and theories in science are influenced by the prevailing social thought. And, in turn, the radical changes in scientific thought influence the social attitudes, beliefs and thinking.

1.5 TERMINAL QUESTIONS

1) Which one among the following statements describes the history of science most adequately? Tick the correct choice.

   The history of science is :

   a) a chronological catalogue of the discoveries in science.
   b) an account of the contributions of great scientists.
   c) a story of the interaction of science and society, how the two influence and change each other.
   d) a general description of the magnificent scientific advances that have occurred through the ages.

2) In the space provided below, give short answers in about four or five lines, to the following questions.

   a) In a given society,

      i) what factors decide the broad areas of scientific activity?

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      ii) what areas of activity set the specific goals for science to achieve?

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   b) What are the conditions that determine whether the fruits of science are used for human good or for destructive purposes?

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c) Who, in the society, **should** decide about the purpose and scope of science?

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3) In the following statements we describe some social conditions which lead to the growth of science and some which impede the advance of science. Put the letter G (for growth) or I (for impediment) against each statement.

i) The emergence of a dominating group whose interest lies in keeping things as they are.

ii) The social organisation is such that the level of production of goods is increased, and the members of the society are largely happy.

iii) The unequal distribution of the fruits of science in society.

iv) In a given form of society, the range of goods produced and the level of their production, both in terms of numbers and quality, are limited. A saturation is reached in production.

v) Societies are receptive to new ideas and adopt new methods of production.

vi) Those who work with their hands and those who do only mental work, interact freely and are treated on an equal footing.

1.6 ANSWERS

Self Assessment Questions

1) a) F (b) T (c) F (d) T (e) T

2) a) inventions, socio-economic
   b) strengthen, domination
   c) secure, stagnation
   d) New, changes
   e) dominated, vested

3) a) (i) × (ii) ✓
   b) (i) ✓ (ii) × (iii) × (iv) ✓

4) a) economic, drinking water, housing, curiosity, universe, individual, earlier
   b) a → b → e → d → c → a

5) a) i, ii, v, vi, vii, viii
   b) i, ii, iv
   c) iv, ix
   d) iii, iv, ix

6) a) The growth of science in a society leads to
      i) an increase in production,
      ii) an improvement in the methods of production such as improved tools, machines, computers etc., in the present-day society.
   b) concepts, disproving, intellectual, different, existing, advances, beliefs, thinking.

Terminal Questions

1) (c)

2) (a) (i) The broad areas of scientific activity in a society are decided by its socio-economic conditions and the prevailing ideological atmosphere. For instance, if, in a society, it is more important to provide for the basic needs of the people, science will be used to first satisfy these needs. But, if a society thrives on market economy, it will promote scientific activity in areas which increase the profits, such as making weapons or consumer products like fancy electronic gadgets etc. In this context, you should try to analyse the present Indian society.

ii) The specific areas such as trade, health, resource mapping and management, agriculture, industry, transport, communication, military activity etc. set the specific goals for science to achieve.

b) The use or misuse of science depends on, who the dominating groups in a society are and what their interests are. As the study of this block will show you, these things are also determined by the particular period of time, in which a society exists and functions.

c) The vast majority of common people like us should decide, for what purposes and how science should be used in the society. For example, in our society, science should be used not only to make and launch satellites, build nuclear reactors, or send expeditions to Antarctica but also to provide basic necessities, like clean drinking water, food, shelter etc., and to improve the quality of life by providing suitable health-care, better transport, electricity etc.

3) (i) I (ii) G (iii) I (iv) I (v) G (vi) G