UNIT 28 TECHNOLOGY AND ECONOMIC DEVELOPMENT

Structure

28.1 INTRODUCTION

When the Second World War ended in 1945, the political situation changed considerably. Many colonial countries that had been struggling to achieve independence got their chance. Our country became independent in 1947 and, since then, many large and small countries have won their freedom. The economies of these nations had remained backward due to exploitation by the colonisers. On achieving independence the question that has faced them is how to rapidly develop their economies and reform their societies so that their people have a decent standard of living, and access to basic education and culture. In India also there has been considerable debate about what basic policy to adopt in order to ensure rapid economic and social progress.

You can listen to our audio programme "Technology transfer" at your study centre.

As a result of this debate, the Scientific Policy Resolution was drafted and adopted by the Indian Parliament in 1958. (We have already discussed some aspects of this policy in Unit 27) This resolution clearly stated that "the wealth and prosperity of a nation depends on the effective utilisation of its human and material resources through industrialisation". The same resolution further said that "national prosperity depends upon the effective combination of three factors, namely, technology, raw materials and capital. Of these factors technology is perhaps the most important". The reason given in the Resolution is that "the creation and adoption of new scientific techniques can, in fact, make up for a deficiency in natural resources and reduce the demands on capital. But technology can only grow out of the study of science and its applications." In our country numerous steps have been taken to promote education and science, but a clear statement of our technology policy was made only in 1983, a full 25 years after the Scientific Policy Resolution.

The Technology Policy Statement is again a clear formulation of the realities of the national and international situation with regard to technology, because, just as technology is essential for industrialisation and proper economic development of the country, it is also the field where interests of many countries clash. For example, to establish our economic strength, we may need to obtain technology which may already have been developed abroad. But why should the developed countries, which maintain their economic superiority on the basis of their technology, help us to cut loose from their influence and hold? In order to intelligently follow the crucial problems of our social and economic development, it is necessary to understand the main features of our technology policy and the situations in which transfer of technology from one country to another takes place.

In Section 28.2, we discuss India's technology policy. In Section 28.3 we describe the problems of technology transfer. The current technological developments in some industries

in India is given in Section 28.4. Finally, in Section 28.5, we make a case for making technology accessible to all levels of our society so that India can really progress as a whole, and be counted among the developed nations in the future.

Objectives

After reading this unit you should be able to :

- give reasons for the need for developing our own technology,
- discuss the aims and objectives of our technology policy,
- explain the different aspects of transfer of technology,
- list some recent technological developments in a few important Indian industries,
- give reasons for the benefits of our technological development not reaching all strata of our society.

28.2 TECHNOLOGY POLICY

In Unit 7 we discussed the colonisation of India and explained how the ruling country, Britain, was able to develop its science, technology and industrial potential to become a "developed" nation of today, while India remained undeveloped and economically dependent on Britain.

Other colonial nations faced similar situations. When they won freedom, they discovered that their economies were very strongly bound to those of their previous masters. For buying and selling their products they were dependent on the "world market" where pricing of goods was not in their hands, and where numerous discriminatory practices existed. Technological progress, of which they had been deprived, enabled the industrialised countries to offer superior goods at lower prices. And when these ex-colonies wanted to upgrade their technology by their own research and development effort, or even by purchasing foreign technology, the response from most of the developed countries was not helpful. Obviously, technological superiority ensured dominance over the markets, and hence, technology could not be given to the colonial countries just because they needed it! On the other hand, technological deficiencies of the newly independent countries, prevented them from raising productivity and meeting even the basic needs of their people. This often made the governments of these countries weak and unstable.

The question of technology has, thus, become a crucial question for all developing countries. There seems to be only one answer, and that is to develop our own technology, suitable for our needs and fitting into the pattern of our natural human resources. This requires identifying our priorities, and steadily pursuing the path that will help us achieve them. A clear national technology policy is needed, from which there should be no deviation, irrespective of pressures from the developed countries or the corrupting influence of their trading partners in our own countries.

SAQ 1

Put T or F against each of the following statements depending on whether they are true or false.

i) Our technology policy should ensure that every Indian's food, clothing and shelter requirements are met. ☐

ii) A technology policy is the first step towards not being dependent on other nations for essential goods and services. ☐

iii) A nation's technology policy should be designed to make best use of its human resources. ☐

iv) India should have a technology policy so that we can soon be in a position to dominate over other nations. ☐

In 1983, a Technology Policy Statement was issued by our Government and its very first sentence is "Political freedom must lead to economic independence and the alleviation of the burden of poverty". A crucial paragraph produced below neatly summarises several important aspects of the Policy:

"The use and development of technology must relate to the people's aspirations. Our own immediate needs in India are the attainment of technological self-reliance, a swift and tangible improvement in the conditions of the weakest sections of the population and the speedy development of backward regions. India is known for its diversity. Technology must

suit local needs and, to make an impact on the lives of ordinary citizens, must give constant thought to even small improvements which could make better and more cost-effective use of existing materials and methods of work. Our development must be based on our own culture and personality. Our future depends on our ability to resist the imposition of technology which is obsolete or unrelated to our specific requirements, and of policies which tie us to systems which serve the purposes of others rather than our own, and on our success in dealing with vested interests in our organizations: governmental, economic, social and even intellectual, which bind us to outmoded systems and institutions."

The paragraph mentions "attainment of technological self-reliance" as our immediate need. This refers to the competence of our scientific and technological personnel, who should be well-versed in modern knowledge and "know-how". They should be able to innovate technology according to our need, and develop new technology. For example, they should be able to harness sources of energy, such as solar energy, in which our country abounds: or they should be able to effectively use the raw materials that we possess in plenty.

...and lastly, I must thank all the foreign collaborators, foreign technicians and foreign advisers who put up this great plant which is truly a national achievement ...!

Fig. 28.1

Technological self-reliance also implies capability in our institutions to support technology development through their infrastructure and skilled manpower. Self-reliance means, we should be able to foresee and forecast our needs so that development work can be undertaken at suitable centres. It means, we should not be helpless watchers of new technology emerging from other countries. If it is decided to import new technology, we should be in a position to develop it further in order to save the country from importing similar technology again after a few years. Self-reliance implies existence of industry to produce the goods we need.

So you see that "self-reliance" is a simple word, but, in practice, it means developing our own capabilities through planning, coordination, education and research.

We now give another excerpt from the Technology Policy Statement, in which its aims and objectives are listed.

"The basic objectives of the Technology Policy will be the development of indigenous technology and efficient absorption and adaptation of imported technology appropriate to national priorities and resources. Its aims are to :

a) attain technological competence and self-reliance by making the maximum use of indigenous resources, to reduce vulnerability, particularly in strategic and critical areas;
b) provide the maximum gainful and satisfying employment to all strata of society, with emphasis on the employment of women and weaker sections of society;
c) use traditional skills and capabilities, making them commercially competitive;
d) ensure maximum development with minimum capital outlay;
e) identify obsolescence of the technology in use and arrange for modernisation of both equipment and technology;
f) develop technologies which are internationally competitive, particularly those with export potential;
g) improve production speedily through greater efficiency and fuller utilisation of existing capabilities, and enhance the quality and reliability of performance and output;
h) reduce demands on energy, particularly energy from non-renewable sources;
i) ensure harmony with the environment, preserve the ecological balance and improve the quality of the habitat; and
j) recycle waste material and make full utilisation of by-products."

Thus, we see that the policy stresses attainment of self-reliance in technological development and utilisation of our own resources for indigenous technology.

The aims of the technology policy also show the government's concern for the environment.

Environmental considerations include the following:

i) **Making the air less polluted:** This can be done by controlling the combustion processes. One should ensure the complete burning of coal or other fuel. Where combustion takes place, the chimneys must be high enough to ensure that the gases don't spoil our environment. These chimneys must also be fitted with pollution reducing mechanisms.

ii) **Disposing of solid waste:** For example the ash from thermal power plants or the waste from cement factories should be properly disposed of.

iii) **Treating industrial effluent:** Effluents, that are discharged from chemical factories into rivers or oceans should be appropriately treated to make them free from toxic materials. A Ganga Pollution Control Authority has been created by the Government of India for cleaning the river Ganga throughout its stretch by using appropriate treatment plants.

iv) **Prevention of soil erosion:** Through social forestry, farm forestry, grassland and wasteland development, measures must be taken to control soil erosion, which has many untoward consequences (see Unit 15).

The Department of Environment was set up in 1980. It conducts research, creates public awareness and runs training programmes related to the environment.

For implementing the Technology Policy Statement, a Technology Policy Implementation Committee (TPIC) was constituted by the Government. A special plan to provide funds to institutions of higher education on a selective basis is now being implemented by the University Grants Commission. The aim is to enable the institutions to strengthen and modernise their infrastructure for undertaking work in front line areas in science and technology. The Department of Science and Technology (DST) has been the focal organisation for supporting research of a multi-disciplinary nature. Many of the States have been persuaded to set up separate councils of science and technology. The DST has been providing secretarial support to the Scientific Advisory Committee of the Cabinet since March, 1981. The research programmes supported by the DST are being utilised to improve actual production processes.

Having read about the Technology Policy of the Government, see if you can solve this SAQ now.

SAQ 2

Match each of the following sentences with an aim of our technology policy that it represents. Indicate the aim by putting the corresponding letter (as on p. 20) in the box provided.

i) Utilise all our human resources. ☐

ii) Uses should be found for waste material. ☐

iii) Develop to the maximum extent at least cost. ☐

iv) Achieve development without creating ecological imbalance. ☐

v) Replace, by suitable development, outdated technology, machines and processes. ☐

28.3 TECHNOLOGY TRANSFER

In the section above we have discussed our technology policy. We stressed self-reliance and mentioned that sometimes it becomes necessary to import technology from other nations. Import of technology is one of the forms of technology transfer, a term that we will discuss in this section.

There are three ways in which we can transfer techno:

- import of technology,
- transfer of technology from the laboratory to the field, and
- export of technology from India.

Although India's aim is to be technologically self-reliant, in the initial stages of our development we may have to depend heavily on imported technology in certain carefully determined fields. We must generate our own technology, but we must also have the ability to absorb imported technology and build on it so as to advance more rapidly.

Let us see what the features of the import of technology are

28.3.1 Import of Technology

This form of transfer involves transferring the essential expertise associated with the capabilities of more developed nations to the lesser developed nations, who require it for accelerated industrialisation. This can be done in several ways: through licensing, joint ventures with foreign firms, direct foreign investments, etc. Its efficiency depends on many factors like the supplier's ability and desire to transfer, the recipient's capacity and desire to absorb, the recipient's socio-economic and cultural environment and communications processes.

Clearly, technology import could be advantageous. A major gain is that it would help to save considerable time, money and energy by skipping the stages which other countries had to pass through to achieve the present level of development. But, in practice, the import of technology has a lot of problems and disadvantages. Here we spell out some of these.

The buying of technology may be very expensive. Take, for example, the buying of the latest defence aircraft from France. Though we have saved money on going through the various stages of research and development, we still have to pay large sums of money to buy these aircraft outright. This is because the price includes the developmental expenditure that France incurred in this connection! So, we end up paying for research and development, and that too, in foreign exchange. Further, the R & D structure within the country also remains undeveloped.

Table 28.1 may give you some idea of how expensive foreign technology is. It shows that royalties and the cost of technical know-how are increasing year by year. These have to be paid in foreign exchange also.

Table 28.1: Remittances by Indian enterprises to organisations abroad

Year	Royalty (Rs. million)	Technical know-how (Rs. million)
1979-80	95.3	439.7
1980-81	88.8	1049
1981-82	159.9	2707.0
1982-83	397.2	2585.8

- Imported technology often comes with restrictions or "political strings" attached to it by the supplier. For example, India used to import enriched uranium from the United States to use in its fission reactors. A time came when the US Government insisted that we sign the Nuclear Non-proliferation Treaty, otherwise they would stop the supply. India refused to do so and argued that this was not a condition in the original agreement. However, India's argument was of no use, and the US stopped the supply.
- The supplier often unloads obsolete technology on the recipient, sometimes at a very high cost. Since the receiving country does not have the technology, it may not even know how outdated the offered technology may be. An example is the automobile industry in which we continue to be saddled with models that are no more in demand in the developed countries or in the parent country. Also, since the end of World War II, one of the major areas of industrial development has been that of domestic conveniences, such as air conditioners, refrigerators and electronic goods like the TV, VCR, etc. Once the domestic market in Europe & USA was saturated, markets were created in the developing countries for the finished products, and later, for the sale of related technologies. Since, in these areas, the technologies are quick change ones, what is transferred to the developing countries is outdated.
- The receiving country may permanently have to depend on the donor country, especially in crucial areas like defence equipment. The donor may sell a modern defence aircraft, but with the condition that the receiver always buys the spares and ancillaries from them. This way the receiving nation will not be allowed to be self-sufficient.
- When a country imports technology from more than one country for an industry, then the spare parts may not fit into various models. As you know, the technology for Maruti, Fiat and Ambassador cars was imported from three different countries, namely, Japan, Italy and Britain; and the spare parts of one don't fit into the others. So the scale of production of spare parts will vary, thus increasing the cost of production.
- A multi-national corporation of a developed nation may give technological know-how to a developing nation with the restriction that the knowledge is not to be shared with other developing nations. This ensures their direct hold over different countries.

We now give a table that shows the quantum of technology imported, in some key industries.

Table 28.2: Number of foreign collaboration approvals in some industries

Industry \ Year	1982	1983	1984	1985
Electrical Equipment	107	129	157	205
Industrial Machinery	107	115	138	152
Chemicals (non-fertilisers)	53	62	69	69
Transportation	28	39	63	101
Telecommunications	7	7	3	13

This table shows how the cost in foreign exchange keeps mounting.

On the basis of the arguments presented in this section you can do this SAQ.

SAQ 3

Fill in the blanks from the words given after the paragraph.

When importing technology, the receiving country must ensure that it is the..... technology; that it will be possible for them to manufacture all the items ..... within a reasonably short period of time; that the donor country doesn't attach ..... strings or exert any pressure on them. This will ultimately lead to the ..... nation being .....

political, latest, self-reliant, indigenously, receiving.

Now, we will discuss the second form of technology transfer.

28.3.2 Lab to Field

It has been the policy of the Government of India, from the time of Independence, to achieve self-reliance by developing indigenous technology in as many areas of industry as possible. We, therefore, had created a chain of laboratories in all areas. The National Research and Development Corporation of India (NRDC) was set up in 1953 for facilitating the transfer of

technology from the laboratories of national R & D institutes to the field. These institutes offer their processes for commercial exploitation to NRDC.

If indigenous efforts are not considered adequate at the policy-making level of the different ministries, a new policy is formulated for updating technology and for the import of technology from the developed countries. The Department of Science and Technology, Planning Commission, Science and Engineering Research Council and various Scientific Advisory Committees attached to the ministries monitor the technological needs of India.

SAQ 4

The Indian Council of Agricultural Research has initiated the Krishi Vigyan Kendra (K.V.K.) project. One component of this project is to train rural women in food technology, post-harvest technology, use of non-conventional sources of energy, etc.

Is this a form of technology transfer? Give reasons for your answer, in about 50 words.

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We end this section with a short paragraph on technology exports from India.

28.3.3 Export of Technology

India has gained experience and expertise in various fields of technology. Thus, we are in a position to assist a lot of developing nations in the process of technological advancement. India exports technology to a large number of Asian, Middle-Eastern, African & Latin American nations. This is in the form of technological know-how or machinery. We give you some examples in the following table.

Table 28.3: Technology exports from India

Receiving Country	Area of technology transfer	Technology
Burma	Switchgears & electrical distribution material, steel work for buildings	Supply & installation
Kuwait	Light fibre appliances & cables	Installation & maintenance
Malaysia	Computer equipment & software	Supply, delivery, installation and maintenance of hardware & software
Ethiopia	Microwave network	Erection, construction & commissioning
Kenya	Cement, machine tools & PVC resins industry	Technical assistance, consultancy & training
Brazil	Small & medium industries	Know-how & consultancy
Mexico	Disks & magnetic tapes for computers	Know-how & consultancy
Argentina	Hydro-electricity generation technology	Know-how & consultancy

So far we have discussed the ways in which research and development can be used to make technological progress. In the next section we will give examples of some industries in which recent developments in technology have taken place. But let's do an SAQ first.

SAQ 5

Fill in the blanks in the following paragraph.

In 1955 India was.....a lot of technology. By 1975 our scientists were able to.....various technologies to suit our own conditions. These.....developed technologies were.....to the field, the form of transfer being..... Now we are in a position to.....know-how related to electronics to countries like..... and.....

28.4 CURRENT TECHNOLOGICAL DEVELOPMENTS

In recent years R & D efforts in the fields of pure and applied chemistry, mathematics and physics have helped a great deal in our progress from agro-based industries to the areas of heavy industries, chemicals, steels, textiles, sugar, pharmaceuticals, computers and electronics. To give a few examples, the developments in the field of metallurgy have depended on the applications of the principles of chemistry, physics and engineering. A large number of manufacturing operations in the chemicals, steel, textile, sugar and pharmaceutical industries depend on chemical conversions. The development of computers and electronics have been based on fundamental physics and mathematics with the help of electrical, mechanical and production engineering. Research in materials science has led to experiments with fibre glass. This can be used in making lighter aircraft and lighter luggage, among other things.

One has to remember that the whole process of technology involves the processing of raw materials into useful and profitable products. These products are used both as consumer goods and as an intermediate for further chemical and physical modifications to yield consumer products. For example, in the chemical industry, about one-quarter of the total chemical output is utilised in the manufacture of other chemicals.

The Council of Scientific and Industrial Research (CSIR) has a chain of laboratories in almost all areas relating to the national development effort: fuels, ceramics and glass, chemicals, metallurgical and electro-chemical products, etc. Silk & Art Silk Manufacturing Research Association (SASMIRA) in Bombay and Indian Jute Industries Research Association (IJIRA) in Calcutta, which are maintained jointly by the collaborative efforts of the Government and the industries concerned, are active in their fields. Regional research laboratories maintained by the CSIR at different places like Trivandrum, Jammu, Hyderabad, Bhubaneshwar and Jorhat, look after the regional research and development needs.

Before dealing with current technological changes in some industries, let us look at the thrust of our developments in the area of energy.

28.4.1 Energy Sector

The energy related developments have been in the direction of energy saving and search for new energy sources for present and future needs.

It has been estimated that in 1850 coal, oil and gas were responsible for 5% of the world's energy, while human and animal labour did about 95% of the work. Today, coal, oil, gas and nuclear sources account for approximately 94%, water power about 1% and human and animal labour the remaining 5% of the world's energy. While this is the overall picture of the world, in our country the picture is quite different. Human and animal energy and burning of wood and dung cakes accounts for a much higher proportion of energy in India. Our nuclear power generation is just gaining momentum.

From Unit 17, you know that among the energy sources available in India are fossil fuels (like lignite, coal and petroleum) the sun, wind, geothermal energy (for example, hot springs) water (hydro-electric power) and human and animal labour. The cost of energy varies. It is the lowest in the case of direct combustion of biomass and peat, which is wet, partially decomposed organic matter. The cost of energy is also quite low in the case of fossil fuels. Large deposits of lignite have been found in Tamil Nadu. But it costs more than coal, as it has to be processed into briquets before it can be used. Gaseous fuels and manufactured gas, such as fuel gases like coke-oven gas, water gas, producer gas, etc., cost much more. There have been attempts to prepare ethyl alcohol by biomass conversion and methane by fermentation. Vegetable oil, in recent years, is also being used as a replacement for diesel.

Among the other energy sources, nuclear energy is considered to be one of the proven alternative energy sources, and, in some countries, such as France, 70% of their energy is now derived from nuclear sources. In the Bhabha Atomic Research Centre, apart from uranium, thorium, obtained from monazite sands from the beaches in Kerala, has been successfully used to produce nuclear power. The first such reactor has been commissioned in Kalpakkam near Madras. There are over 550 nuclear power plants all over the world. India, at the moment, has only five. A few more power plants are soon to be put into service.

Other energy sources which have received considerable attention are geothermal energy, wave and tidal energy, solar energy, ocean thermal energy and electro-chemical cells which generate electricity. Conversion of biomass into biogas needs particular mention. In India, at present, fossil fuels, hydro-electric power, biomass conversion, and nuclear power are the ones which are being used. Others still remain more or less in the experimental stage as far as practical utilisation is concerned.

28.4.2 Some Key Industries

We will now talk about recent developments in some of the key industries, namely, the textile, sugar, pharmaceutical, steel, chemical and electronic industries.

The Textile Industry: A current development in the textile industry has been the remarkable development of synthetic fibres. Naturally occurring cotton, wool and silk are being replaced by man-made fibres. At present, synthetic fibres represent about 50% of the world's fibre production. In 1981, 14 million tons of man-made fibres were produced in the world, while natural fibres prepared amounted to 17 million tons. Earlier developed fibres like rayon were based on cellulose. Nylon was the first wholly man-made synthetic fibre. It chemically belongs to the group called polyamides. The next fibre to be developed was polyester, commonly known as terylene.

Today, the range of synthetic fibres has been enlarged and also includes glass fibre. Multi-component fibres, which are superior to fibres spun from only one of the components, are also being manufactured. These fibres are prepared by spinning two or more polymers together

The manufacture of any synthetic fibre begins with the preparation of a polymer consisting of a very long chain of molecules. By controlling the average chain length of the molecules, a single polymer can be used to make a number of fibres with widely differing mechanical properties. They can be made weak and stretchable or strong and stiff.

Along with the above mentioned synthetic fibres, mention should be made of the fibres which have been developed from cellulosic raw materials like cotton. Examples of fibres made of these materials are raw nylon or viscose. Viscose is made from wood pulp by chemical processes. Polymeric films like cellophane are also manufactured from cellulose by a special process. A recent development has been the manufacture of carbon fibres which may be prepared from rayon or polyacrylon. These carbon fibres can withstand high temperatures and are used for manufacturing heat shields for nose cones of rockets, particularly those that return to earth from space voyages. It has also been possible to prepare such fibre from coal-tar or petroleum pitch. Carbon fibres are used for reinforcing engineering plastics and plastics which are used for sports goods.

Cotton or woolen textile industries are major traditional industries in India. Recently, some developments have taken place improving their spinning, dyeing, bleaching and printing methods, and also in the methods for giving special finish, such as for crease recovery, dimensional stability, resistance to microbial attack and ultraviolet light, flame resistance, etc. Treatments are also aimed at changing their properties to improve their usefulness. For example, it is possible, through appropriate treatments, to achieve flame proofing by application of certain chemicals. Mildew proofing or rot proofing can be done by the use of many organic and inorganic compounds. There are special chemicals which can be used to produce a water repelling property. Shrink proofing of wool can be done by applying various chlorinating processes or by coating the fibres with a melamine formaldehyde resin. In recent years chemical finishes have been used to react with fibre material such as cotton for changing its properties.

Sugar Industry: The sugar and starch industries in India are considerably important. Sugar is necessary for the energy it gives. Of course it is liked for its sweet taste also! Sugarcane is the main source of sugar in India. The states which are important for our sugar industry are Maharashtra, Uttar Pradesh, Karnataka, Bihar, Andhra Pradesh and Tamil Nadu.

The method used in India for manufacturing sugar from sugarcane has not changed over the years. But the use of bagasse, the residue left after cane juice extraction, has changed. It used to be utilised as a raw material in manufacturing paper. A recent development is its use for fermentation to produce alcohol. Raw sugar is decolorised with bone charcoal or activated carbon. A decolorising chemical additive has now been developed. For removal of inorganic salts, a recent development is the use of ion exchange resins.

The other raw material for obtaining sugar, which is now in the process of development in India, is sugar-beet. The sugar-beet differs from ordinary table beetroot. It is much larger and

is not red. The sugar-beet industry is being sought to be developed in such areas like Sundarbans of West Bengal and a few other places. But sugar-cane is likely to remain the major source of sugar in India.

The Pharmaceutical Industries: This is a major industry in India. India is meeting 70% of its requirement of bulk drugs, and almost all its requirement of formulations. The products are usually classified according to chemical structures, or by chemical reactions needed to manufacture them, or by their use. There are about 50 commonly prescribed drugs.

Some of these drugs are prepared by isolation from natural raw materials. For example, Serpasil, a drug given to patients suffering from high blood pressure, is obtained from a plant called Rauwolfia Serpentina. A drug against blood cancer, Vincrystine, is obtained from a common plant, Vinca-Rosea. Digitalis, a drug for heart patients, is got from the fox-glove plant.

But many drugs are prepared by synthesis. For example, Aspirin, the common analgesic, is obtained from salicylic acid. Antibiotics like Penicillin or Streptomycin were originally prepared by fermentation, or through a process of biosynthesis. Now they can be prepared synthetically. Again, the chemical compound, Isoniazide, is one of the most potent and selective medicines against tuberculosis. One of the important developments has been in the manufacture of Insulin, an anti-diabetic drug. Earlier this was being produced from the pancreatic glands of animals. Now, it is prepared by gene splicing, of which you will read more in Sec. 29.6.1.

Two public sector undertakings, Hindustant Antibiotics Limited and Indian Drugs and Pharmaceuticals Limited, manufacture many of the 50 commonly used drugs mentioned earlier by processes of synthesis and/or isolation from plants or animals.

Steel Industry: In India this industry has developed significantly since Independence, and is now under a central authority, namely, Steel Authority of India Limited (SAIL). Some steel plants come under the public sector, such as those at Durgapur, Burnpur, Bokaro, Rourkela, Bhilai, etc. Some are in the private sector such as the Tata Iron and Steel Company at Jamshedpur. The most significant development has been the use of a multi-pronged approach in getting technology from a number of developed countries. The earliest Tata plant was put up with American technology. Now we are using Soviet technology at Bokaro and Bhilai, and German technology at Rourkela. The Tatas are trying to develop indigenous technology.

Chemical Industry: Under this heading we include the manufacture of caustic soda, chlorine, cement, carbon, coal, urea, nitric acid, super phosphates and gases like hydrogen, oxygen and nitrogen. We have a sizeable glass and ceramic industry, surface coating industry, food and food by-product industry. Our agrochemical industries have developed indigenous technology for the manufacture of pesticides and insecticides. Our soap and detergent industry manufactures soap, detergents and glycerine. Our oils and fats industries manufacture vegetables and animal oils and fats. A major breakthrough has been achieved in the field of petrochemicals. We have a number of petroleum processing plants and petrochemical industries, the biggest being in Baroda. India produces two-thirds of her petroleum requirements. The rest is imported from countries of the Middle East, the Soviet Union, some East European countries and some South American countries. We have a number of petroleum refineries situated in Bombay, Visakhapatnam, Assam, Bihar, West Bengal and Kerala. Some more are expected to come up during the present plant period.

Electronic Industry: In recent years the whole world has seen a revolution in electronics. It is a very important part of practically every industry, as well as many spheres of human activity like communications, transport, education and entertainment. The computer industry has been radically altered in recent years due to a shift from the analogue to the digital technology. This has led to a very big change in communications technology. A combination of analogue and digital technology has made distant or remote control of machines possible.

Computerisation has also helped in various fields of engineering. In the old days, in mechanical, civil or chemical engineering, it would take a long time from the first stage of designing to the last stage of creating the actual product. Since the advent of computers, through computer-aided designing methods, much of the labour and cost involved is saved.

Also, with the help of the computer, the sensitivity, accuracy and dependability of a particular design can be tested quite easily.

In computer and electronics based industries, the percentage of employees involved in research and development may be anywhere between 33% and 50%, because, in these areas, the competition is high and development of new materials and new technology is very important for maintaining a lead over other competitors. There may be a new model of a computer design every 2 or 3 years.

India's annual electronics production level is more than Rs. 1,00,000 million (in 1994). India has started producing:

- electronic switching systems;
- VLSI (Very Large Scale Integration) circuits, which form the basis for modern electronic systems;
- polysilicon to meet the requirements of integrated circuits, and to harness solar energy;
- highpower microwave tubes, which form the basis for radar systems;
- computers.

One of the most important programmes in education that has been introduced is CLASS, computer literacy and studies in schools. In this programme school children are being taught to use and appreciate computers, which have been installed in about 4000 schools in India.

The general outlook of the electronics industry seems to be bright. There have been substantial growth rates recorded in computers, office equipment and software exports. In the coming years the communication sector is expected to grow rapidly.

To conclude, it can be said that industries in India are progressing, but we have far to go. Often, we need to import current technology. According to one estimate, 35% of drugs and pharmaceuticals, 70% of agricultural machinery, 75% of electronics, and almost all petrochemicals and fertilisers are products of foreign technology. This position has to be changed by conscious policy and careful planning combined with increasing support for education, research and development.

SAQ 6

Fill in the blanks:

i) A recent development in the ..... industry is the manufacture of ..... fibres for reinforcing plastics. They can be prepared from ..... .

ii) ....., a drug to combat diabetes, is now prepared synthetically.

iii) In the steel industry we are still.....technology from a lot of ..... nations.

iv) In the chemical industry, the major recent development has been in the production of..... .

28.5 LIMITED ACCESS TO TECHNOLOGY

India has made rapid advances in technology since Independence. A lot of technological innovations are available here. But, for a number of reasons, the weaker sections of our society have not been able to benefit from these technologies. Two important reasons are lack of awareness of them and lack of access to them.

Let us first discuss the lack of awareness. A major reason is the lack of even primary education. In our country about 48% of the population, that is about 48 crore people, are illiterate. Schools are not available to everyone within a convenient distance. On top of it, the massive poverty in a large section of the Indian society does not allow them enough time to go to school, even if the school is nearby. All the members of a poor family have to work and struggle for the basic necessities of life.

Again, because of a lack of communication, the illiterate people feel that technological progress is beyond their comprehension and not of any use to them. There have been attempts through the media, like radio and T.V., to reach our population who live in villages and tell them about the benefits of modern technological innovations that are available in India. But these are not enough.

Often, when people know about the technological advancements that are available, they are reluctant to utilise them. This is due to prejudice because of religious beliefs, superstitions and old customs. For example, although vaccinations have been available to us for nearly 100 years, there are people in our society, even in the cities, who are opposed to vaccinating their children against DPT (Diphtheria, pertussis, typhoid). Similarly, it is known that water can be polluted and cause disease. Though boiling the water can easily prevent many water borne diseases, most people in the villages, where pure drinking water is not available, don't bother to do it. This is because of old customs as well as lack of fuel.

Thus, we have in the country today, the urban society which has had an exposure to modern ideas through education. They have accepted technological innovations as a means for progress. But the majority of Indians remain indifferent. Elementary scientific knowledge or exposure to science is not available to them. The only way to right this wrong is to spread elementary education and science education. This can be done through radio and T.V. But, these are not available to all the rural masses. It may be necessary to approach them through their own social hierarchy and village level organisations like Panchayats. This aspect of society's transformation has to be kept in view in our mass education programme if the inter-relationship of science, industry and technology is to be brought home to them. Through rural development programmes and rural science programmes, it can be shown, how simple labour saving devices can reduce their daily load of work, or how, for example, solar energy or wind energy can make lighting or irrigation possible. The efforts should be concentrated, therefore, in spreading awareness to this deprived section of our population so that they understand the benefits of technology, which can bring a change in their lives.

But is awareness enough? You may be aware of a better technology for irrigation, but if you do not have enough funds to obtain it, the awareness will not help you. In India, there are millions of people who can't benefit from advanced technology only because it is beyond their budget. This is where the government can help. It can subsidise the technologies that will aid the weaker sections of our society. It can also market them to ensure that these technologies are available wherever they are needed. Such a strategy would certainly make the advantages of technological progress available to more and more people.

SAQ 7

Which of the following statements are true? Put T for a true statement in the box provided, and F otherwise.

i) Villagers have far less access to information about technology than the people living in cities. ☐

ii) Rural women have generally remained untouched by, and unaware of, the benefits of technology. ☐

iii) By producing more radios and televisions we can raise the level of awareness of science in India. ☐

iv) If the purchasing power of every Indian is increased, the benefits of technological developments will filter down to all strata of our society. ☐

28.6 SUMMARY

We end this unit by summarising what is covered in it.

- Why it is necessary for India to develop its own technology.
- The Technology Policy Statement.
- Technology transfer encompasses import of technology from developed nations, exporting technology to lesser developed nations and transferring indigenously developed technology from the laboratories to industry or agriculture. The import of technology has a lot of drawbacks and should be minimised.
- Current developments in the following Indian industries: textile, sugar, pharmaceuticals, steel, chemical, electronics.
- Why all strata of Indian society have not utilised India's technological advancement fully.

28.7 TERMINAL QUESTIONS

If you have been through the unit you will be able to answer the following exercises.

1) Give three reasons for the need for a nation to develop its own technology.

2) While choosing appropriate technology, that is, technology suited to our needs, we must keep certain factors in mind. Can you list three of these factors?

3) How does import of technology relate to self-reliance, in the Indian context? Answer in about 100 words.

4) List two recent developments in the technology related to
   a) the textile industry,
   b) the electronic industry,
   c) the pharmaceutical industry.

5) Why is SAQ 7 (ii) true? Answer in about 75 words.

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28.8 ANSWERS

Self Assesment Questions

1) i) T; ii) T; iii) T; iv) F

2) i) b; ii) j; iii) d; iv) i; v) e.

3) latest, indigenously, political, receiving, self-reliant.

4) Yes. This is a case of transferring indigenously developed technology to the field. Technology does not consist only of machines or processes. It also consists of the know-how needed to use these processes. The training programmes spread this know-how.

5) importing, develop, indigenously, transferred, lab-to-field, export, Burma/Malaysia/ Ethiopia/Mexico/Argentina.

6) i) textile, carbon, rayon/coal-tar/pitch/polyacrylon
ii) Insulin
iii) importing, developed
iv) petrochemicals.

7) i) T; ii) T; iii) F; iv) T

Terminal Questions

1) A nation should develop its own technology because
i) it should be self-reliant,
ii) the basic needs of its citizens must be met,
iii) this will lead to an increase in its national productivity,
You can add many more reasons

2) There are many factors. Three of them are:
a) The technology must utilise our human resources optimally,
b) It should utilise locally available natural resources.
c) It should be geared towards energy conservation.

3) Since India was a colony, it did not have adequate opportunities to develop technologically. Therefore, it has had to import technology from the technologically advanced nations. But, import of technology has several drawbacks. Therefore, we should not keep on importing technology. We must develop our own infrastructure so that, after a certain stage, we can be in a position to develop our own technology. We should also be in a position to improve the borrowed technology and adapt it to Indian conditions. This is the way to self-reliance.

Thus, import of technology, to a limited extent, will help us to develop. But, if we always rely on imported technology, and don't develop our indigenous technology, we will never be self-reliant.

4) There could be several answers. The answer we give is
a) Flame proofing, shrink proofing of wool;
b) Introduction of telematics, production of high power microwave tubes;
c) Synthetic manufacture of Insulin, synthetic manufacture of antibiotics.

5) Rural women have far less access to information about technology than rural men because, firstly, they are deprived of even basic education. Secondly, since their activities are often limited to their homes, they are isolated from the world outside. Taking care of their families and working in the fields takes up all their time. Therefore, they cannot come into contact with various technological developments unless a special effort is made by technocrats to reach them.