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Global Warming: A Threat to Living Creatures

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Introduction

GLOBAL WARMING is the excess warming near the earth's surface that is a result of the trapping of more heat from the Sun. The earth is slowly getting warmer. The changes are low so far, but significant because they are expected to speed up. The effects of such warming have cumulative effects on nature and natural habitats. Some adverse effects have already been observed and within the next fifty to one hundred years, the problems may appear as a deadly threat.

As oceans warm and glaciers melt, land and cities along coasts may be flooded. Heat and drought may cause forests to die and food crops to fail. Global warming will have a cascading effect on weather, plants, animals and people everywhere. We, the human beings are overheating the earth's atmosphere by creating greenhouse layer through the burning of fuels, cutting down forests, and by taking part in other activities that release heat trapping gases into the air.The combined average temperature over global land and ocean surfaces for March 2016 was the highest above the 20th century average temperature for this month in the 1880-2016 record. If we fit a linear trend from 1980-2010 and then extend the trend through 2016 it is obvious that recent temperatures have diverged significantly from the previous trend (Fig. 1). This article investigates why this might be the case. Discussions have been made about the global scenario to combat with the man-made or natural changes for peaceful living of habitants on the earth.

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The Natural Equilibrium between Incoming and Outgoing Radiation

The sun sends out energy in the form of heat and light. During the day time this energy comes to our Earth in the form of visible light, plus ultraviolet (UV), infrared (IR) and other types of radiation that are invisible to the human eye. UV radiation has a shorter wavelength and a higher energy level than visible light; on the other hand, IR radiation has a longer wavelength and a weaker energy level than visible light. Some of the sun's rays get trapped in the atmosphere. Around 30% of them get reflected back out to space by clouds, ice, snow, sand and other reflective surfaces, according to NASA. The rest (about 70%) of the heat which gets through the atmosphere warms up the earth. So our Earth is now getting hotter. As they heat up, the oceans, land and atmosphere release heat in the form of IR thermal radiation. Part of this radiation is absorbed in the atmosphere and the rest passes out of the atmosphere and into space. The total incoming solar radiation and the net radiation going out in space (part of radiation emitted by the Earth plus reflected solar radiation) are the same. It is the equilibrium of incoming and outgoing radiation that makes the Earth fit for habitation by humans as well as other forms of life. This equilibrium maintains

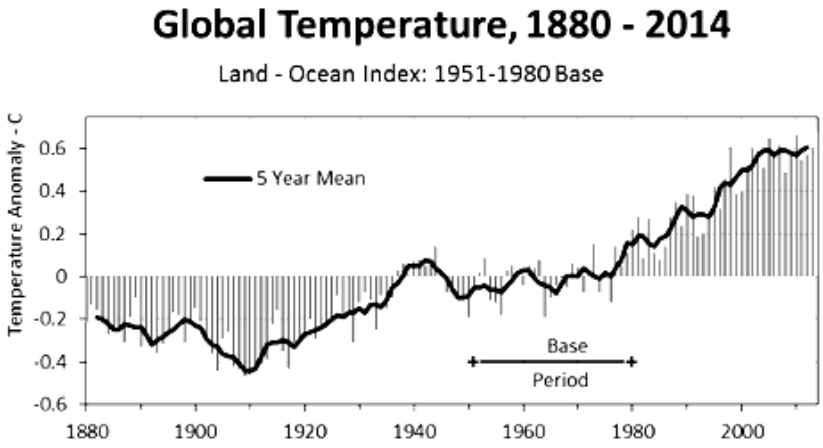

Figure 1: Global temperature anomaly from 1880 to 2010. Source: Goddard Institute for Space Studies (GISS) and Climate Research Unit (CRU)

an average global temperature of about 15 degrees Celsius according to NASA. On the moon, which has almost no atmosphere, the temperature is about minus 153 degree Celsius on its dark side. So this extreme cold results in no habitation being there.On the other hand, Venus has a very dense atmosphere that traps solar radiation more, thus creating average temperature about 462 degree Celsius which is too hot for any sort of life.

The greenhouse effect

The amount of energy absorbed by the atmosphere is often referred to as the 'greenhouse effect' because a greenhouse works in the same way. In a greenhouse, plants are kept inside a house made up of glass or similar transparent materials to achieve it's the warmth required for their habitation. Incoming higher energy (lower wavelength) part of solar energy is easily transmitted through the glass walls and is absorbed by the plants as well as rigid surfaces inside a real greenhouse and heats them up. The IR radiation emitted from inside the greenhouse (owing to higher wavelength and lower energy), however, has difficulty in transmitting/passing through the glass walls and is trapped inside. So inside the greenhouse the plants get the required extra heat. This effect is helpful for the plants in a greenhouse in the cold areas.

Similarly, in the atmosphere the gas molecules that can absorb thermal infrared radiation, and are in significant enough quantity are called greenhouse gases. Carbon dioxide (CO_2) and other greenhouse gases act like a blanket, absorbing IR radiation and preventing a large part of it it from escaping into outer space. These greenhouse gases include water vapor, CO_2, methane, nitrous oxide (N2O) and other gases like CFC, HFCs according to the Environmental Protection Agency (EPA).

Natural and Enhanced Greenhouse Effect

The atmosphere is the air around the surface of the earth. It is made up of a mixture of gases. It helps us to get proper warmth for our habitants. We need it for animals

and plants to survive. This is known as the 'Natural Greenhouse Effect'. Without it, the earth would be much colder. Some things that people do are increasing the amounts of the greenhouse gases in the atmosphere, so more heat is trapped. If too much heat is trapped, our planet will warm up and the climate will change. The heating of the earth through human activities is called the 'Enhanced Greenhouse Effect' and this is causing the earth to heat up. However, global warming does not just mean that the earth gets hotter; it means that the whole climate is changing. In natural greenhouse effect, less heat gets absorbed in the atmosphere as the amount of green house gases is small. Required amount of heat is trapped in this case and the earth is warm enough for life. But in enhanced greenhouse effect, more amount of heat is absorbed as the amount of greenhouse gases is high. More heat is trapped and causes global warming.

Gases Responsible in the Atmosphere for Trapping Heat

The atmosphere is made of 78% Nitrogen and 21% Oxygen. But these gases do not trap heat or long wavelength radiation and cause global warming or climate change. The greenhouse gases which trap heat are made up of less than 1% of the atmosphere! The main greenhouse gases are:

1. Carbon dioxide: Carbon dioxide is a big absorber of the solar heat rays. If there is more carbon dioxide in the atmosphere, more heat from the sun and from the Earth's radiation is absorbed. This will cause the rise of temperature of the atmosphere and the Earth's surface. The warming of the earth will cause the water of the oceans to become warmer. At the increased temperature, more water is evaporated, causing more heat to be trapped. It is a cumulative effect and is extremely difficult to control.

2. Methane: Methane absorbs infrared radiation 25 times more effectively than carbon dioxide.So it is an important greenhouse gas though its concentration is relatively low. There have been many studies on how methane is released into theatmosphere. Methane is mainly produced by biological activity. Its production is related to rice cultivation, leaks in domestic and industrial gaslines, and the digestive process of domestic livestock, especially cattle.

3. Other gases: Nitrous oxide, ozone, water vapour (Water vapour accounts for 80 percent of natural greenhouse warming.), Halocarbons like CFC, HFC, etc.

Anthropogenic Cause of Global Temperature Change

The average temperature of the earth's surface can also vary due to internally generated variability, also known as unforced variability. This type of variability may be due to the essential changing of ocean-atmosphere system itself because of its own chaotic motion. The most well-known mode of unforced variability is called the El-Niño Southern Oscillation (often referred to as the El-Niño, La-Niña cycle). During La-Niña years, heat is absorbed and stored in the deep Pacific Ocean and thus the global mean temperature at the earth's surface is little bit lower than it would be otherwise. Whereas during El-Niño years, this stored heat is released back to the surface and so the global mean temperature tends to be a little warmer than it would be otherwise. The unforced variability can also change the total amount of energy in the earth system by changing constituents of the surface or atmosphere. For example, if some internally generated change in an ocean

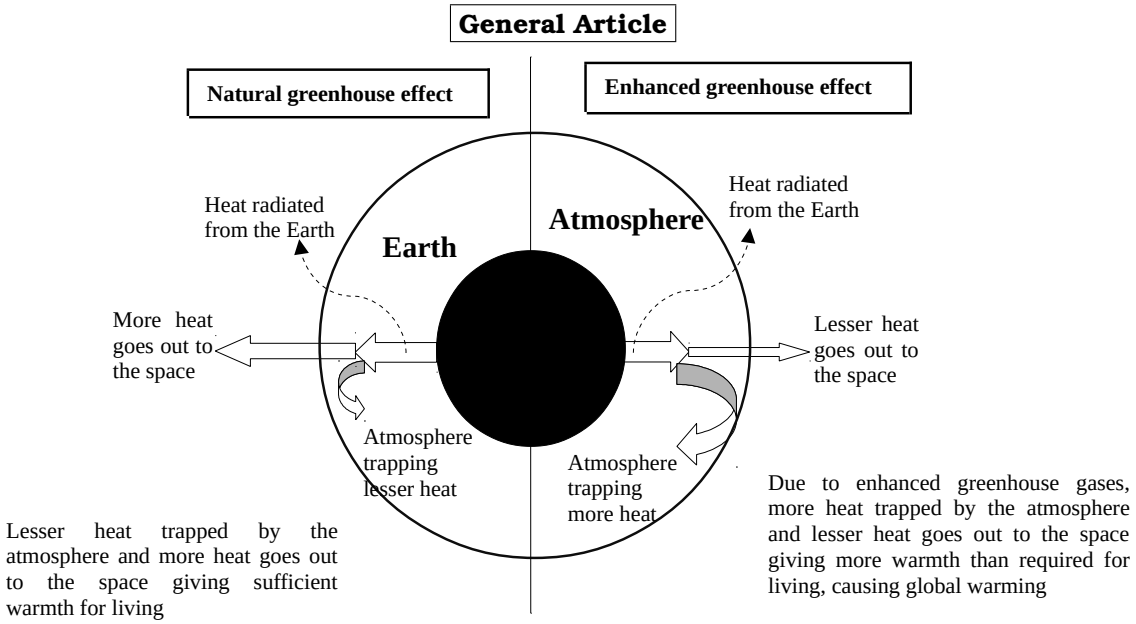

Figure 2: Schematic diagram showing natural and enhanced greenhouse effect

current movement caused more heat to be distributed to polar latitudes; this could cause sea ice to melt. This melting sea ice would result in less solar energy to be reflected back to space (because ice is much more reflective than Open Ocean). Hence, this would increase the total amount of energy in the climate system and thus would increase the temperature of the earth's surface.

It has not yet been definitely ascertained whether humans are the primary cause of global warming; or the enhanced temperature that is observed is nothing but a natural variation of the earth's surface temperature. Natural causes are generally attributed to ocean currents; increased solar activity or cosmic rays. The solar radiation may have increased by 0.12 W/m^2 since 1750, compared to 1.6 W/m^2 for the net anthropogenic forcing. However some studies revealed that combined change in radiative forcing of the two major natural factors (solar variation and volcanic aerosols) is estimated to be negative for the past two, and possibly the past four decades.

A few studies say that the present level of solar activity is historically high as determined by sunspot activity and other observations. Solar activity could affect climate either by variation in the Sun's output or, by an indirect effect on the amount of cloud formation. Most of the studies did not confirm the solar variability as the dominant cause of the strong warming during the past three decades, and concluded that only 30% of the strong warming could be of solar origin.

Causes of increased greenhouse gases or Global Warming

Burning Fossil Fuels

One major cause of global warming is the burning of fossil fuels. Fossil fuels like coal, oil, and natural gas that were formed from the residue of plant material deposited in the geological past. It is only for a

few hundred years that mankind has burnt coal, oil, and natural gas to get energy. We began to burn very large quantities of these fossil fuels after mid-1800s to meet the demands of the industrial revolution. The worldwide consumption of fossil fuel has increased dramatically for production of electricity. The world now burns at least five billion tons of fossil fuel each year. When the carbon dioxide from burning fossil fuels reaches the atmosphere, some of it is taken up by photosynthesizing plants, and some of it is absorbed by the oceans. But we are burning a great amount of fossil fuel at a very rapid rate, by which we are putting carbon dioxide into the atmosphere much faster than these natural processes are taking it out. So, there is no longer a balance between the amount of carbon dioxide being added to the air and the amount of carbon dioxide being removed. As a result, the concentration of carbon dioxide in the air is increasing (Fig. 3).

Large-scale atmospheric changes such as El Niño and La Niña bring varying amounts of flooding, drought, and fires to different regions at different a time, which affects global plant growth. Thus, the amount of human-produced CO_2 emissions absorbed by plants varies from as little as 30% to as much as 80% from year to year. However, the consistent rise in carbon dioxide (CO_2) is clearly evident in modern times. From the measurement at the Mauna Loa Observatory in Hawaii, we see that CO_2 has been observed since 1958. Upto December 2008, the concentration of CO_2 in Earth's atmosphere was about 386 parts per million (ppm), with a steady recent growth rate of about 2 ppm per year.

Deforestation

Burning fossil fuels is not the only thing that we are doing to increase the amount of carbon dioxide in the atmosphere. At the same time, forests are being destroyed at an alarming rate. Huge numbers of trees are being cut down for providing timber and also for clearing the land for cultivation, housing or for industrialization. This destructive process is called deforestation. For agricultural purpose people cut down and burn all the trees in an area. When the flames die down, nothing is left but acres of blackened, lifeless landscape. The fire destroys all the plants and kills or drives off the animals. Unfortunately, there has been little attempt to replant trees in deforested areas. So the world's forests are vanishing very quickly. This deforestation aggravates the problem of the greenhouse effect in two ways. When trees are burned, huge amount of carbon dioxide is released into the atmosphere. So it simply increases the strength of greenhouse gas in the air. In addition to that, deforestation does more than just add carbon dioxide into the air. This foolish action of cutting plants also eliminates huge amount of carbon dioxide-absorbing agents from the environment. As fewer and fewer trees are left to absorb the carbon dioxide, the concentration of carbon dioxide in the atmosphere increases faster and faster.

Methane emissions

There are both natural and human sources of methane emissions. Since the Industrial Revolution, human sources of methane emissions have been growing. Fossil fuel production and intensive livestock farming have caused the current increase methane levels. Methane gets released whenever fossil fuels are extracted from the earth. It may be in the form of natural gas, coal or petroleum. More methane is released during any type of handling, transportation (pipeline, truck delivery, etc.) or refinement of fossil fuels. Finally some methane is also produced during burning of fossil fuel.

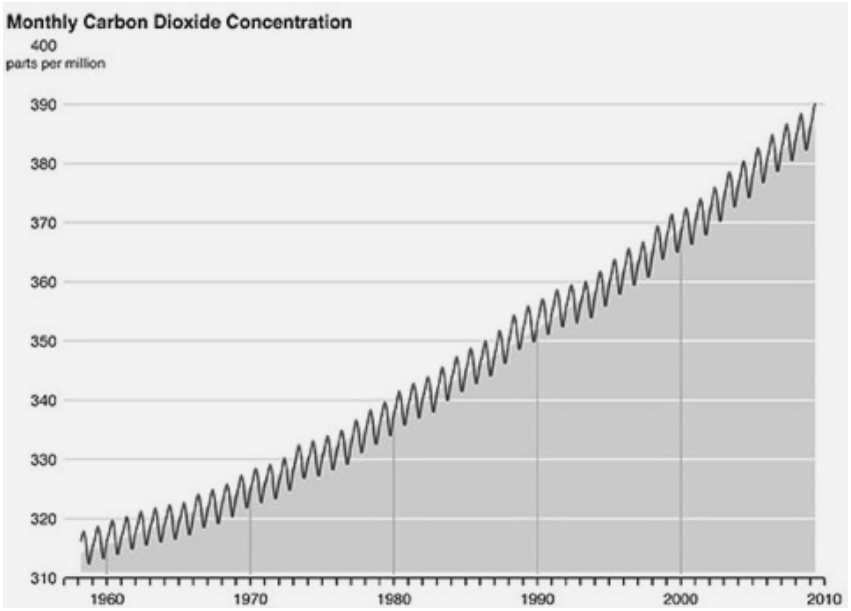

Figure 3: Rise of CO_2 level in the atmosphere: [Adopted from – Down to Earth Climate Change: Teaching Tomorrow's Leaders Today is a joint project of UCR, NASA and RUSD: http://globalclimate.ucr.edu/resources.html]

1. A large part of methane emissions are from natural gas. Methane is the main component of natural gas. So leakage during industrial handling releases methane directly into the atmosphere. This includes the extraction, processing and transportation of natural gas.

2. Coal is another important source of methane emissions. In coal formation, pockets of methane are encapsulated around and within the rock. Coal mining related activities such as extraction, crushing, distribution release some of this trapped methane.

3. Oil wells can also have methane deposits that are also released during drilling and extraction. The refinement, transportation and storage of oil are also causing methane emissions.

4. Incomplete combustion of fossil fuels also produces methane emissions. No combustion process is one hundred percent efficient. So when fossil fuels are used to make electricity, heat or power cars then production of methane is inevitable.

5. During the normal digestion process of ruminant animals like cows, sheep and goats, they create large amounts of methane. Because of microorganisms in the stomach of these animals enteric fermentation occurs. The methane is formed as a by-product. This is either exhaled by the animal or released via flatus.

6. Methane is also generated by the decomposition of solid waste in landfills. This also happens with animal and human waste streams. Our garbage contains things like food scraps, newspapers, cut grass and leaves. Every time new

garbage comes in, it gets piled over the old garbage that is already there. The organic matters in our garbage are trapped in conditions where there is no oxygen. This is an excellent condition for methane producing microbes. These microbes break down the waste and produces large amounts of methane. Even after a landfill is closed, bacteria will continue to decompose the buried waste that will continue to emit methane for years.

7. Wastewater from domestic, municipal and industrial sources can also produce methane emissions. When the decay of organic material in wastewater happens without oxygen, then this will create methane.

8. Biomass is material from living or dead organic matter. Incomplete burning of biomass leads to methane emissions. During large scale burning, huge amount of methane can be released.

9. Large open fires during destruction of crop waste and clearing of land for agricultural or other uses can contribute to methane emissions.

10. Another large source of methane emissions is rice agriculture. Paddy fields have high moisture content without oxygen and have abundant organic material. This creates a great environment for methane producing microbes that decompose the organic matter.

11. Biomass used to produce energy for domestic or other purposes is referred to as biofuel. Incomplete biofuel combustion leads to the production of methane. Open cooking fires burning wood, agricultural waste, or animal dung are great contributors to global biofuel emissions.

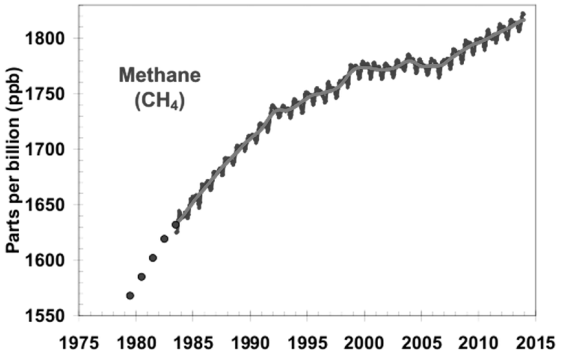

Figure 4: Increase in Methane concentration in the atmosphere: [Adopted from – https://eu.idtdna.com/pages/education/decoded/article/methane-oxidizing-bacteria-for-a-reduced-carbon-footprint]

The troposphere layer in the atmosphere is the largest sink for methane. Methane in the troposphere reacts with hydroxyl (OH) radicals, forming mainly water and carbon dioxide. So, the methane produced by natural sources is completely offset by natural methane sinks. It was running for thousands of years. Methane levels were quite steady because of this natural balance before the influence of human activities. At present, human-related sources create the majority of total methane emissions. This has upset the natural balance that existed before the Industrial Revolution.

Vehicular Emissions

Most of the today's cars and trucks are driven by using internal combustion engines that burn petrol or other fossil fuels. The process of burning petrol/diesel to power cars and trucks /motor vehicles contributes emissions that are released directly into the atmosphere.Motor vehicles also pollute the air during the processes of manufacturing, refueling, and from the emissions associated with oil refining and distribution of the fuel they burn.

The major pollutants associated with motor vehicles are

1. Ozone (O_3) which is created when hydrocarbons and nitrogen oxides (NO x) react with sunlight. Hydrocarbons and nitrogen oxides (NOx) are chemicals released by automobile fuel combustion.

2. The particles of soot, metals, and pollen give smog its cloudy color. These are called particulate matter (PM). Among the PM, fine particles (those less than one-tenth the diameter of a human hair) create the most serious threat to human health by penetrating deep into lungs.

3. Nitrogen oxides (NO_x) which weaken the body's defenses against respiratory infections such as pneumonia and influenza can also assist in the formation of ozone and particulate matter.

4. Carbon monoxide (CO), which is formed by the combustion of fossil fuels such as gasoline, when inhaled, blocks the transport of oxygen to the brain, heart, and other vital organs in the human body.

5. Sulphur dioxide (SO_2) is produced due to burning of sulfur-containing fuels, especially diesel. It can react in the atmosphere to form health hazardous particles.

6. Other toxic chemical compounds, which are emitted by cars, trucks, refineries, gas pumps, and related sources, have been linked to birth defects, cancer, and other serious illnesses. The EPA calculates approximately that the air toxins emitted from cars and trucks account for half of all cancers caused by air pollution.

7. Emissions from cars also increase the amount of carbon dioxide in the atmosphere.

How Much Warmed Up?

Studies showed that averaged over all land and ocean surfaces temperatures have increased roughly 0.74°C over the last century, according to the Intergovernmental Panel on Climate Change. More than half of this warming (i.e., about 0.4°C) has occurred since 1979. Because oceans tend to warm and cool more slowly than land areas, continents have warmed the most 0.7°C since 1979, especially over the Northern Hemisphere.There are slight differences in global records between the groups at NCDC, NASA, and the University of East Anglia. Actually, each group calculates global temperature year by year, using slightly different techniques. However, results from all three groups point to the decade between 1998 and 2008 as the hottest since 1850.

Indian Scenario

The effect of global warming on the climate of India has led to climate disasters according to some experts. India is a disaster prone area with floods being the most frequent disasters. The process of global warming has led to an increase in the frequency and intensity of these climatic disasters. The Gangetic plains, the Deccan, and the Central Plateau and Rajasthan desert were covered with dense vegetation (more than 36% in 1912). Today it is below 20%. The combination of deforestation and increasing fossil fuel burning is responsible for the increasing deviation in the climate. In the metro cities the decline of trees combined with the heat-sink effect of the high rise buildings enhanced the accumulation of CO2 in the local atmosphere. It is revealed from the studies in the cities like Mumbai, Kolkata and Delhi that the heat sink effect raises the night temperature by 4-6 degree Centigrade compared to open

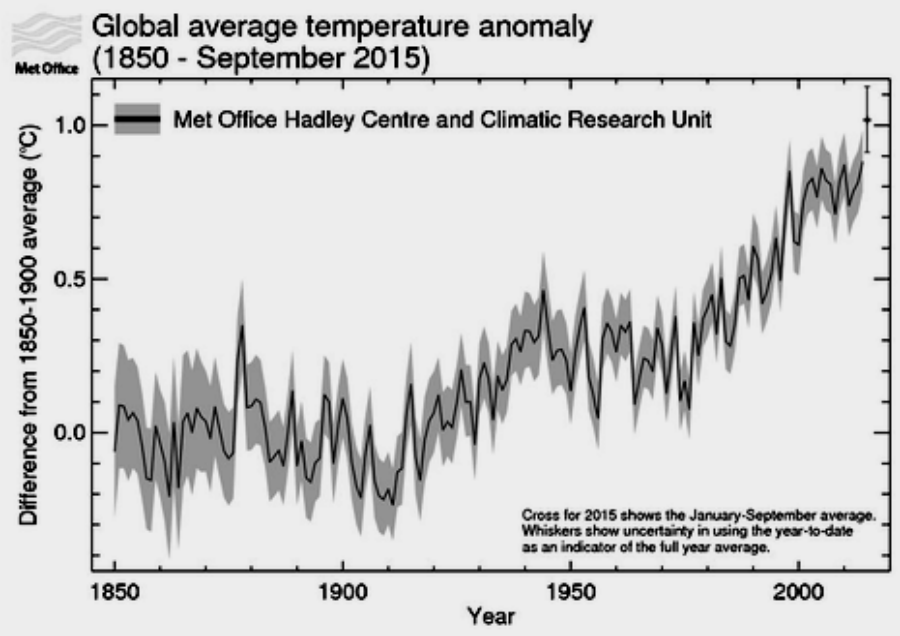

Figure 5: Global average temperature variation from the year 1850 to 2015. [Adopted from – http://www.metoffice.gov.uk/media/image/9/c/hadcrut4_new_logo.1850-1900_600.jpg]

areas. Such ecological and climatic crisis may lead to the following problems:

1. Unusual and exceptionally hot weather are expected to take place more frequently covering much larger areas.

2. A 1.5°C rise in the world's average temperatures may lead to India's summer monsoon becoming highly unpredictable.An abrupt change in the monsoon pattern can create a major crisis, causing more frequent droughts as well as greater flooding in large parts of India.India's northwest coast to the south eastern coastal region can have higher than average rainfall.

3. Droughts are expected to be more frequent in some areas, especially in northwestern India, Jharkhand, Orissa and Chhattisgarh. Productions of crops arepredicted to fall significantly because of extreme heat by the 2050s.

4. Falling of water tables can be expected to reduce further due to increasing demand for water from a growing population, more comfortable life styles and industries.

5. Melting of glaciers and the loss of snow cover over the Himalayas arelikely to disturb the balance and reliability of northern India's primarily glacier-fed rivers, particularly the Indus and the Brahmaputra due to 2.5°C rise of global temperature. Alterations in the flows of the Indus, Ganges, and Brahmaputra rivers may havesignificant impact on irrigation, affecting the amounts of food that can be produced in their basins as well as the occupations of millions of people.

6. Sea-level rise and storm surges may

lead to saltwater imposition/intrusions in the coastal areas. These will have impact on agriculture, degradation of groundwater quality, contamination of drinking water, etc.

7. Kolkata and Mumbai, both densely populated cities, are particularly vulnerable to the impacts of sea-level rise, tropical cyclones, and riverine flooding.

8. The increasing variability and long-term decreases in river flows can pose a major challenge to hydropower plants and increase the risk of physical damage from landslides, flash floods, glacial lake outbursts, and other climate-related natural disasters.Decreases in the availability of water and increases in temperature will pose major risk factors to thermal power generation.

Combating Strategies

To overcome the crisis we have to take steps to reduce production of greenhouse gases, mainly CO_2 and to increase the absorption of CO_2. More and more comfortable lifestyle means more and more consumption of energy, so we are led to produce more and more electric power, mainly by burning fossil fuels. So our objective should be to reduce energy consumption and thereby reduce energy production especially in developed countries. Again we have to go for non-conventional clean and green energy sources, where greenhouse gas emission is almost nil.

It is the duty of major greenhouse gas emitting countries to take drastic steps by changing their lifestyles, industrial policies, urbanization policies, etc, and work towards reduction of emission of greenhouse gases.

What can we do in our daily life?

We can do very little in daily basis but it accumulates huge contributions if everyone does it in regular basis. If each of us does our little bit on a daily basis, the accumulated contribution can prove to be significant,

1. Replacement of Incandescent Light bulb by CFL and LED: We can replace regular incandescent light bulb with compact fluorescent light (CFL) and LED bulbs. They consume 70% less energy then ordinary bulbs and have longer lifetime.Using energy star appliances will not only save money, but also the amount of energy wasted in your home.

2. Less use of Cars: We can minimize the use of personal cars which will not only save fuel but also help in reducing global warming. We should use more public transport. The Government should take effective steps to improve the public transport system and discourage the use of personal transport. The friends living in the same area can combine and pool cars. For going to a local market, we can either walk or go by cycle. Both of them are great forms of exercise. Oil and gasoline used in the cars are the biggest source of pollution emitting fumes. So cutting down consumption is a huge step to save energy and reduce harmful emissions.

3. Reduce, Reuse, and Recycle - the 3R formula: We can reduce our need to buy new products or consume less, resulting in a smaller amount of waste. If it is really necessary to buy, we should buy eco-friendly products. They can be more effectively reused and recycled. We should discourage use of plastic bottles, plastic containers for items bought at the grocery store. We can recycle almost

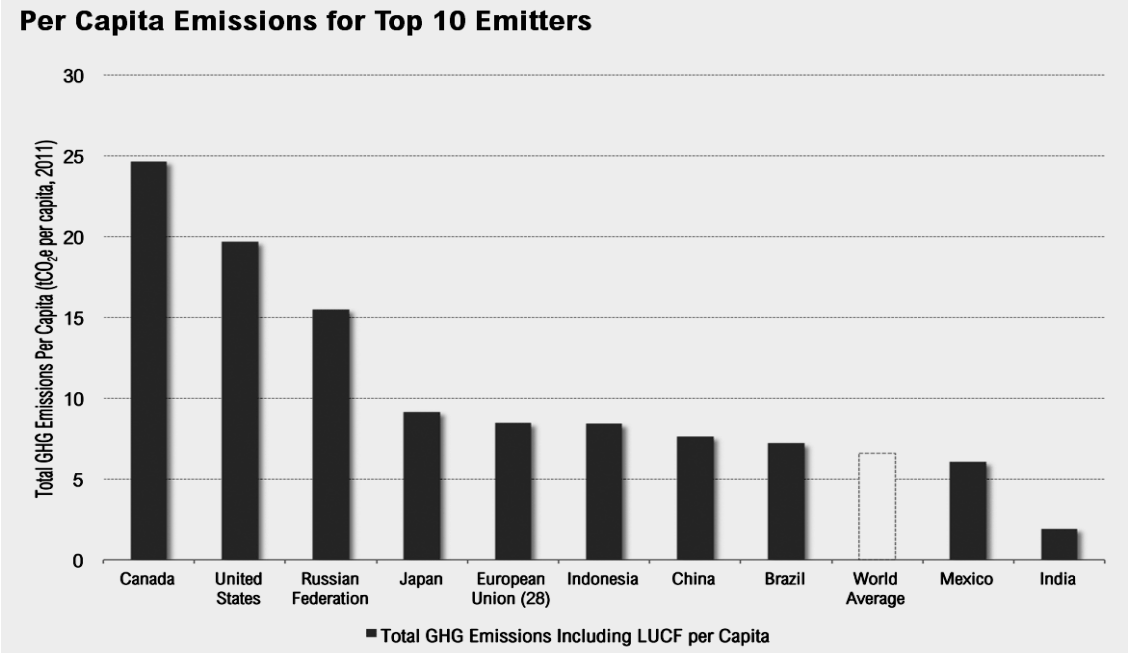

Figure 6: Top ten Greenhouse gas emitting countries: [adopted from –http://bit.ly/11SMpjA]. Here, GHG stands for Green House Gas and LUCF stands for Land Use Change and Forestry.

anything - paper, aluminium foil, cans, newspapers, etc.

4. Use of Solar Energy: It's a clean and green source of energy. So we must go for solar panels. The installation is simple and available within countries and discounts are given by government agencies and energy companies making solar energy equipments.

5. Reduction of Waste: Landfills are the major contributor of methane and other greenhouse gases. When the waste is burnt, it releases toxic gases in the atmosphere which result in global warming. So we should try and reuse and recycle old items. This can significantly reduce our carbon footprint as less energy is required compared to energy use for the production of new items from virgin materials.

6. Reduction of Products With Lot of Packaging: When we buy products with lot of packaging, we end up throwing the packaging material in the garbage, which will find its way to landfill sites and pollute the environment.

7. Use of Programmable Thermostat: A programmable thermostat in AC and Refrigerators is very energy efficient. Its initial cost can be recovered from the amount that we save by reducing energy consumption. The easiest and most cost effective advice is simply adjusting our thermostat to different settings in winter and summer.

8. Adoption of good habits like turning off the lights and fans: When we are not using a room, there is no need for the light or fan to be on. Unnecessary usage of electronic appliances will not

only save fuel, i.e., coal by which we get electricity but also increase the lifetime of electronic gadgets.When we consume less, indirectly the less carbon dioxide is released into the atmosphere.

9. Planting Trees: More than any other method, planting trees can help much in reducing global warming. They not only give out oxygen but also take in carbon dioxide, during the process of photosynthesis.

10. Use of clean fuels: Electric, smart cars, cars run on non-polluting vegetable oil, etcare great examples for using renewable energy. During refilling of oil for cars we must buy as cleanest gasoline as possible.

11. Not wasting Water: With the water wasted by the millions of us during brushing and bathing due to mismanagement, we can provide water to many more people with drinking water. We should take into account the energy to draw and filter water from underground. We can adopt shower during bathing because it uses less water than baths by 25%.

12. Cutting down processed food: Natural foods are healthier than processed foods. So in addition to health benefits we can cut down the energy costs used by factories that produce processed food.

Political Scenario

Global warming remains an unwanted political debate, often split along party political lines, especially in the United States. Many of the issues that are established within the scientific community remain under discussion of politically or economically motivated attempts to downplay, dismiss or deny them. There are disputes about the best policy responses to the science, their cost-effectiveness and their urgency. Climate scientists, especially in the United States, have reported to censor or suppression of their work and scientific data, with directives not to discuss the subject in public communications. Legal cases regarding global warming, its effects, and measures to reduce it have reached American courts. Another important controversy is whether action towards restriction on fossil fuels should be taken now, or in the near future; and whether those restrictions would have any meaningful effect on global temperature. Some economists argue that the negative economic effects of emission controls prevail over the environmental benefits. They state that even if global warming is caused solely by the burning of fossil fuels, restricting their use would have more damaging effects on the world economy than the increases in global temperature.

Conversely, others argue that early action to reduce emissions would help avoid much greater economic costs afterwards and would reduce the risk of catastrophy. Many eco-scientists give importance about the urgency to act, but the depressing fact is that America is refusing to do so. However, many projects have been started in an effort to push the world's leaders towards changing laws and policies that would effectively reduce the world's carbon emissions and use of non-renewable energy resources.

Conclusion

We should always try our best to educate people about global warming and its causes and after affects. We should be aware how we can contribute to combat the problems simply by saving energy. Saving energy means less amount of energy production

which results less greenhouse gas emissions. Wherever possible, we should go for nonconventional clean and green renewable energy sources. These will be good for the environment. We should share information with friends, relatives and neighbours regarding the effect of global warming and combating strategies through different awareness programmes. □

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Indian Civilisation — The story that genes tell

R L Mauryan*

QUESTIONS HAVE BEEN raised since a long time about who we are, where we came from, are we the original inhabitants of India? Did the Indus Valley Civilisation (IVC) flourish much prior to the Vedic civilisation? These are the fundamental questions being asked.

Recent studies in genetics – 'genome' of the people now living all over the globe and the ancient remains of the people who lived on the earth tens of thousands of years ago, by DNA geneticists and archaeologists from all over the world – have answered these questions on the basis of their objective findings. These will be discussed in this article.

It is now well settled that Africa was the original home from where the people (man's ancestors) migrated to all over the globe about 65,000 to 70,000 years ago. "They crossed from Africa to Asia and walked along the coast of southern Asia and all the way to Australia, while another group went towards Central Asia and Europe. The genetic ancestry of these first inhabitants of the Indian subcontinent constitutes 50-65% of DNA of the current inhabitants of India. Thus, 'original Indians' never really existed. All human beings are descended from Africa. After the first migration, apparently there were three more waves of major migrations into India and the new migrants mixed with the pre-existing population. Interestingly, as early as 20,000 years ago, the subcontinent had the world's largest human population" (TOI – 23 Feb, 2019).

"The second major migration occurred 9,000 to 5,000 years ago, when agriculturists from Iran's Zagros region moved into India's North-West and mixed with the first settlers of the subcontinent to create probably the Harappan people and later the urban Indus Valley Civilisation. The Harappan people moved south and mixed with the local people to produce what geneticists call Ancestral South Indians (ASI) with a culture based on Dravidian languages.

A third farming-related migration occurred around 2000 BC when migrants from the Chinese heartland swamped South-East Asia and reached India, bringing the Austro-Asiatic family of languages (such as Mundari and Khasi spoken in Eastern and Central India). The fourth migration took place between 2000 and 1000 BC, soon after the Indus Valley Civilisation collapsed. It brought Central Asian pastoralists from the Kazakh Steppe, who spoke an Indo-European language" (TOI – 23 Feb, 2019).

The map in Fig. 1 shows that Iranian agriculturists spread out East after 7000 BCE and migrated to the West of India, Afghanistan, and Pakistan, and settled there with the then existing people, which gave birth to the Indus Valley Civilisation (IVC). But when the "Indus Valley Civili-

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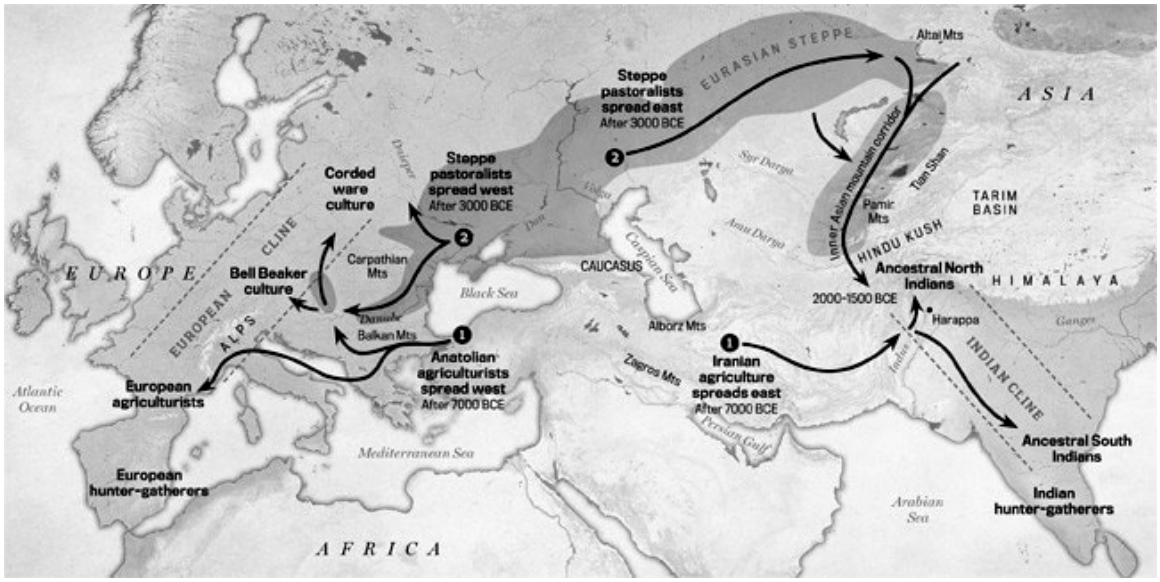

Figure 1: The map of Migration : (Source: India Today – Sep 10, 2018 Kai Friese)

sation was first discovered in the 1920s, colonial archaeologists quickly identified it as evidence of a pre-Vedic culture, which, they theorised, had been utterly destroyed by the advent of 'Aryan' invaders from the Northwest who represented the dawn of Hindu India. In later years, most mainstream historians have discarded the 'Aryan invasion theory' or 'AIT' as an over-simplification – while retaining a chronology that places the Vedic civilisation as a successor of the Indus Valley Civilisation" (Ibid).

"That Indus Valley was a misnomer and that in size it was the largest pre-historic urban civilisation – even bigger than Pharaonic Egypt" ··· "Its geographical boundaries are now believed to extend up to the Iranian border on the West, Turkmenistan and Kashmir in the North, Delhi in the East and the Godavari Valley in the South. A recent count showed that as many as 1,400 Indus sites have been found, of which 917 are in India, 481 in Pakistan and one in Afghanistan. While Mohenjodaro and Harappa were rightly regarded as principal cities, there were at least several others such as Rakhigarhi in Haryana and Ganweriwala in Pakistan's Punjab province that match them both in size and importance" ··· "For, in Harappa as in most Indus sites, the distinct grid-iron pattern for streets appear, a scientific system of drainage that linked up to even the smallest house in the lower city is established, precise weights and measures begin to circulate, and the writing system evolves" ··· "Archaeologists say the Indus people couldn't have copied their town-planning from Egypt and Mesopotamia because in those civilisations the roads meandered like village streets. Nor was the writing similar to Sumer's". (India Today – 26 Jan, 1998).

"The Harappans had their own distinctive style. There were clearly skilled engineers who planned the big cities with awesome precision. Most of the cities were parallelograms in shape and the bricks had

uniformity in size with a clear ratio of 4:2:1. Weights were standardised and the same script was used by the entire empire" ··· "The citadel was a good 20 ft higher than the lower or middle cities. It led the Wisconsin archaeologist Jonathan Mark Kenoyer to envisage several competing elite classes who maintained different levels of control. Instead of one social group with absolute control, he speculates that the rulers included merchants, ritual specialists and individuals who controlled resources such as land, livestock and raw materials ··· The inscriptions are usually short, made up of 26 characters written usually in one line. The script, largely glyptic in content, has around 419 signs, which is far short of the 50,000 the Chinese script has" ··· "The Indus people also wrote from right to left as is manifest by the strokes, but it does follow at times a rebus style similar to that of a farmer ploughing a field. Among lettering, a jar-shaped alphabet is the most common" (Ibid).

"Independent evidence started flowing in when Indus seals were found both in Iraq, where the ancient Sumer civilisation flourished, and in the Persian Gulf. The Sumers apparently called India "Meluha", and their inscriptions talk of how they purchased beads of various kinds, timber, copper, gold and ivory crafts from India" (Ibid).

"Indus sailors appear to have discovered the trade winds long before Hippolus, and their maritime interests were vast. Harappan traders were among the most enterprising. Harappans are credited with being the earliest growers of rice and cotton. The agricultural surpluses ensured craft specialisation. The flourishing trade was an energiser that powered Indus' phenomenal growth in the middle of the third millennium BC. It brought prosperity that saw the cities provide their citizens with the finest of drainage systems and reservoirs to supply water. And helped them evolve into one of the greatest Civilisations ever" ··· "The weight and decimal system too lived on. And so did the bullock-cart technology that the Indus had perfected" (Ibid).

One can conclude from the above description that Indus Valley Civilisation was one of the oldest urban civilisations that flourished in the region much before the arrival of the Euro-Asian people from the areas between Black and Caspian steppe between 2000 to 1500 BCE. These Euro-Asian people travelled to both West and to the East of India. These people had a distinct genome, called 'R1a'.

It is seen that "Until recently, only data on mtDNA (or matrilineal DNA, transmitted only from mother to daughter) were available and that seemed to suggest there was little external infusion into the Indian gene pool over the last 12,500 years or so. New data on Y-chromosomes (or chromosomes that are transmitted through the male parental line, from father to son) is available. This New Y-DNA data has turned that conclusion upside down, with strong evidence of external infusion of genes into the Indian male lineage during the period in question." "In other words, those who migrated were predominantly male and, therefore, those gene flows do not really show up in the mtDNA data. On the other hand, they do show up in the Y-DNA data: specifically, about 17.5% of Indian male lineage has been found to belong to haplogroup R1a (haplogroups identify a single line of descent), which is today spread across Central Asia, Europe and South Asia. Pontic-Caspian Steppe is seen as the region from where R1a spread both West and East, splitting into different subbranches long the way" (The Hindu – June 16, 2017).

In a Subsequent research paper, titled "A Genetic Chronology for the Indian Sub-

Figure 2: The Rakhigarhi excavation. Source: India Today August 31, 2018

continent Points to Heavily Sex-biased Dispersals", 16 scientists led by Prof. Martin P. Richards of the University of Huddersfield, U.K., concluded: "Genetic influx from Central Asia in the Bronze Age was strongly male-driven, consistent with the patriarchal, patrilocal and patrilineal social structure attributed to the inferred pastoralist early Indo-European society. This was part of a much wider process of Indo-European expansion, with an ultimate source in the Pontic-Caspian region, which carried closely related Y-chromosome lineages across a vast swathe of Eurasia between 5,000 and 3,500 years ago" (Ibid). Prof. Richards said that the prevalence of R1a in India was "very powerful evidence for a substantial Bronze Age migration from Central Asia that most likely brought Indo-European speakers to India" (Ibid).

"Three years ago, a team of 32 scientists published a massive study mapping the distribution and linkages of R1a. It used a panel of 16,244 male subjects from 126 populations across Eurasia. Dr. Underhill's research found that R1a had two sub-haplogroups, one found primarily in Europe and the other confined to Central and South Asia. Ninety-six per cent of the R1a samples in Europe belonged to sub-haplogroup Z282, while 98.4% of the Central and South Asian R1a lineages belonged to sub-haplogroup Z93. The two groups diverged from each other only about 5,800 years ago. Dr. Underhill's research showed that within the Z93 that is predominant in India, there is a further splintering into multiple branches" (Ibid).

This proves our ancestry from Euro Asian region. "So in a nutshell: R1a is distributed all over Europe, Central Asia and South Asia; its sub-group Z282 is distributed only in Europe while another subgroup Z93 is distributed only in parts of Central Asia and South Asia; and three major subgroups of Z93 are distributed only in India, Pakistan, Afghanistan and the Himalayas" (Ibid). This is one of the basic and objective bases to conclude about the Ancestral North Indian (ANI) ancestry to Euro-Asian region. Some people may say that R1a gene originated from India and then spread to Euro-Asian region. This is what pro-Hindutva groups would like us believe. But what is the objective discovery made by the modern geneticists? Let us see further.

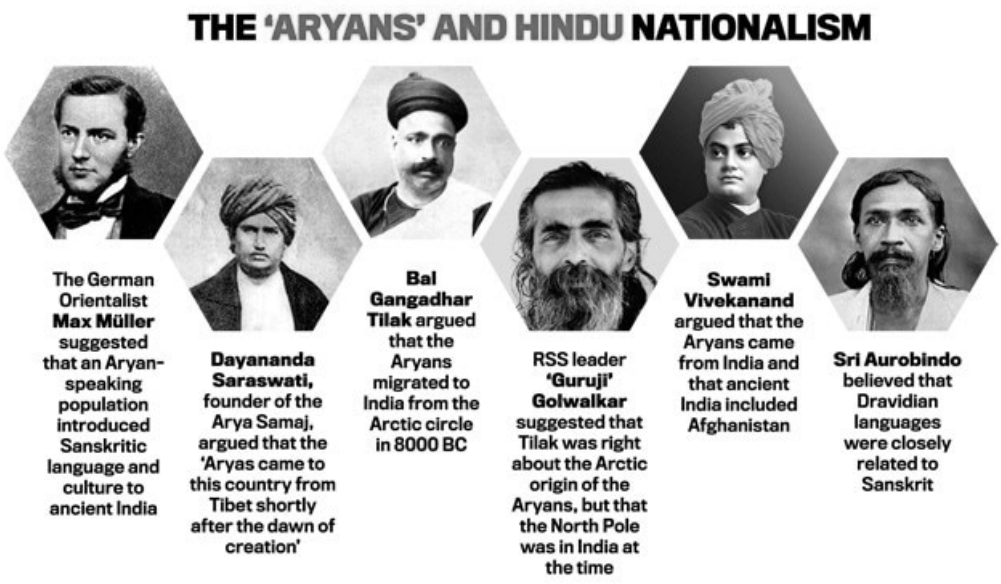

Figure 3: The above picture shows the different opinions about the origin of Indian civilisation, but none of them are based on scientific facts and hence cannot be accepted. Source: India Today; August 31, 2018.

"This clear picture of the distribution of R1a has finally put to rest an earlier hypothesis that this haplogroup perhaps originated in India and then spread outwards. This hypothesis was based on the erroneous assumption that R1a lineages in India had huge diversity compared to other regions, which could be indicative of its origin here. As Prof. Richards puts it, "the idea that R1a is very diverse in India, which was largely based on fuzzy microsatellite data, has been laid to rest" thanks to the arrival of large numbers of genomic Y-chromosome data" (Ibid). "A mammoth, global study of R1a haplogroup published last year showed that R1a lineages in India mostly belong to just three sub-clades of the R1a-Z93 and they are only about 4,000 to 4,500 years old." (Ibid). So to say that R1a travelled from India to Euro-Asian region has been proved wrong.

A paper was published in April 2016 under the title "Punctuated bursts in human male demography inferred from 1,244 worldwide Y-chromosome sequences". "This paper, which looked at major expansions of Y-DNA haplogroups within five continental populations, was lead-authored by David Poznik of Stanford University, with Dr. Underhill as one of the 42 co-authors. The study found "the most striking expansions within Z93 occurring approximately 4,000 to 4,500 years ago". "This is remarkable, because roughly 4,000 years ago is when the Indus Valley civilization began falling apart. There is no evidence so far, archaeologically or otherwise, to suggest that one caused the other; it is quite possible that the two events happened to coincide" (Ibid).

From the above paragraph, the genetic age of the R1a splinter into Indian soil is dated around 4000 years ago, which coincides with the falling era of IVC in the

region. Another argument put forward by some people is that, both the ANI (Ancestral North Indian) and ASI (Ancestral South Indian) categories of people lived side by side about 10,000 yrs ago. However, "the third argument was that there were two ancient groups in India, ANI and ASI, both of which settled here tens of thousands of years earlier, much before the supposed migration of Indo-European language speakers to India. This argument was false to begin with because ANI – as the original paper that put forward this theoretical construct itself had warned – is a mixture of multiple migrations, including probably the migration of Indo-European language speakers" (Ibid). It means that ANI was a mixture of many migrants over a long period between 1500, 800, 600 BCE. "Lastly, from long-established archaeological studies, we also know that 2000 BC was around the time when the Indus Valley civilization began to decline" (Ibid).

Now the next question that comes is, what was the language of these people, who carried the Z93 "Aryan gene", who could be called not invaders but migrants? "Moving outwards from the steppe, they spread what would become their biggest contribution to the modern world: their language. It was the ancestor of Greek, Latin, Old Iranian, Sanskrit, and all their daughter tongues, now known as the Indo-European language family. Today, over 40% of the world's people speak a mother tongue descended from the language of those nomads of the steppe" (scroll.com, Sep 06.2018). "The study of ancient DNA is a new, evolving science and more findings are expected. But so far, the genetic evidence confirms the old colonial hypothesis that Indo-European language speakers, who called themselves Aryans, did migrate to India when the Indus Valley civilisation came to an end, bringing with them an early version of Sanskrit" (TOI 23 Feb2019). This also indicates that Sanskrit is a foreign language because there many similarities – words presently found in European languages are common to Sanskrit. It was the language of 'Aryan gene' migrants from the region between Black sea and Caspian sea, called Steppes, or Central Asia (TOI- 23 Feb 2019). "It corresponds to the time of the composition of the Rig Veda, the oldest Hindu religious text, one of the oldest pieces of literature in the world, which describes a mixed society". (The Hindu – 16 June, 2017)

It is now very well confirmed from the genetic evidences that "the Vedas were composed long after the peak of the Indus Valley Civilisation, by a people who migrated into the sub-continent at most 4,000 years ago, whose language descended from one of the first spoken in the grasslands of Eastern Europe and Central Asia" (scroll.com, Sep 06, 2018). It invalidates and refutes the theory of the Hindutva groups, who claim that the Vedic Civilisation is the oldest civilisation of the Indian people.

Rakhigahri is a small village in Hissar District of Haryana, 150 km away from Delhi. An old skeleton of a human being about 4500 yrs old was excavated from this village in 2015. This is named as 14411. "Most importantly, the village with its seven teelas or mounds has produced enough evidence to identify it as the site of a 'mature' Harappan settlement of the 2nd and 3rd millennium BCE. In other words, a town that witnessed the rise and – more than 4,000 years ago – the mysterious fall, of India's first urban civilisation". (India Today – 31 Aug, 2018). A team led by Dr Vasant Shinde, an archaeologist and Vice-Chancellor of Deccan College, Pune, and a South Korean geneticist have been analysing its DNA composition.

Its DNA material is taken from "the 'petrous bone', which is an inelegant but

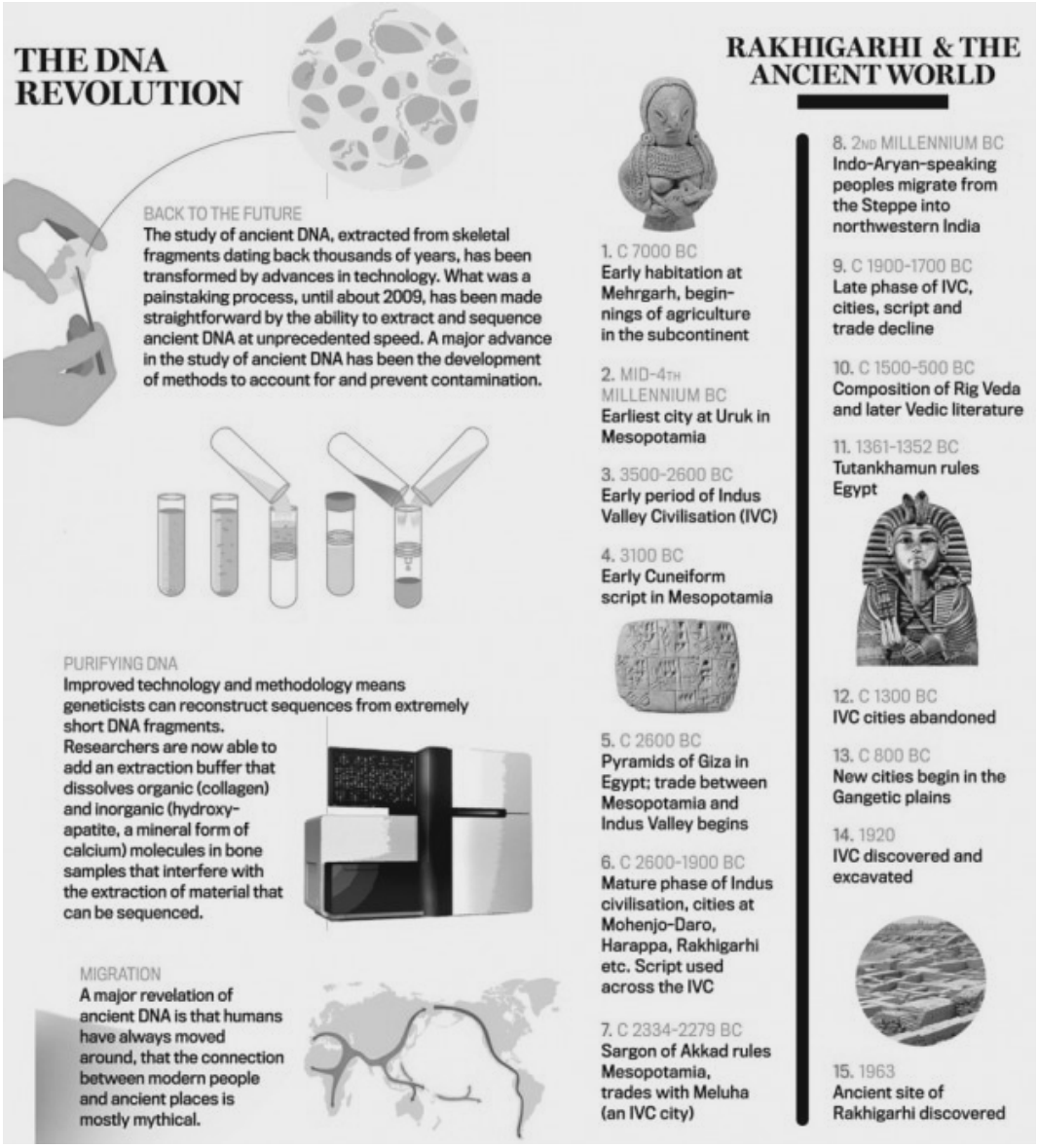

Figure 4: Above diagram shows the evolution of various civilisations with the period indicated therein. It confirms our study of migration and origin of each civilisation. Source: India Today August 31, 2018.

useful chunk of the human skull – basically it protects your inner ear". DNA analysis has revealed that this person had close link with IVC and was part of its large spread. Most important finding is the total absence of R1a DNA (the 'Aryan gene') in Rakhigarhi's skeleton. It means that "the inhabitants of ancient Rakhigarhi "do not

have any affinity with the Central Asians" (Ibid). However, it had link with Iranian gene, which interbred with and was part of Indus Valley Civilisation.

As we have seen earlier, genetically two main threads are considered for analysing the population in India. One is Ancestral North Indian (ANI) and second is Ancestral South Indian (ASI). ANI has R1a sub gene-Z93 (17.5%) of the Euro-Asian people, who came from Steppes of Black and Caspian Sea region, in 1500, 800, 600, BCE and settled in the Western to Northern part of India and interbred with the people living there. Surprisingly this Rakhigarh inhabitant's DNA has direct link with DNA of Ancestral South Indian (ASI), and with the people of South India, the Dravidian culture. Its genetic link is also found with the 'Irula tribes' living in the Nilgiri Hills, Tamil Nadu.

Based on DNA evidence, geneticists conclude that Indus Valley Civilisation, having Iranian gene, had migrated down to Southern part of India. Some are further concluding that IVC's and Rakhigarhi's people were the ancestors of the South Indian population and hence Dravidian by nature. Genetic studies are done on the basis of scientific methods and it will be difficult to deny the conclusions drawn by it just because of political considerations or old myths and prejudices. The ASI migration down to south of India can traced in the map given in Fig. 1.

"The absence of this genetic imprint (R1a) in the first genome sample of an individual from the Indus Valley culture will bolster what is already a consensus among genetic scientists, historians and philologists: that the Indus Valley culture preceded and was distinct from this population of cattle-herding, horse-rearing, chariot-driving, battle-axe-wielding, proto-Sanskrit-speaking migrants whose ancestry is most evident in high-caste North Indian communities today" (India Today – August 31, 2018). This also once again proves our previous conclusion that IVC flourished and survived much before the arrival of the 'Aryan gene' Steppes people from Euro- Central Asia. So the Vedic civilisation was established much later and is not the most ancient civilisation as claimed by Hindutva groups, who are trying to rewrite the history of Indian civilisation.

In fact "the Vedic people were pastoralists, moving around with their cattle (the word Aryavarta means the "turning of the Arya", in a reference to a large herd being moved around). Whereas the Indus Valley Civilisation, including Lothal and Babar Kot in Gujarat, Rakhigarhi and the places today in Pakistan, was urban and built around planned cities, which also had drainage and sanitation"(Deccan Chronicle, dated March 10, 2019.). So there is a distinct difference between the levels of development in both the civilisations. Historically, there is a time difference also, one was prior and diminished (IVC) before the arrival of the second (Vedic).

Attempts are now being made to rewrite history in India. "The Union Minister for Culture Mahesh Sharma, who has prioritised the project of 'rewriting Indian history', whether by appointing a pliant obscurantist as head of the Indian Council of Historical Research or promoting the 'research' of para-scientific outfits such as I-SERVE (Institute of Scientific Research on Vedas). "In March this year a Reuters report revealed details of a meeting of a 'history committee' convened by Sharma at the office of the Director General of the Archaeological Survey of India in January 2017. Its task, according to the committee chairman K N Dixit, was "to present a report that will help the government rewrite certain aspects of ancient history".

The minutes of the meeting apparently "set out its aims: to use evidence such as archaeological finds and DNA to prove that today's Hindus are directly descended from the land's first inhabitants many thousands of years ago, and make the case that ancient Hindu scriptures are fact, not myth" (India today; August 31, 2018).

It is understood that Dr. Vasant Sindhe (who himself is not a geneticist, but is an archaeologist) of Deccan College, Pune, is not much interested to conclude the research on Rakhigahri samples, due to political compulsions, and also has not shared his findings with geneticist David Reich of Harvard University, who has done wonderful work on this subject and has published many papers. Even the South Korean geneticist collaborating with Dr Shinde did not show much interest afterwards. It is said that the samples were not shared with other geneticists, because their conclusion of the DNA study do not favour the present political dispensation. More importantly it proves that the 'Aryan gene' came from outsiders.

In the end we can conclude that Indus Valley Civilisation (IVC) was prior to the Vedic civilisation. People of IVC lived in well-planned the urban cities having drainage and water distribution ways. Whereas Vedic people were pastoralists, moving around with their cattle and horses. They were not the original inhabitants of the Gangetic plains.

It is not proper to say there was an Aryan 'invasion'. At best we can call them migrants, who migrated from Euro-Asian steppe region between 1500-1000 BCE.

Vedic civilisation is not the most ancient civilisation as claimed by Hindutva groups. Except Rig-Veda, all the other Vedas would have been written subsequently, by the people who came from the Euro-Asia Steppes. Sanskrit is a foreign language having its origin in the different languages of the European and Central Asian regions.

Ancestral North Indian (ANI) had no link with Indus Valley Civilisation and its DNA R1a (Aryan Gene) is mostly confined to North India's 17.5% population and is totally absent in the Southern part of India. Ancestral South Indian (ASI) people had link with IVC and Rakhigarhi's people and now with the South Indian population. □

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Oral contraception: Science, ethics and policies

Jayasree Sengupta*

The history of the development and the practice of oral contraceptive, known as the 'Pill' in the 1950-60s, considered a landmark in research in reproduction, permitting to women reproductive autonomy with the ability of mothers to plan and space their pregnancies, is mired with controversial moral and ethical issues. The Pill's development in the family planning programme had its origin in the contemporarily prevailing eugenics agenda and was based on unethically conducted clinical trials. The Pill received huge global acceptance despite many users developing cancer, venous thromboembolic disease, myocardial infarction, stroke as well as depression. While the social acceptance of the Pill may have been compounded by the contextual autonomy enjoyed by the pill user, there was, on the other hand, no serious attempt by the scientific community and government policy makers to bring the deleterious health issues into the public domain through dialogue and discourses. In the present essay, an attempt is made to focus upon moral and ethical issues, and policy controversies that arose surrounding the women's health care issue in advocating OC and how science failed the ethics from the view point of women's welfare.

SCIENTISTS ARE the vanguards of a society. Advances in science and technology ought to transform the way we live, help to create new industries, allow us to tackle serious healthcare, social and environmental problems. The results of scientific endeavours should be tailored to suit societal influences on education and research toward overall benefit of mankind, thereby meaning that science merits cooperative activity within a larger social and political context for fulfilling its full potential.

With this background in mind, I shall make an attempt to discuss how and why the underlying policy issues failed the ethics of administration of scientific and technological knowledge in women's healthcare in the last century despite considerable developments in the related areas around the same time. The specific issue that I call upon is the oral contraceptive (OC) pill, a stated tool to women's reproductive autonomy. I shall largely focus upon moral and ethical issues, and policy con-

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troversies that have arisen in the science surrounding the women's health care issue in advocating OC.

Development of birth control movement in the womb of Eugenics

Post-WWII, the world is widely informed of the Nazi type of eugenics research conducted in various concentration camps across Germany and Austria, but eugenics has its origin much earlier. Eugenics is a set of beliefs and practices that aims at improving the genetic quality of a human population. Francis Galton coined this term in 1883 and suggested its application in the principles of selective breeding to humans. The practices of eugenics funded by the Carnegie Foundation and the Rockefeller Foundation among others, in fact, started registering its footprint in the United States at the turn of the twentieth century. Charles Davenport (1866-1944), a renowned biologist, was a strong proponent of eugenics, and he had no hesitation in enforcing sterilizations of immigrants, socially disadvantaged and mentally deranged citizens, despite strong dissent and criticism from Thomas Morgan (1866-1945), who was an evolutionary biologist, geneticist and Nobel laureate.

At about the same time in the early 20th century, several feminist reformers in the US were seeking eugenics agenda in the legal reform. Margaret Sanger (1879-1966) was one prominent feminist who championed the eugenics agenda. As a champion of the Birth Control Movement (BCM) of America, Sanger considered birth control as a means to prevent unwanted children from being born into a disadvantaged life, and incorporated the language of eugenics to advance this movement. Thus, the campaign for birth control did not merely have eugenics as a core value but it tactically translates the aims of eugenics. In the concept of BCM and the history of the contraceptive revolution, eugenics was indeed a dominant mover.

The BCM envisaged and initiated by Margaret Sanger and her colleagues with a humanitarian dream, a world without poverty and illness, but soon it deteriorated into a coercion where the poor, the disabled and the addicted simply disappear. Sanger spoke publicly of the need to put an end to breeding by the unfit. In 1920, Sanger publicly stated that "birth control is nothing more or less than the facilitation of the process of weeding out the unfit [and] of preventing the birth of defectives." It is not surprising therefore that the impoverished African-American community argued that government-supported and organized family planning with the development of the Pill was racist and immoral. Population control through coercive methods is not only immoral, it interferes with an individual's liberty and lies in direct contrast to the UN Declaration of Human and Reproductive Health Rights.

Science of oral contraception

The discovery of estrogen in 1929 by Edgar Allen and Edward Doisy laid the foundation of our understanding of the female reproductive physiology, which was further amplified by the scientific contributions of Gregory Pincus who was an endocrinologist and M. C. Chang who was a reproductive physiologist. Margaret Sanger moved Pincus into the eugenics agenda and into the idea of developing the contraceptive pill. He believed that user-friendly contraceptive method will reduce the miserable plight of women belonging to the lower strata of society enduring multiple pregnancies and 'unwanted' children. Chang and Pincus tested the effectiveness of orally administered steroids in the control of mammalian fertility that led to their co-invention of

the first birth control pill. Searle in 1960 marketed the first oral contraceptive (OC) pill Enovid which was a combination of synthetic estrogen (mestranol) and progesterone (norethynodrel).

In the clinical trials, there were reports of several adverse side reactions including three deaths making it unacceptable despite giving one hundred percent protection against pregnancy. However, Pincus laid aside those inputs of potential hazards of the Pill on the pretext that even a placebo led to similar responses and proceeded to expand the clinical trials of the Pill in several more countries including Puerto Rico and Mexico. The first real large scale clinical trial of the pill was conducted in 1956 in Rio Piédras, a Puerto Rican housing project by Pincus and John Rock. The 200 plus women involved in the trial had reportedly received little information about the safety of the product they were given, were not even informed that they were a part of a clinical trial, that the Pill was experimental, and that there was a chance of potentially dangerous side effects. They rather understood the medicine being administered was to prevent pregnancy. Despite substantial positive effect, the history of the Pill is thus marked by serious lack of consent, lack of full disclosure, lack of true informed choice, and lack of clinically relevant research regarding the risk factors.

The human trials thus proceeded to investigate the safety and efficacy of the pill with orally administered steroids for pregnancy protection despite previous reports that unbridled use of estrogen results in pre-cancerous lesions and cancer of the cervix. This observation, together with reports of several adverse side reactions, was cast aside in the interest of developing a new industry and the fulfillment of the eugenics agenda. The pill approved by the FDA and introduced by the pharmaceutical company Searle in 1960 quickly dominated the market and this new contraceptive agenda quickly spread across the world. It helped women to regulate their child bearing potential but at the cost of their own health and wellbeing.

In the 1960s and early 1970s, many women who might have supported the development of new contraceptive methods were becoming concerned about the goals of those advocating government subsidized birth control, about the role and influence of the medical profession in contraceptive development and provision, and about the lack of concern for the users' perspective.

Scientific evidence soon began to emerge that OCs, aside from causing cancerous lesions, inflicted users with venous thromboembolic disease, myocardial infarction and stroke. An even more recent claim is the association of hormonal OCs with depression as a potential adverse effect on young adolescents. The modern women may still be willing to bear the blunt trauma of the use of contraceptive Pill for the advantages that it renders in form of effective and reversible contraception that decreases the personal and societal burdens associated with unintended and unwanted pregnancies. But, what is about the post-partum use of OCs?

The post-partum period and the first two years of a child's life is a time for close mother-child bonding essential for infant growth and development. Post-partum contraception is considered to improve the health of mothers and children by lengthening birth intervals, and lactation per se is a powerful tool to inhibit ovulation, if a child is suckled frequently and in spaced manner. There are conflicting reports on the use of hormonal oral contraceptives during this period. It is known that combined oral contraceptives (COCs) are detrimental to infant growth and development as the

milk yield is lowered with steroid ingestion. Additionally, long-term passage of steroids to the child in breast milk remains even today an unresolved issue even in progestin only contraception.

Sadly, the biomedical fraternity and pharmaceutical houses at their own level have been failing to understand and educate society for the need of 'user perspective' in contraceptive development and use. Collectively, the biomedical scientists failed to restrict the hegemony of OC over the body of women welfare. Many scientists, in fact, believe that science studies facts, employs objective methods, and produces knowledge and consensus. Ethics, on the other hand, involves the study of values, employs subjective methods, and produces only opinion and disagreement.

Arguments have been placed that scientists in the conduct of 'objective' science are neutral and they need not concern themselves with ethical issues in the application of scientific discoveries, despite the practice of standard ethical principles for medical research involving human subjects, including research on identifiable human material and data that were put into practice by the World Medical Association (WMA) Declaration of Helsinki.

Scientists and physicians as members of society must confront specific ethical issues that pertain to our societal needs and they need to be trained to address various aspects of ethics of good practices in facing societal issues. Probably, they have a better edge in handling those issues especially in the face of application of scientific and technological discoveries and advancements for the good of the world. They cannot behave like the ostrich sticking its head into the sand while whirlwinds strike in the desert land.

Governance policy: the final nail

On December 16, 1975, women's health activists held the first-ever protest at the headquarters of the US FDA with a demonstration that took the form of a "memorial service" to commemorate the thousands of women who had died from using the contraceptive pill and other estrogen-containing drugs, calling to attention the 'dangerous experiment' being 'performed using women as guinea pigs.' At the US Senate Hearings that began in 1970 to assess the hazards of the Pill, women in the audience who had taken the Pill were outraged that their doctors had not informed them the risks since experts at this hearing bluntly stated, "Estrogen is to cancer what fertilizer is to wheat." Angered upon hearing the discussions at the Senate Hearings the attending women demanded "Why are you letting the drug companies murder us for their profit and convenience?"

The positive impact of the Senate Hearings included: (i) making informed consent a national issue – Pharmaceutical companies had to include a Patient Information Sheet with complete information on side effects on every package of birth control pills sold; (ii) lowering the dose of the steroids in the Pill, and (iii) a large percentage of women quit taking the Pill; but not total stoppage of the use of the Pill. Very soon the pattern became clear. After an initial decline, the sales of the Pill again rebounded very soon.

The medical evidence available at that time was nevertheless only the tip of the iceberg. While the Institute of Medicine took cognizance of this healthcare problem and constituted a Committee in 1991 to explore the relationship between breast cancer and the use of combined oral contraceptive pill (COC) as some of the steroids used in oral contraceptives were found to be capable of inducing tumors in man and in animals

(http://www.nap.edu/catalog/1814.html).

Ironically though, the Committee did not ban the use of the Pill but recommended measures to fill the gap by: (i) maintaining surveillance, (ii) developing a broader array of contraceptives, (iii) assessing knowledge for use in clinical practice, and (iv) filling gaps in biological and epidemiological knowledge.

Meanwhile the contraceptive revolution continued unabated despite the National Cancer Institute observing a 24% increased risk of breast cancer with combined estrogen and progestin therapy, an increasing risk by as much as 10% per year of use. The World Health Organization officially classified oral contraceptives as a Class 1 carcinogen in 2005, yet we find its continued use from a 2017 scientific report, "The risk of breast cancer was higher among women who currently or recently used contemporary hormonal contraceptives than among women who had never used hormonal contraceptives, and this risk increased with longer durations of use."

The Center for Drug Control (CDC) in its wisdom continued to recommend hormonal contraception as one method of birth control, "$\cdots$ because no test reliably verifies cessation of fertility, it is prudent to consider contraceptive use until menopause, or at least until 50 to 55 years of age" recommending a systematic approach to contraceptive counseling and education to ensure safe, high-quality care.

The inherent history of how the Pill was conceived, developed and then spread without alerting the 'user' of the short- and long-term unintended side effects and of the grave societal impact it thus caused is of genuine concern. The ethical misconduct by scientists and clinicians and absence of adequate policy decisions by the global health administrators resulted in the death of women. The malfeasant conduct of scientists, medical fraternity, and industry as they appear to have joined hands in advocating and promoting, even today, the use of the Pill, the Morning-after-Pill, and extended combined oral contraceptives (ECOCs) to adolescents and young women despite serious health concerns is alarming for both immediate and long-term reasons.

Epilogue

I have highlighted a few moral, ethical and governance related issues in biomedical research and clinical application of OC and women welfare. The biomedical community of scientists, physicians and industrial partners must exhibit scientific integrity in sharing with the community at large all relevant information through 'outreach programmes'. Scientists working in these fields can help to educate on the dos and don'ts of these steroid based interventions by addressing students in schools and colleges and at public meetings as well as in the media.

We note with great interest the introduction of the Café Scientifique, a grassroots public science initiative in Bangalore (www.cafescientifique.in/about) based on the French Café Philosophique model aiming to demystify scientific research for the general public and empower non-scientists to more comfortably and accurately assess science and technology issues, particularly those that impact on social policy making. More such movements are the need of the hour in all urban and rural spaces to really break through the barriers that exist between scientists, health caregivers, governmental policy makers, industry partners and the common man towards vanquishing vested profit interests at a lower strata and achieving the higher goal, 'Health for All'. □

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Research Funding for Cow Urine and Panchgavaya at the Cost of Basic Science

Pradip K Datta*

RECENTLY Pragya Singh Thakur has claimed that drinking cow urine cured her cancer. "I was a patient of cancer and I cured myself by consuming gaumutra and panchgavya mixed Ayurvedic herbs," she told India Today TV. Since she was a candidate from Bhopal Parliamentary constituency and now an elected member of the Parliament, her statement may influence many people. That is why it is necessary to examine whether her claim has any scientific basis.

The claim has not been substantiated

While she claims cow urine cured her cancer, Dr. S.S. Rajput, a surgeon at the Ram Manohar Lohia Institute of Medical Sciences in Lucknow, confirmed that he had performed three surgeries on Thakur's breasts to remove the cancer. Dr. Rajput said, "I operated on her first in 2008 at the Mumbai's JJ Hospital when she had developed a tumour in the right breast. At that time, the report of the tumour was inconclusive. In 2012, the tumour recurred," The second surgery was at a private hospital in Bhopal and it removed one third of her right breast with the tumour. The third surgery and the bilateral mastectomy were carried out at his hospital in Lucknow. In 2017, Dr. Rajput spoke to the media after the surgery saying: "The tissues in both her breasts have been removed with consent so that there are negligible chances of cancer relapse" (The Hindu, 26.4.19).

Cow urine has no usefulness

That cow urine has no usefulness in treating cancer has been corroborated by senior oncologists of the country. For example, the Director of the Tata Memorial Centre, Dr Rajendra Badwe, one of the seniormost breast cancer surgeons in the country, said that there has not been a shred of evidence to show that cow urine or other such products were remotely useful in cancer treatment. "There are no studies to support such claims. Only radiotherapy, chemotherapy and now immunotherapy are accepted worldwide as scientific treatments for breast cancer," Badwe said. Badwe and his team said that such claims could "mislead" people.

Dr. Pankaj Chaturvedi, Deputy Director of Tata Memorial Centre and senior head and neck oncology surgeon, said, "Such statements can misguide cancer patients who reach out to hospitals only at advanced stage of their disease." Dr. Shripad Banavali, Academics Director of the Centre, who has published several research papers on breast and paediatric cancer, said breast and blood cancer are highly treatable but with proven scientific treatment. "If someone claims that gau-mutra cures breast cancer, can they prove this through any study?" he questioned. Dr. Sultan Pradhan, top surgical oncologist of Prince

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Aly Khan and Breach Candy Hospitals, said claims like that of Thakur should not be endorsed. "Every day, I see patients who go for such non-evidence based treatment and by the time they reach the hospital, it's too late," he said.

The claim has brought back to the fore the issue of whether medical science in our country will be governed by myths or by evidence-based ideas. Some claim a variety of beneficial effects of consuming cow urine. However, there is no evidence in support of the claim. Further, any item marked for human consumption must first undergo tests that prove it is both useful and harmless, more so with products labeled medicinal. This hasn't been the case.

Our body has an elaborate system to make use of whatever is needed and to excrete those materials that are either unnecessary or harmful. It is common knowledge that part of the food that we eat is digested and the rest is excreted through the gastrointestinal tract. Waste products generated during the metabolism of the 'useful' food is filtered through the kidneys and passed out as urine. Because most mammal excretory systems work this way, the chemical composition of the urine they produce is also essentially the same. Cow urine is not much different from human urine, so it is hard to believe drinking one is good for health but drinking the other is disgusting.

The ideas backing the use of cow urine and 'panchagavya' (a concoction of organic products derived from the cow – milk, curd, clarified butter, dung and urine) belong to a belief system, not science. The Department of Animal Husbandry, Dairying and Fisheries and 22 departments of the Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana – ranked first among 14 state veterinary universities in the country, according to the Indian Council of Agricultural Research in 2016 – have no information on record about the usefulness of cow urine. On the other hand, some studies have suggested consuming cow urine can have toxic effects as well as precipitate infections and serious health problems.

Claims have no scientific evidence

On July 3, 2018 a research team consisting of Assistant Professors Shraddh Bhatt and Rukamsinh Tomar and research fellow Kavita Joshi at Junagadh Agricultural University (JAU), Gujarat, claimed that they have succeeded in killing cancer cells using cow urine. They claim that cow urine can cure most types of common cancers such as those of mouth, cervix, lungs, kidney, skin and breast. "Chemotherapy kills healthy cells too while cow urine only kills infected cells," Tomar said (TOI 3 July, 2018). Their study does not exhibit the use of a proper methodology nor does it appear to have passed peer review.

The Government of India, led by Shripad Yesso Naik, the Minister of State for AYUSH, has been promoting traditional medicines. Much the AYUSH Ministry's thrust has been through efforts to promote the use of cow urine as a form of medication. According to a PTI report on November 25, 2016, Naik said in a statement that "the Council of Scientific and Industrial Research (CSIR), through its constituent laboratories, has conducted research studies in collaboration with Go-Vigyan Anusandhan Kendra, Nagpur, on cow urine distillate for its antioxidant and bio-enhancing properties on anti-infective and anti-cancer agents and nutrients". This raises many concerns and though some may seem downright funny, they do present some awful consequences:

1. No transparency – The Ministry of AYUSH, despite its ostensible support for these forms of medicine, has made

little effort to publish research it funds in peer-reviewed journals, put up its findings in the public domain or submit to public peer-review/data-validation. It hasn't mandated any healthy practices either, leading to an abundance of 'studies' with little or no merit.

2. Patents instead of papers – The Ministry of AYUSH's announcements in the media are often accompanied by claims that so-so patents have been received. While patents signify uniqueness, they don't mean the patented object is useful to the human body. Such a thing has to be proven scientifically. Moreover, some claims do not hold up when followed up. For example, in the case of the purportedly anti-diabetic drug BGR-34, developed by CSIR and commercialised by the Ministry of AYUSH, no patents were found to have been granted for the formulation even though officials had claimed that they had been.

3. Loss of resources – In October 2015, the Government of India drastically reduced the CSIR's budget and asked the various Centres to make up the remaining amount by themselves through product realisations. They were also asked to redirect their focus towards social-sector technologies (including research on cow urine). This move effectively amounted to a funding cut of about Rs 2,000 crore, through which many of the CSIR's 38 centres lost the ability to conduct robust and reliable research.

4. Research protocols – The Ministry of AYUSH has displayed an apparent disdain for the established methods of scientific investigation. The Council for Scientific and Industrial Research (CSIR) recently launched BGR-34, an anti-diabetic, ayurvedic drug designed for Type 2 diabetes – diabetes mellitus. Developed jointly by the National Botanical Research Institute (NBRI) and the Central Institute for Medicinal and Aromatic Plants (CIMAP), it claims to control blood sugar and enhance metabolism. However, the manner in which BGR-34 is being promoted leaves many questions unanswered. Sanchit Sharma, Executive, AIMIL Pharmaceutical, the commercial producer and distributor of the drug, said that it is for the first time that an ayurvedic medicine is being launched, which has been researched and "scientifically validated" and meets "allopathic standards".

Surprisingly, BGR-34 finds no mention in any peer-reviewed journal. "Clinical trials of the drug have been performed by AIMIL and have shown a 67% success rate, according to the data provided by them, which is significant," says S.K. Rawat, Assistant Director, CSIR. However, Clinical Trials Registry, India (CTRI), a registry of all the clinical drug trials in India, does not list any of these rials. The duration of the research has been reported differently in different documents, ranging from 18 months to five years, sometimes stretching to seven years. The number of people BGR-34 has been tested upon is inconsistent, too, ranging from 100 to 1,000 people. The fact that neither of these studies are verified or published in peer-reviewed scientific journals raises more questions. Officials claimed phase III clinical trials had been conducted with 48 patients at the Agarwal Hospital OPD in New Delhi. However, the Drugs and Cosmetics Act requires phase III trials for allopathic medications to be conducted with at least 500 people in multiple centres. So, the researchers' claim that their tests conformed to 'allopathic standards' was simply not true.

5. An unspecified substance – Naik's statement (which PTI reported) suggests the existence of a substance distilled out of cow urine that can enhance the activity of anti-bacterial agents. There are at least three US patents associated with this description: 6410059, 6896907 and 7235262. But the substance's chemical composition has not been specified.

6. Perilous prescription – The patent is suggesting that cancer and multi-drug resistant TB patients consuming the distillate along with their medication can reduce the dosage of their medication and still reap positive results. This is a perilous suggestion that could take many lives, and endanger India's already painful efforts to combat the rise of drug-resistant TB.

National Programme to Study Concoctions of Cow Excreta

Cow science, or "cowpathy", as it has been termed by Hindutva ideologues, is in for a new national level makeover. In April 2017 it was elevated to the status of a major agenda for national level scientific research cutting across many scientific departments and national laboratories.

On April 25, 2017 a national programme for 'Scientific Validation and Research on Panchgavya (SVAROP)' was initiated by the DST, the Department of Biotechnology (DBT) and the Council of Scientific & Industrial Research (CSIR), in collaboration with IIT-Delhi. A 19-member National Steering Committee (NSC) was constituted to validate :

1. Uniqueness of indigenous cows
2. Panchgavya for medicine and health
3. Panchgavya and its products for agriculture applications
4. Panchgavya for food and nutrition
5. Panchgavya based utility products.

The committee is chaired by Dr Harsh Vardhan, the Union Minister for Science, Technology and Earth Sciences, and co-chaired by Vijay P. Bhatkar, Chancellor of Nalanda University, as well as the National President of Vijnana Bharati, an NGO linked to the Rashtriya Swayamsevak Sangh and seen as engaged in pushing the Hindutwa agenda on the science and technology front. Other members in the NSC include R.A. Mashelkar, the former Director-General of the CSIR; the secretaries of DST, DBT and the Ministry of New and Renewable Energy (MNRE); the Director-Generals of CSIR, ICAR, ICMR and the Central Council for Research in Ayurvedic Sciences (CCRAS), the Director of IIT-Delhi, the Secretary of Vijnana Bharati, A. Jayakumar; and Sunil Mansighka of the Go-Vigyan Anusandhan Kendra (GVAK), Nagpur.

It is clear from the discussions above that cow urine and 'panchagavya' have no utility in treating cancer or any other disease, and yet the Union government is giving much stress on the research on cowpathy and allotting generous funds for the purpose while it is curtailing funds for basic research. It is very unfortunate. □

Organisational News

May 4, Global March for Science: Scientists express what they expect of the new government

The following statement was released on 4 May 2019 in Press Meets and demonstrations held across the country.

THE INDIAN scientific community and science enthusiasts across India express solidarity with scientists all over the world who will be marching on the streets of all the major cities on May 4, 2019. They are coming out to defend science, because the progress of civilization depends on the progress of science.

The mission statement of the Global March for Science is as follows "The March for Science champions robustly funded and publicly communicated science as a pillar of human freedom and prosperity. We unite as a diverse nonpartisan group to call for science that upholds the common good, and for political leaders and policy makers to enact evidence-based policies in public interest".

The policy makers of these countries are undermining the role of science in modern society by systematically ignoring scientific data on the status of the planet – the only home for humanity. The greed for maximum profit is causing unrestrained exploitation of natural resources and emission of toxic substances into the environment, driving the planet to the brink of a cataclysmic climate disaster. Scientists are demanding their respective governments to take all necessary steps to save the planet.

The Seminar and Press Meet in Delhi on 4 May. Prof. Dhruv Raina of JNU addressing the gathering.

In most countries the governmental support for science is dwindling, driving scientific research in universities and institutions into deep crisis. Scientists are demanding that governments provide adequate financial support to scientific and technological research, so that science can play its role in onward development of the society.

The attacks on science have become a global phenomenon and are affecting science in India as well. However, we are not able to hold the March for Science on May 4, 2019, because the day falls in the middle of the General Election. However, on this day, we take this opportunity to

The demonstration in Hyderabad in support of the Global March for Science on 4 May.

put forth what the scientific community in India expects of the political dispensation that comes to power through this election.

One of the many problems plaguing science in India is that there has been an alarming rise of institutionalised propagation of unverified claims as science. The Indian Science Congresses bear testimony to this fact. Many myths about ancient India are being foisted on people as scientific facts. This is undermining the constitutional obligation to cultivate scientific temper. Whichever government comes to power should refrain from these attempts to undermine science. Science demands evidence before believing anything. We are happy to note that the protests that were held opposing the claims made in the Indian Science Congresses have yielded a positive result. In a resolution, the Indian Science Congress Association has decided to obtain in advance the abstracts of the lectures of all speakers, especially those speaking at the Children's Science Congress, and to remove the speakers from the dais if they go beyond the purview of the submitted abstracts.

Secondly, with less than 3% of the country's GDP being spent for education, it has been seriously neglected resulting in a large fraction of the population remaining illiterate or semi-literate even after 70 years of Independence. The government-run schools and colleges have been most neglected resulting in rampant commercialization of education and deterioration of educational standards. We demand that the next government should spend at least 6% of the GDP on education, the desirable figure being 10%.

Thirdly, successive governments have neglected science, spending less than 0.8% of the GDP on scientific and technological research. All scientific and technological institutions are in deep financial crisis, leaving very little resources for proper scientific research. If India is to prosper economically and is to claim a leading position in the world of science and technology, at least 3% of the GDP should be spent on S&T research.

Fourthly, following a meeting of the Secretary Higher Education, of the Union Ministry of Human Resource Development, Chairman, University Grants Commission and the Vice-Chancellors of the 11 Cen-

The demonstration in Kolkata in support of the Global March for Science on 4 May.

tral Universities, held on December 15, 2018, the MHRD has issued a directive to the Central Universities to "discourage research in irrelevant areas" and to ensure that PhD topics "should be in accordance with the national priorities". This is totally against freedom of pursuit of knowledge and development of free thinking. It curbs academic autonomy of the institutions which undertake research and is thus naked intervention upon academic freedom of teachers and researchers.

Finally, we urge that the coming government should pay heed to scientific data and should base its decisions on scientifically informed advice. The science and technology Academies should be involved in the decision-making process in the issues that affect peoples' lives.

On these and other important issues concerning the development of science in our country, we plan to organise an 'India March for Science' on August 9, 2019 to stand up for science and to press our demands.

Demonstrations to express solidarity with the Global March for Science

The Indian scientific community and science enthusiasts across India expressed solidarity with the May 4 Global March for Science to defend science and scientific temper.

As the day of 4th May fell in the middle of the General Elections, big Marches could not be orgtanized in the Indian cities. However, in several cities and towns across the country, programs in support of the Global March were organised.

Delhi: In the capital city a seminar-cum-press meet was organized on May 4 at the N D Tiwari Bhawan, ITO, New Delhi to express solidarity with the Global March for Science. Dr Raghunandan (Director, CTD, New Delhi), Prof Dhruv Raina (JNU) and Prof Soumitro Banerjee (Gen Secretary, Breakthrough Science Society) explained the issues being raised through the global march for science. The program was organized by March for Science, Delhi Organising Committee.

Kolkata: Demonstrations were held in

front of Calcutta University and Presidency University. Prof Amitava Dutta (President, BSS, WB State Committee), Prof Dhurbajyoti Mukhopadhyay (President, BSS All India Committee) and several others addressed the gathering of researchers, students, teachers, and science loving people.

Bengaluru: A seminar on 'Women in Science' was organized at K L E College, Rajajinagar, Bengaluru on May 4, in solidarity with the Global March for Science. The panelists included Prof Jayant Murthy (Acting Director, Indian Institute of Astrophysics), Ms Rajani K S (Secretary, BSS, Karnataka), Prof Prajval Shastri (Senior Astrophysicist), Prof Sumati Surya (Professor, Raman Research Institute), Mr G Sathish Kumar (President, BSS, Karnataka), Dr Sudha Kamath (Retd. Plastic Surgeon), Prof S Chatterjee (President, AIPSN) and Dr Jyotsana Dixit (Science Writer).

Chennai: On May 4, a People's Meet in solidarity with the Global March was organised at the Elliots Beach, Besant Nagar, Chennai. Scientists, researchers, students and science enthusiasts participated in the meet. Mr Ilango Subramanian (Newton Science Club) and Dr Uma Ramachandran (Convener, March for Science Chennai Organising Committee) addressed the gathering.

Hyderabad: Breakthrough Science Society, Jana Vignana Vedika (AIPSN) and OYSTER (NGO) jointly organised a Science March on May 4 from NCC gate to the Science Block at Osmania University, Hyderabad. Prof Adinarayana (JVV President), Mr R Gangadhar (BSS Convener), Dr K Babu Rao (Former Scientist, IICT), Prof Satyaprasad (Osmania University), Dr Bapuji (Scientist, CCMB) and Sri Varaprasad (Secretary, JVV) addressed the gathering.

Ahemedabad: Universe Science Forum (USF) organised a meeting in support of the Global March for Science on May 4 at the Narmad-Meghani Library, Ahmedabad. Shri Prashantbhai Joshi, Mr Kishan Malaviya, Mr Jahaan Thakkar, Dr A R Prasanna (Retd. Scientist, PRL) and Dr Raghavan Rangarajan (Professor, Ahmedabad University) spoke in the meeting.

Agartala: BSS Tripura unit organised a demonstration at the City centre in support of the global march for science.

Darjeeling (North Bengal): A rally and a street drama were organised in front of North Bengal University.

Dhupguri (Jalpaiguri): A demonstration was held at Dhupguri in support of the global march.

Namchi (Sikkim): A convention on 'Climate change' was organised on May 4 by the Namchi Science Club affiliated to Breakthrough Science Society.

Alappuzha (Kerala): A science march was taken out on May 5 at Alappuzha town in solidarity with the global march.

Guna (Madhya Pradesh): A discussion on the topic "Science in today's scenario" was organized by BSS Guna unit on May 5 in solidarity with the global march for science.

Other programs

Kerala

G S Padmakumar memorial public lecture on 'Science and Society'

The BSS Kerala chapter has instituted a public lecture programme in honour of Mr. G S Padmakumar, former president of Breakthrough Science Society, Kerala chapter, who had played a very significant and leading role in building up a new science movement in Kerala. The first lecture was organised on the occasion of his first death anniversary on April 28, 2019 at

The G S Padmakumar memorial lecture in Thiruvananthapuram. Prof. Liaquat Ali speaking on 'Science and Renaissance – European and Indian contexts'.

the seminar hall, Priyadarsini Planetarium, Thiruvananthapuram. The invited speaker was Dr Liaquat Ali, former Vice-Chancellor, Bangladesh University of Health Sciences, Dhaka.

Speaking on the topic titled 'Science and Renaissance – European and Indian contexts' he opined that, unlike the European renaissance, the Indian renaissance could not be carried to its culmination, resulting in weakness in developing scientific outlook among people. As a result, various kinds of superstitions, casteism and communalism could not be eradicated from society. This has created a favourable ground for widespread misuse of religion in politics, a sign of regression in the Indian subcontinent. The lack of scientific outlook is also reflected in the unbridled consumerism at the cost of environment, ideology and ethics. Realising that the Indian renaissance remained an unfinished revolution we all have the responsibility to fulfil its unfinished tasks.

The talk was followed by lively interactions with the audience. Dr. P S Babu, President, BSS Kerala Chapter, presided over the meeting. Dr. T K Shajahan (BSS NEC member), Prof. K P Saji (Vice president, BSS Kerala chapter), Dr. P P Rajeevan (BSS NEC member), Mr. Shaji Albert and Ms Medha Surendranath (both executive committee members of BSS Kerala chapter) also spoke in the meeting attended by a large number of people from different parts of Kerala.

West Bengal

March 13 – A seminar was organised by the BSS Panskura College chapter on the topic 'Astrology and Astronomy'. Mr. Surajit Saha spoke on the occasion. Sky watching was also conducted.

March 14 – Einstein Day was observed at Belda, West Midnapore by Belda Science Forum.

March 27 – Bandwan Science and Cultural Centre, Purulia along with the Kangsavati (South) Forest Department organised a campaign at Bandwan and its nearby places in order to protect the wildlife of our country. The importance of protecting

forest and its wild lives was explained to the local people.

May 12 – A science exhibition and a seminar was organised at Saktigarh, Darjeeling, by the local BSS unit. 'Hands on Experiment' was conducted. A new science club was formed at Saktigarh.

May 14 – Inter school Science Quest was organised by S.N. Bose Science Club, Asansol. An organising committee was also formed through this programme.

May 19 – Seminar on Einstein was organised at Dantan, West Midnapore.

June 1 – 'Hands on Experiments' was organised at Krishnanagar, Nadia by Krishnanagar Science Centre. A discussion on the significance of the World Environment Day was also conducted by Mr Avijit Mondal.

June 5 – World Environment Day was observed by various affiliated Science Cubs of BSS. Programmes like planting saplings, eradication of poisonous shrub 'Parthenium', discussions, poster campaigns and processions were organised. More than 25 science clubs spread all over the state organized such programmes.

June 9 – Sky watching programme was jointly conducted by the BSS Tarakeshwar Unit and a discussion on 'Science and Scientific Outlook' was conducted by Mr Somnath Pal (Secretary, BSS, Tarakeshwar Unit)

Telangana

A children's science camp was organised at Pallavi International School, Hyderabad from May 24 to 26.

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Karnataka

BSS in association with Raman Science Club organized a sky gazing program at Priyadarshini Vidya Kendra, Kengeri on Feb 15 2019. Mr Bharath and Ms Dipti conducted the program.

A summer camp was organized at Tumkuru on 14 May 2019. Ms Lakshmi B V demonstrated simple science experiments covering principles in physics and chemistry to arouse curiosity in the children.

Sky gazing programs with the help of a demonstrable Dobsonian telescope were organised at Vivekavardhini High School, Prakash Nagar and at Govt. High School, Kanakpura, in the month of March. Mr Anand Raj conducted the programs.

Jharkhand

On the occasion of the World Environment Day on June 5, about 200 plants were planted in different areas of Ghatashila by the Einstein Club. Environmental enthusiasts and students took part in the program actively. About 10 varieties of plants were planted. The Bokaro chapter of BSS also organised environmental awareness programs on the day.

Delhi

On 20 February, the BSS Delhi Chapter organized a seminar on "Science and Scientific Outlook" at the Vivekananda School, Narela. Mr Dinesh Mohanta, member of BSS all India Committee was the main speaker.

On 21 February another seminar on the same topic was organized in the Brahma Shakti Public School, Rohini. Mr Vinay Kumar, in-charge, BSS Delhi Chapter was the main speaker. The documentary "Cosmos" was also shown.

Both the programmes were attended by more than 150 students and teachers.