PASSAGE – 4

Around 4th millennium BC, the early nomadic villages began to settle in more homogeneous style and this led to the uniform growth of culture. Around the beginning of the third millennium BC, in the north-western parts of the Indian subcontinent, flourished a highly developed civilization. It derived its name from the main river of that region, 'Sindhu' or Indus.

Discovered in the 1920s, it was thought to have been confined to the Indus valley. However, subsequent excavations established that, this civilization was not restricted to the Indus valley but was spread across a wide area in northwestern and western India. The recent excavation and satellite mapping shows that these areas were more prominent on the banks of the erstwhile Sarasvati river, which later on dried and paved way for the Thar Desert. Since the first excavation was on the site known as Harappa, it is also known as Harappan civilization. Some of the important cities of the civilization were Mohenjo-daro, Harappa, Chandudaro, Kalibangan, Banavali, Lothal and Rupad.

The main characteristic feature of this civilization was its urbanization. It was far more advanced than its counterparts in Egypt, Mesopotamia or anywhere else in Western Asia. The cities show evidence of an advanced sense of planning and organization. Each city was divided into the citadel area, where the essential institutions of civic and religious life were located, and the residential area where urban population lived.

The streets ran straight and at right angles to each other following the grid system and was unique to this civilization. The roads were very wide and the houses, built of burnt bricks, lined both sides of the street. The houses were of varying sizes and had a remarkable drainage system of ceramic drain pipes, covered sewers and subterranean conduits.

As in most other contemporary civilizations, agriculture was the backbone of the Indus economy. The people made extensive use of the wooden plough. Barley and wheat were the main food crops. Perhaps, the most remarkable achievement was the cultivation of cotton. The people ate, besides cereals, vegetables and fruits, fish, fowl, mutton, beef and pork. There is also evidence of the domestication of cats, dogs, goats, sheep and the elephant.

The Indus people made extensive use of bronze and copper. However, iron was not known to them. The people were very artistic. Evidence can be found in pottery, stone sculpture and seal making. The pottery was made up of well-levigated and well-fired clay, with painting done in black pigment. People worshipped natural forces like the tree, humped bull and Mother Goddess. Even amulets and charms were used by the people to ward off evil spirits.

Unlike their counterparts in the rest of the world, who were managed by kings, the Indus people were ruled by groups of merchants. They had commercial links with Afghanistan, Persia, Egypt, Mesopotamia and the Samaritans. Trade was in the form of 'barter'. There was a cleverly organized system of weights and measures. The script during this time, was pictographic. The writing was boustrophedon or from right to left and from left to right in alternate lines. It has been referred to as being Proto-Dravidian.

They knew mining, metal working and the art of constructing well-planned buildings, some of which were higher than two storeys. They used gypsum cement which was used to join stones and even metals. They knew about long lasting paints and dyes.

There is a striking contrast between the rest of the civilizations and the Indus valley in the way it was managed. In other areas, money and thought were lavished on building magnificent temples of Gods, palaces and tombs of kings. The common people seemingly had to content themselves with insignificant dwellings of mud. In the Indus valley, the picture is reversed. The finest structures were erected for the convenience of the citizens.

During the period of late 2000 BC, the main river Sarasvati, on which this civilization flourished, slowly started to dry. Decreasing fertility and the expansion of the Thar desert, finally forced this civilization to move towards north and north-east of the Indian sub-continent. The beautiful cities were abandoned and thus became ruins.

Reading speed: w.p.m.

PASSAGE – 2

In 1999, a joint US-French-Russian team completed drilling at Vostok station in East Antarctica, one of the coldest places on Earth. By analysing the composition of ice cores from many kilometres deep into the ice sheet, they have been able to build up a record of past temperatures and levels of carbon dioxide and methane- two of the most important greenhouse gases - in the atmosphere going back 420,000 years. This period covers the last four glacial-interglacial cycles, where the Earth has cooled and then warmed over many thousands of years.

First, the scientists discovered that there is more CO_2 and methane in the atmosphere than at any point during the past 420,000 years. This shows that despite volcanic eruptions and other natural phenomena which release greenhouse gases into the atmosphere, humans appear to have pushed CO_2 and methane in the atmosphere to unprecedented levels.

The team then investigated the link between the amount of CO_2 and methane in the atmosphere with temperature fluctuations. They found that during warm, inter-glacial phases such as the one we are currently in, greenhouse gases and temperature are very closely and positively correlated. Basically, as CO_2 increases in the atmosphere, the world warms. This is an important discovery because it proves that the greenhouse effect, and not some other occurrence such as sunspots or changes in the Earth's orbit around the sun, is largely responsible for the current warming of the climate. The results of drilling at Vostok station in East Antarctica have allowed the extension of the ice record of atmospheric composition and climate to the past four glacial-interglacial cycles. The succession of changes through each climate cycle and termination was similar, and atmospheric and climatic properties oscillated between stable bounds. Interglacial periods differed in temporal evolution and duration. Atmospheric concentrations of carbon dioxide and methane correlate well with Antarctic air-temperature throughout the record. Present-day atmospheric burdens of these two important greenhouse gases seem to have been unprecedented during the past 4,20,000 years.

The strongest evidence that the world is warming does not come from any natural source: it comes from land temperature records kept since 1860, which show a fluctuating but steady rise in most parts of the world. This temperature increase is closely correlated with levels of carbon dioxide in the atmosphere, which have shown a similar increase since the industrial revolution took off in the mid-1800s.

The majority of climatologists now agree that these two increases are related in some way. Few assert that humans are wholly responsible for global warming - and this is where the scientific community is somewhat divided. But most scientists believe that we are accelerating and intensifying natural climatic fluctuations by releasing greenhouse gases such as carbon dioxide and methane into the atmosphere. As the Intergovernmental Panel on Climate Change announced in carefully chosen words in 1995: 'The balance of evidence suggests a discernible human influence on global climate.'

This statement was reaffirmed in December 1999, when the heads of the Meteorological Office in the U.K. and the National Oceanic and Atmospheric Administration of the U.S. made a joint declaration to the world's media. A year ago, both organisations sat on the fence about the human 'fingerprint' in climate change. Now they are more emphatic: climate change is happening, and we are at least partly responsible.

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A female polar bear and her cubs roam the Arctic in search of prey. The mother smells a distant ringed seal, and slowly stalks it. From fifteen metres away, she explodes in a burst of energy, her paw shattering the seal's skull. The family feeds, enjoying the fat layer so vital for their survival. Fat which is full of pollutants, fat which is slowly but surely poisoning the bears.

The Arctic is Europe's last true wilderness. Yet today, pollutants are contaminating this unique ecosystem. Dying seabirds, seals with obstructed uteri, and polar bears with impaired immune systems may just be the tip of the iceberg. Many pollutants can travel large distances. Air currents over Europe and Russia take the chemicals northwards, where because of the low temperatures, they condense and are deposited in the Arctic Ocean. The Arctic thus functions as Europe's garbage can.

At the bottom of the Arctic food chain is plankton, microscopic animals rich in fat, which absorbs pollutants from the sea. Plankton is eaten by small crustaceans, which are food for fishes. Seals and seabirds prey on fish, and polar bears feed exclusively on seals. The pollutants are transferred from prey to predator, accumulating in fat stores, and increase in concentration, at every step. Seal and polar bear milk is more than 30 per cent fat to enable their young to develop rapidly. But, again, contaminants build up in the milk. Polar bear cubs contaminated by their mother's milk, have a reduced immune function compared with cubs from 'cleaner' mothers. About 2 per cent of female polar bears at Svalbard appears to have both male and female sex organs. In the Canadian Arctic, an area with generally less pollution, these hermaphrodites aren't found.

We've found dead seabirds with high concentrations of Polychlorinated Biphenyls (PCBs), and though we've no proof that this killed them, it's fairly certain. Pollutants may also interfere with hormonal processes, causing reproductive abnormalities. High levels of insecticides called toxaphenes have been found in seal fat. Tests suggest that toxaphene affects the enzymes regulating the seals' testosterone concentrations, which could easily result in the seals' reduced fertility. Recently, sperm whales in Europe and seals in Canada showed shockingly high concentrations of flame retardant chemicals. Flame retardants are chemically related to PCBs, and scientists suspect they have similar toxic effects.

To prove the effects of pollution on wildlife is complex. In nature, many factors are impossible to control. Therefore, differences between polluted and non-polluted animal populations, though very suggestive, could be due to other factors. There are ways round this. In the Netherlands, scientists fed two groups of seals with herring originating from a polluted and a non-polluted area. Their results conclusively showed that the seals fed on polluted herrings had less effective immune systems compared with the other group.

The sensitive Arctic is an indicator of the health of our environment. We mustn't ignore the warning signs. But it's not all bad news. Most northern European countries, including the U.K., and some southern European ones, are signatories to the Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention), which entered into force on 25th March 1998. Its stated aim is to "move towards the target of the cessation of discharges, emissions and losses of hazardous substances by the year 2020."

One important feature of the convention is the recognition of the need to provide information on hazardous substances contained in consumer goods, giving people the choice not to buy those products. Greenpeace is compiling a list of products which contain chemicals regarded as being the most dangerous. OSPAR lists both PCBs and brominated flame retardants as chemicals it wants to see banned or more tightly regulated.

A single electron makes the difference between "on" and "off" for a new transistor made from a single carbon nanotube, whose minute size and low-energy requirements make it an ideal device for molecular computers. Dutch researchers introduced this nanotube single electron transistor, the first to operate efficiently at room temperature. "We've added yet another important piece to the toolbox for molecular electronics," said author Cees Dekker of Delft University of Technology, in the Netherlands.

Used in all kinds of electronic devices, transistors may be best known as the workhorses of the computer industry. Working together, million of transistors on a single silicon chip help perform logic functions or store information. In their "off" state, transistors block the flow of current, but when a small voltage is applied, they allow current to flow.

As researchers make computer chips ever smaller, the idea of using a type of transistor called a "single electron transistor," or SET has become increasingly appealing. Like several other electronic devices, they can be made at a molecular-scale, and would take up far less space than their conventional silicon counterparts. The particular advantage of SETs is that they require only one electron to toggle between on and off states. In contrast, transistors in conventional microelectronics use millions. Researchers currently foresee a limit to how densely they'll be able to pack such conventional transistors together, because the abundance of electrons whizzing around would ultimately produce too much heat for the chip to function. SETs might provide a means to avoid this problem.

A SET is like a one-way bridge with tolls at each end that ensures that cars cross, one by one. Specifically, it consists of a metallic "island," separated from "source" and "drain" electrodes by two barriers, through which electrons can tunnel. A gate attached to the island tunes the voltage of the whole system. Controlling the voltage on the gate regulates the number of electrons hopping on or off the island, one at a time.

But, there's a catch: most previous SETs could only operate at super-low temperatures, because heat can also provide the energy necessary to add electrons to the island. Now, Dekker's group has made a device so tiny that heat fluctuations are irrelevant, even at room temperature. That's because the smaller the space in which electrons are confined on the island, the more energy it takes to add them. Dekker and his colleagues started with a single carbon nanotube, and used the tip of an atomic force microscope to create sharp bends, or buckles, in the tube. These buckles worked as the barriers, only allowing single electrons through under the right voltages. The whole device was only 1 nanometer wide and 20 nm long, altogether less than 1/500th the distance across a human hair. Researchers may someday assemble these transistors into the molecular versions of silicon chips, but there are still formidable hurdles to cross.

One basic challenge to any application will be producing the devices more efficiently. It now takes a student all afternoon in the lab to make just one of the buckled nanotubes. But, Dekker proposed that it might be possible to use a patterned substrate to physically induce buckles in many nanotubes at once, or to do this via chemical processes.

The authors also discovered some unusual physics when they investigated how exactly their single electron transistor was working. In most versions, the electrons hop on and off the island independently, but this wasn't the case for Dekker's group. Instead, the electrons seemed to have a type of quantum connection that has not been observed before, in which they hopped on and off in an intimately coupled way. "The present work shows that short metallic nanotubes can be applied as RTSETs [room temperature single-electron transistors]. It also exemplifies that the search for functional molecular devices often yields interesting fundamental science," the authors wrote in their paper.