



Unit 1

The Development of Science and Technology

Primitive man had to spend all of his time fighting for survival. He lived on herbs, berries and any animals that he managed to kill. He made crude clubs from stone and wood. He also fabricated spears and slings. This was the beginning of technology. He gradually learned by trial and error how to make axes with stone. He also created sharp arrows and spears with flint. He later learned how to make tools and weapons from bronze and then iron.

As the centuries passed, groups of nomadic hunters began forming settlements. They discovered how to plant crops, harvest grain and make bread. The small settlements gradually enlarged into villages and towns. People began to specialize in a trade or activity. Some settlements would have a surplus of some material that another community needed. People began to barter and then trade with some form of currency. This led ancient civilizations to become great cities with organized social structures.

Ancient Civilizations

Ancient civilizations had amazing architecture and sculptures. The woodworking, metalworking and ceramic skills of the people at this time are seldom matched. Think of the pyramids in Egypt and Mexico, the temple at Karnak, the Parthenon and the theater at Epidaurus. They were created thanks to some of the highest technical skills ever achieved by man.

These skills were also applied to design more powerful weapons and stronger fortifications. Archimedes (287-212BC) is said to have burned the ships of his enemies with mirrors. He also apparently designed catapults. The application of technology and later science to war has continued through the centuries. Many scientists of the Renaissance, such as Leonardo da Vinci (1452-1519) and Galileo Galilei (1564-1642), were employed by princes, and were expected to design weapons and plan fortifications. They could do scientific research only in their spare time. In the twentieth century, whether a war was won or lost often depended upon the work of scientists.

Some of the greatest thinkers, poets, historians and dramatists lived in these civilizations, particularly in Greece. The ancient Greeks asked some profound questions. Why do things change? What is the world made of? What causes things to happen? However, they did not necessarily know how to investigate to find the answers.

The greatest of the Greek philosophers was Aristotle (384-323BC). He observed things very carefully and described a wide range of natural phenomena. He theorized that everything must happen in accordance with fundamental principles. He believed a “Prime Mover” was responsible for everything. He speculated that everything was made of four elements—earth, air, fire and water.

He felt each element had a natural place that it sought to attain. Therefore, fire goes upwards and earthy bodies fall to the ground. He noticed that things on Earth changed. He also observed that the stars and planets appeared not to change. He concluded that there were two types of matter. First, there was the unchangeable celestial matter of stars and planets. Second, there was the changeable terrestrial matter on Earth. 5

Mathematics

Practical mathematics was developed in ancient Egypt. Geometry was needed to establish the boundaries of fields after the annual Nile floods and to design the pyramids. In Greece, Euclid (fl.c280BC) wrote books on geometry that were used for many generations. Eratosthenes (c270-c194BC) used geometry to obtain a remarkably accurate estimate of the radius of the earth by measuring the angular elevation of the sun at two different places at the same time. Plato (427-347BC), a philosopher, spoke of mathematical harmonies in nature. An example would be musical scales. He taught that physical things in the world were imperfect shadows of the pure and perfect in the abstract world. 10 15

The Structure of Matter

Democritus (c460-371BC) suggested that all matter was made up of tiny particles that could not be cut into pieces. These particles were called atoms. He tried to explain everything that happened in terms of the motions and interactions of these particles. Socrates (470-399BC) did not like this explanation because it did not include human free will. He preferred to think in terms of purpose. 20 25

Aristotle was interested in the natural world. He made many acute biological observations. He detailed the structure and work-

ings of the human body in his writings. The science of medicine was founded by Hippocrates (c500-400BC). He proposed the Hippocratic oath, which is a promise that doctors still make today. The Hippocratic oath states that doctors should do everything they can do to heal those who came to them for help. However their understanding of diseases was rudimentary and so too was their treatment. Galen (c130-200) collected together the available medical knowledge. He wrote a treatise on the usefulness of body parts, which was a major reference of medical knowledge until well into the Renaissance. He insisted that observation was important and he was in demand as a physician.

Early Astronomy

People have been awed by stars and planets since the earliest times. The Babylonians were able to predict many eclipses by making careful observations. Aristotle reasoned that since celestial bodies are perfect and incorruptible they must move along the most perfect curve, which is the circle. Claudius Ptolemy (c100-170), an astronomer, made the first systematic attempt to describe the motions of the heavenly bodies. He noted that the stars appeared to move in circles around the Earth. But planets have more complicated motions. Although centuries later Nicolas Copernicus (1473-1543) put forward the notion that the Earth traveled around the Sun, Ptolemy's descriptions were accepted for many centuries. Like most Greeks, Ptolemy believed planets were bound by a vital force, like birds. They moved in apparent regularity, just like a group of well-drilled soldiers. He described their motions, but did not give an explanation.

The Failure of Ancient Greek Science

Many impressive achievements were made by the Greeks. But Greek science never became a self-sustaining enterprise. There are many reasons. First, the elite believed that manual work should be done only by slaves. Therefore, they did not experiment, which is necessary for the development of science. Like all ancient civilisations, they thought time was cyclic. In other words, a story would begin again after many years. Most importantly, they lacked clear ideas about the nature of the material world. 5

The writings of the Greek philosophers were handed down and eventually made their way into the hands of the Muslims. These writings were translated into Arabic. The Muslims used this knowledge and made notable advances in mathematics and other practical sciences. Mathematics, astronomy, optics, physics and medicine were far more developed in Islamic countries than in Western Europe around the eighth and ninth centuries. However the impetus soon waned and the lead soon passed to Western Europe. 10 15