EVERYMAN'S SCIENCE

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EDITORIAL

CHALLENGES OF GLOBAL WARMING

Global warming is one of the most formidable challenges facing the mankind. This term refers to earth's climate change occurring as a result of external forces such as atmospheric greenhouse gas concentrations, volcanic eruptions and variations in the orbit of earth around the sun. In simple terms 'Global warming' is defined as the increase in the average temperature of the Earth's near-surface air and oceans in recent decades and its projected continuation. It is estimated that during last hundred years ending in 2005, the average air temperature of the globe near the earth's surface rose 0.74 + 0.18 C (1.33 + 0.32F). The UN agency, the Intergovernmental Panel on Climate Change (IPCC) has concluded "most of the observed increase in globally averaged temperatures since mid-twentieth century is very likely due to the observed increase in the anthropogenic greenhouse gas concentrations" through greenhouse effect. The contribution due to the solar variation and volcanic eruptions is small.

The greenhouse effect was discovered in 1824 by Joseph Fourier and studied quantitatively by Arrhenius in 1896. In this process the planet's lower atmosphere and surface is warmed up due to the absorption and emission of infrared radiation by atmospheric gases. On earth greenhouse gases are water vapor, carbon dioxide, methane, nitrous oxide and ozone. The greenhouse effect produced by them is water vapor 36-70%, carbon dioxide 9-26%, methane 4-9%, ozone 3-7%. If compared quantitatively at the molecular level, then methane is a more effective greenhouse gas than carbon dioxide, but due to its smaller concentration its effect is only about one fourth of that of carbon dioxide. Since the beginning of industrial revolution in the mid-1700 the atmospheric concentration of carbon dioxide and methane have increased by 31% and 149% respectively. These levels are much higher than at any time during the last 650,000 years, the period for which reliable data has been extracted from ice cores. Fossil fuel burning has been responsible for about three quarters of the increase in carbon dioxide from human activity over the past 20 years.

Although it is difficult to correlate specific weather phenomena to global warming, an increase in temperature may in turn cause broader climate change events such as more hurricanes, cyclones, snowstorms, heat waves, tornados, droughts, and storms fed on warm weather. Some records indicate that glaciers have been retreating since early 1800's. Though measurements began in 1950 which allowed the glacial mass balance. Increase in warm weather will result in melting of glaciers and ice caps which in turn will raise the ocean levels to cause flooding in coastal areas putting some cities in danger. Sea level flooding of coastal areas will increase salinity and the crops will suffer. It is estimated that 1°C rise in temperature of bottom of sea level at North (Arctic ocean) and South pole (Antarctic ocean) will attract king crabs and sharks who will be a danger to the food chain of polar bears, penguins and walrus and will put their existence in peril. Warmth in other rivers will promote breeding grounds for more insects and bacteria harmful to health.

In a recent World Development Report—2008, the World Bank said that climate change would haev far reaching consequences for agriculture, which would disproportionately affect the poor. Greater risk of crop failures and livestock deaths have begun causing ecomic losses and undermining food security and the impact would become more severe as global warming continues. In tropical countries a rise in temperature by 1°C could prove fatal for wheat and maize and a 2°C can lower rice productivity. However, the crop productivity in the temperature zone in many developed countries would increase. But if the temperature increases by 3°C the loss of yield would be widespread. In parts of Africa, Asia, and Central America yields of wheat and maize would decrease by 20% to 40%.

The concept that bio-fuels will decrease the consumption of fossil fuels thus resulting in the reduction in greenhouse gases requires careful consideration. Current share of bio-fuels is around 1% which is proposed to be increased up to 5% by the year 2020. The World Bank has admitted the competition between food and fuel crops for land and water and has asked the national governments to carefully assess economic, environmental and social benefits. The maize required to fill in the tank of a sports utility vehicle with ethanol (240 Kg of maize for 100 litre of ethanol) is sufficient to feed one person for a year. Thus the competition for land and water between food and fuel is real.

Global warming as a phenomenon affects all the nations and touches the whole humanity. The dangers of rising temperature, melting polar ice, deteriorating drought conditions and floods and intensifying heat waves have created keen interest among the nations of the world for finding some solution of the problem. Without taking an alarmist view, it is important for the U. S., big developing countries and European Union to come forward to find an quitable solution. It is also desirable that the public awareness and compulsory education is taken as a mission for the mitigation of the effects of global warming.

Sarvagya S. Katiyar

All of science is nothing more than the refinement of everyday thinking

— Einstein

PRESIDENTIAL ADDRESS

NITROGEN PROBLEM

N.R. DHAR,
D.SC. (LONDON), DR. ES SCIENCES (PARIS), F.R.I.C. (LONDON), F.N.I. F.N.A.S.C

INTRODUCTION

In the Sixth International Soil Science Congress held in Paris in 1956 where representatives of 51 nations considered the problems of soil fertility improvement, Dr. P. Bruin, Director of the Soil Fertility Institute at Gröningen, Holland, moved that experiments by applying heavy doses of nitrogenous fertilizers should be undertaken on an international scale in temperate climates. On opening the discussion I stated at follows : "I think that the resolution of Dr. Bruin is inconsistent because he wants international cooperation but restricts it to nations living in temperate countries. In this resolution the words "temperate countries" should be omitted. Asia, Africa and South America where the majority of human beings of the world subsist, require the application of Science for crop production much more than Northwest Europe and North America. Hence all nations should be invited in this international cooperation. The plan should not be restricted to the temperate country soils. Moreover, as all soils contain organic matter, the proposed scheme should include investigations on a mixture or organic matter with inorganic fertilizers". Also Dr. V. Ignatieff, Soil Specialist of the F.A.O., who followed me made the following statement : "Dr. Dhar of India has raised the question of international cooperation in field experimentation on soil fertility outside the temperate climate. He underlined the need for this cooperation in the tropical countries especially in regions where the greater part of the population resides. I would like to bring to the attention of the meeting the work of the International Rice Commission organised by the F.A.O." After some discussion Dr. Bruin withdrew his resolution.

As I sincerely believe that the sound progress of our nation depends essentially on Science and its applications and I have preached this gospel for over 40 years, I am extremely keen on seeing Indian scientists taking up this matter of national regeneration through Science with hard labour, great fortitude, devotion and sacrifice. I am here at your service as President of the Indian Science Congress and happy to join your ranks and grateful to you for inviting me.

In the elementary state nitrogen is a colourless, odourless and almost inert gas which forms 80% of the air we breathe. Over each acre of land the air contains a supply of 35000 tons of nitrogen.

Very appropriately nitrogen has been designated at the "growth element" in plant and animal nutrition. It is present in chlorophyll, proteins and many other compounds essential to plant and animal life. An adequate supply of nitrogen is absolutely essential for growth and reproduction in both plants and animals. Along with carbon, hydrogen, oxygen

* General President, Forty-eight Indian Science Congress held during January, 1961 at Roorkee.

and frequently with phosphorus and sulphur, nitrogen forms a vital component of every living cell and a necessary part of plant and animal tissues. Without nitrogen life is an impossibility.

Except for leguminous plants like clover, lucerne, pulses, *sann hemp*, etc., free nitrogen is no plant food. Nitrogen must be combined with other elements, that is, it has to be fixed before it can serve as a fertilizer or a nitrating agent in the manufacture of dyes, drugs and explosives. Because of the great value of nitrogenous compounds in agriculture and industry, the nitrogen fixation industry in many countries is as important as the coal or steel industry.

It is generally believed that cultivation of food crops was begun by man 10,000 to 12,000 years ago. The value of animal manures was discovered when nomadic man with his animals first settled down and began agriculture and used the dung of his animals for fertilizing land. Man has utilized and frequently wasted the fertility of land created by the leaves of forest trees and by growing grasses. Legumes seem to have been used in land fertility improvement from ancient times. In the Greco-Roman period, the legume lupin was frequently grown for improvement in crop production.

It is of interest to record that from ancient times two viewpoints have been advanced regarding the materials useful in plant nutrition. Bernard Palissy(1510–1589), Bacon (1561–1626), Glauber (1604–1668), Boyle (1627–1691) and especially Liebig (1803–1873) were supporters of the theory, first emphasised by Paracelsus (1493–1541) that salts were the true nutrients of plants. On the other hand, there were several distinguished scientists, notably Home (1719–1813), Wallerius (1709–1785), Thaer (1752–1828), N. T. de Saussure (1767–1845), Davy (1778–1829), De Candolle (1778–1841), Berzelius (1779–1848), Mulder (1802–1884) and others, who were advocates of the Aristotlean doctrine of plant nutrition by soil organic matter.

A. Lavoisier (1743–1794), the founder of Chemistry and Physiology, was impressed by the value of growing grass in improving the fertility of land. He also studied the operation for nitre beds of soils rich in organic matter undergoing decomposition.

It has been stated that Sir Kenelm Digby reported in 1665 that he had obtained increased crop yield by using saltpetre, but the Science of crop fertilizing began when in 1804 N. T. de Saussure analysed plant ashes and reported that the chemicals present in the ashes were derived from the soil. This work of de Saussure was quantitatively verified and extended by J.B.D. Boussingault (1802–1887) in his experimental farm in Alsace i 1830. Baron Justus von Lielbig's great credit is his marked emphasis on the necessary of providing plants with phosphates and potash, but he failed to grasp the essential value of nitrogenous compounds in crop production and this was proved in Rothamsted by Lawes, Gilbert and Pugh in 1857.

Bones are known to have been used for fertilizing in England in the 17th century to the extent of even 1 ton per acre. In this connection Liebig wrote as follows. "England is robbing all other countries of the condition of their fertility. Already in her eagerness for bones she has turned up the battle fields of Leipzig, of Waterloo and of the Crimea; already from the Catacombs of Sicily she has carried away the skeletons of many successive generations".

Guano, the excrement of sea fowl, turtle and seal are found in many parts of the world and the largest deposits occur in Peru. It has been stated that guano was used in Europe in cultivation since the 12th centruy. Bones and guano are rich in calcium phosphates and nitrogenous compounds.

Deposits of the nitrates of aluminium, ammonium, barium, calcium, copper, iron, magnesium, potassium and sodium exist in various localities but those of sodium and potassium are commercially important. Small deposits of sodium nitrate are known to exist in Egypt, Argentina, Colombia, South-west Africa, Mexico and the U.S.A., but the largest deposits are in Chile in the desert of Atacama and Tarapaca. The layer known as *costra*, which covers the surface of the Tarapaca Plateau, consists of sand and gypsum with a small amount of calcium phosphate. The next layer of deposit *congels* is chiefly gravel and clay with a high percentage of sodium chloride. The third layer forms the nitrate known as *calliche* with the following average composition :

Sodium nitrate	8–25%
Potassium nitrate	2–3%
Sodium chloride	8–25%
Sodium sulphate	2–12%
Calcium sulphate	2–6%
Magnesium sulphate	0–3%
Sodium biborate	1–3%
Sodium iodate	0.05–0.1%
Sodium perchlorate	0.1–0.5%
Insoluble matter	23–70%

NITROGEN INDUSTRY

A very eminent English scientist but an eccentric man The Honorable Henry Cavendish (1731–1810) laid the foundation of the nitrogen industry in 1781 by preparing nitric acid on passing electirc discharge through air. Physicists have calculated that approximately 100 million tons of nitrogen are converted into nitric acid by electric discharge in the earth's atmosphere annually but only 6 to 10 million tons of nitrogen fall on the 5000 million acres of land under cultivation in the whole world. This pioneering work of Cavendish or nitrogen fixation remained dormant for over 100 years till Sir William Crookes (1832–1919) emphasised in his Presidential Address to the British Association for the Advancement of Science in 1898 the importance of the nitrogen fixation industry in avoiding starvation facing humanity due to the rapid growth of population. The great German chemist W. Ostwald (1853–1932) in 1904 brought out another facet of the industry by insisting on the manufacture of nitric acid in Germany to fight the British Nation. Professor Ostwald and his son-in-law, Dr. Brauer, manufactured nitric acid by the oxidation of ammonia obtained from German coal and lignite, in presence of platinum by air, but soon realised that the costly catalyst platinum was ruined by the impurities in the coal ammonia. He appealed to his pupils to prepare pure synthetic ammonia on a large scale. This was achieved in France on a small scale by M. Berthelot (1827–1907) and H. Le Chatelier (1850–1936). I had the privilege of working with Prof. Le Chatelier in Sorbonne, Paris during the first war and felt gratified and proud when the eminent Professor stated every year in his university lectures that the steel prepared and forged by the Indians for the Kutub Minar was of excellent quality and such steel could only be prepared in Europe centuries later.

Professor Fritz Haber (1868–1934) a great German chemist of Jewish origin under whom I worked in 1926 and 1931 in Berlin and a pupil of Ostwald toiled for years with his pupils in synthesising ammonia on a large scale and was successful through the daring initiative of the Badische Anilin und Soda Fabrik and the cooperation of industrial chemists of the calibre of Drs. C. Bosch and A. Mittasch. Today large amounts of liquid ammonia and ammonia solution are being applied in crop prodution in the U.S.A., Canada, Denmark, Norway and other countries. The Haber-Bosch process of the manufacture of ammonia forms the basis of the nitrogen industry, although modifications were introduced by G. Claude, L. Casale, G. Fauser and others. At present 7.4 million tons of nitrogen are manufactured in the whole world, out of which 85% is the direct synthesis of ammonia and 15% as calcium cyanamide produced according to the method of A. Frank (1834–1916) and N. Caro (1834–1910) two great pioneers of German chemical industry. 80% of the nitrogen consumption is the artificially fixed nitrogen, 10% from Chile saltpetre and another 10% from coal ammonia.

After the second world war countries like the U.S.A., Canada. etc., had very large stocks of synthetic ammonia which had to be utilised by decomposing it to supply hydrogen to the hydrogenation industry.

About 75% of the 2 million tons of nitric acid at present manufactured in the U.S.A., go to fertilizer, 15% to explosives, and 10% to dyes, fibres and plastics. Increasing application of ammonium nitrate as explosives in open pit mining, quarrying and construction jobs, use of fuming nitric acid, nitrogen tetroxide (N_2O_4) and tetranitro methane used in rockets and missiles increase the demand of nitric acid. Various modifications in the manufacture of nitric acid by ammonia oxidation such as the Atmospheric Pressure process, Complete Pressure process, have been introduced with high temperature oxidation, e.g. 1650°F as in the Complete Pressure process of Dupont and 1500°F in the Montecatini process. The Fauser Process and Bamag-Meguin process of Germany produce concentrated nitric acid by ammonia oxidation to nitric oxide and further oxidation to nitric peroxide.

In recent developments air is heated to 4000°F according to the Wisconsin Process when fixation takes place. Then the mixture is rapidly cooled. The reaction is carried on in a pebble furnace. The effluent gases contain 1.8–1.9% nitric oxide.

Recently nitrogen fixation has been obtained by nuclear energy according to the method of Hartek and Dondes. 10 to 15% nitric oxide is produced by exposing compressed air to radiation from uranium 235. Hartek assumes an overall efficiency of 50% and indicates that one mole of 20% enriched U_{235} can produce 70 tons of fixed nitrogen or 258 tons of 100% nitric acid. The fixed nitrogen sells at 10,000 dollars while the cost of U_{235} is 6000 dollars.

The Cavendish method of nitric acid manufacture by electric discharge was developed by Lord Rayleigh in isolating argon from air in 1893 and commercially worked out by the Norwegian Physicist, C. Birkeland and Engineer S. Eyde who donated his income to research work. But only 1 to 2% of the electric energy is utilized in the production of nitric acid and hence the arc method has been completely abandoned all over the world being inefficient. Even the Haber-Bosch method has the efficiency of 8—10%. Consequently the price of nitrogenous fertilizer is double of that of phosphate and potash.

There has been successful attempts to convert air into nitric oxide in a shock tube and in single short compression machines, in each case the air was subjected to a single cycle of rapid compressional heating and expansive cooling whereupon a measureable concentration of nitirc oxide was frozen out, e.g. 0.34% at 1690°C and 0.64% at 1790°C.

NITROGEN INDUSTRY COSTLY

Although synthetic nitrogen factories have been started in industrially underdeveloped countries like Brazil, Philippines, Colombia, Egypt, Finland, Iceland, India, Israel, Mexico, Pakistan, Peru, Portugal, South Korea, Taiwan, Trinidad, Turkey, Venezuela, Yugoslovia in recent years, these countries find it difficult to meet the heavy capital investment. Different types of ammonia synthesis plants for producing 100 tons of ammonia per day cost as follows in dollars as capital investment.

	Natural gas	Fuel oil	Coal	Coke Oven gas	Catalytic reformer gas
Capital investment in dollars	39,50,000	40,98,000	42,48,000	36,20,000	29,80,000

In a recent study on "Observations on the Planned Provision of Nitrogen, Fertilizer", Professor Tinbergen and others of the Netherlands Economic Institute, Rotterdam have reported that the world demand for nitrogen fertilizer in 1960–61 is expected to be 8.1 million tons (Europe 3.1 million tons, U.S.A. 2.4 million tons and other areas 2.6 million tons). They concluded that the consumption of nitrogen per acre of land is directly proportional to the population density of the country. Moreover, in a recent publication (1957) on "Industrial uses of Nitrogen" by the European Productivity Agency of the O.E.E.C. the following lines occur : "As world nitrogen production is out-stripping the expansion of demand for traditional purposes (particularly for nitrogenous fertilizer) all producers are looking round for new outlets". Hence the amounts of chemical nitrogen used are still inadequate as the quantities of fertilizer nitrogen applied per acre in lbs. per year in 1937 were as follows : Belgium (28.5), Holland (24.8), Germany (15.6), Denmark (10.3), Norway (6.0), Sweden (5.24), Italy (4.3), France (4.0), U.K. (2.5), U.S.A. (1.36), Poland (0.73) and Hungary (0.15).

At present the consumption of nitrogenous fertilizers has increased in many countries and this is evident from the following figures indicating the nitrogen used in kilogram per hectare of land under cultivation in 1956–57; Australia (11.5), Belgium (52.5), Denmark (29.6), France (14.4), West Germany (35.1), Greece (12.1), Iceland (85.9), Ireland (3.2), Italy (14.7), Luxembourg (28.0), Netherlands (79.0), Norway (38.1), Portugal (10.5), Sweden (22.4), Switzerland (10.1), Turkey (0.4), U.K. (23.5), Spain (9.5), U.S.A. (4.2)

It has been reported that there is a shortage of chemical fertilizers in the U.S.S.R. although there are 71 plants producing fertilizers. The following figures show the nitrogen utilization in kilograms per hectare of land in some East European and Eastern countries : East Germany (31.6), Poland (10), Czechoslovakia (5), Japan (109.6), Taiwan (86.7), Republic of Korea (54.1), Ceylon (12.2), Philippines (5.6), China (2.3), Indonesia (2.0), India (1.0), Pakistan (0.3).

NATURAL PROCESS OF RECUPERATION OF NITROGEN DEFICIT BY FIXATION OF ATMOSPHERIC NITROGEN IN OXIDATION OF ORGANIC MATTER IN SOILS

From our researches carried out on the problem of atmospheric nitrogen fixation in soils by the addition of various organic compounds for over 25 years, we have come to the conclusion that these compounds not only improve the tilth, crumb formation and water retention capacity of the soil but the organic substances undergo slow oxidation in the soil and liberate energy, which is utilized in fixing atmospheric nitrogen and enrich the soil from the nitrogen viewpoint. Moreover the carbohydrates in the soil preserve the nitrogenous compounds present in the soil or added to it just as carbohydrates and fats act as protein sparers in the animal body. Some of our recent experimental results are recorded in the following tables using a Swedish clay soil collected from the fields of the Royal College of Agriculture, Uppsala 7. The soil contained 0.147 per cent total nitrogen. 1.207 per cent organic carbon, 1.19 per cent CaO, 3.114 per cent MgO, 1.2 per cent K_2O and 0.225 per cent P_2O_5 of which 0.083 per cent is available by 1 per cent citric acid extraction.

The following results were obtained recently in dishes by mixing organic matter with soil and exposing one set to artificial light for eight hours daily and another set covered with black cloth to exclude light. The moisture content was maintained at 20–25 per cent by adding distilled water every alternate day.

Table – 1. Fixation of atmospheric nitrogen in Swedish soils

	Period of Exposure (days)	Organic carbon (%)	Total nitrogen (%)	Carbon oxidized (%)	Increase in nitrogen (%)	Efficiency nitrogen in mg. per gram of C oxidized
			Swedish Soil + Sucrose			
Light	0	2.3568	0.1470	—	—	—
	150	14833	0.1656	0.8735	0.0186	21.3
	300	1.2723	0.1682	1.0845	0.0262	28.4
Dark	0	2.3568	0.1470	—	—	—
	150	1.7247	0.1554	0.6321	0.0084	13.3
	300	1.5036	0.1598	0.8532	0.0128	15.0
			Swedish soil + 0.25% P_2O_5 Gafsa rock phosphate + Sucrose			
Light	0	2.3568	0.1470	—	—	—
	150	1.4132	0.1862	0.9436	0.0392	41.5
	300	1.1518	0.1992	1.2050	0.0522	43.4
Dark	0	2.3568	0.1470	—	—	—
	150	1.6787	0.1608	0.6781	0.0138	20.3
	300	1.4612	0.1658	0.8956	0.0188	21.02

Table – 2. Fixation of nitrogen in Allahabad soils

	Period of Exposure (days)	Organic carbon (%)	Total nitrogen (%)	Carbon oxidized (%)	Nitrogen fixed (lb/acre)	Efficiency
			Allahabad soil + Wheat straw			
Light	0	0.7356	0.0492	—	—	—
	90	0.5358	0.0533	0.1998	—	20.8
	150	04762	0.0544	0.2594	—	20.6
	180	0.4365	0.0553	0.2991	117.6	20.6
Dark	0	0.7356	0.0492	—	—	—
	90	0.5866	0.0507	0.1490	—	10.6
	150	0.5417	0.0511	0.1939	43.7	30.3
	180	0.5241	0.0513	0.2115	—	10.2
			Allahabad soil + Wheat straw + 0.1% P_2O_5 as $Ca_2(PO_4)_2$			
Light	0	0.7356	0.0492	—	—	—
	90	0.4924	0.0566	0.2432	—	30.9
	150	0.4181	0.0588	0.3175	215.2	30.3
	180	0.3740	0.0602	0.3616	—	30.6

Table – 2. Fixation of nitrogen in Allahabad soils (*Contd.*)

	Period of Exposure (days)	Organic carbon (%)	Total nitrogen (%)	Carbon oxidized (%)	Nitrogen fixed (lb/acre)	Efficiency
Dark	0	0.7356	0.0492	—	—	—
	90	0.5513	0.0522	0.1843	—	16.3
	150	0.4851	0.0532	0.2505	90.0	16.0
	180	0.4652	0.0534	0.2704	—	15.8

FIXATION OF NITROGEN BY WATER HYACHINTH : (*Eichhornia crassipes*)

It is well-known that water hyachinth, which grows abundantly in India and other warm countries is a great menace. But we have observed that this material containing 2.86% CaO, 1% MgO 5.32% K_2O, 0.676% P_2O_5, 41.0% C and 2.39% N when mixed with soil can fix atmospheric nitrogen more in light than in the dark and the nitrogen fixation is increased by adding basic slag. Water hyacinth mixed with basic slag is being used as manure in

Table – 3. Fixation of nitrogen in Allahabad soil

	Period of Exposure (days)	Organic carbon (%)	Total nitrogen (%)	Carbon oxidized (%)	Nitrogen increase (%)	Efficiency
			Allahabad soil + Cowdung			
Light	0	1.7262	0.0942	—	—	—
	60	1.5077	0.0990	0.2185	0.0048	22.4
	120	1.3411	0.1044	0.3851	0.0102	26.5
	180	1.2120	0.1083	0.5142	0.0141	27.5
Dark	0	0.7262	0.0942	—	—	—
	60	1.5230	0.0970	0.2032	0.0028	13.8
	120	1.4248	0.0988	0.3014	0.0046	15.8
	180	1.2647	0.1015	0.4615	0.0073	16.0
			Allahabad soil + Cowdung + 0.25% P_2O_8 as Tata basic slag			
Light	0	0.7125	0.0925	—	—	—
	60	1.0373	0.1208	0.6752	0.0283	41.9
	120	0.9486	0.1249	0.7641	0.0321	42.0
	180	0.9232	0.1279	0.7893	0.0354	44.8
Dark	0	1.7125	0.925	—	—	—
	60	1.3713	0.0984	0.3412	0.0056	17.5
	120	1.2974	0.1010	0.4151	0.0085	20.3
	180	1.2277	0.1030	0.4848	0.0105	21.7

different parts of India and in Florida in rice production. The following nitrogen fixation results are given in Table 4.

of the carbonaceous compounds, there is increase of total nitrogen in all these experiments. When these systems are illuminated by sunlight or artificial light, the light is absorbed by the systems

Table – 4

	Period of exposure in days	Organic carbon (%)	Total nitrogen (%)	Efficiency, that is, the amount of nitrogen fixed in milligrams per gram of carbon oxidized
Soil + Water hyacinth (1.5% carbon) (Temperature at 28°)				
Light	0	1.7305	0.1272	—
	60	1.1308	0.1424	25.3
Dark	0	1.7304	0.1272	—
	60	1.3846	0.1335	18.2
Soil + Water hyacinth (1.5% carbon) + 0.5% P_2O_5 as Tata basic slag				
Light	0	1.7154	0.1244	—
	60	0.7984	0.1552	33.5
Dark	0	1.7154	0.1244	—
	60	0.9226	0.1419	22.1

The nitrogen fixation is more accelerated by di-and tri-calcium phosphates than mono-calcium phosphates. Ferric and aluminium phosphate show a small increase of nitrogen. In all these experiments we have observed that the number of Azotobacter, total bacteria and fungi are much smaller in the vessel receiving light than in that kept in the dark, although the nitrogen fixation is much greater in light in the dark. This clearly proves the influence of light in increasing the nitrogen content of soil and their fertility by light absorption.

The foregoing experimental results show that organic substances like sucrose, straw, cow dung, water hyacinth, lucerne etc. undergo slow oxidation in air when mixed with soil even in the dark as the amount of carbonaceous compounds decrease with lapse of time. In these slow oxidations energy is liberated and this energy is utilized in fixing the nitrogen of the air on the soil surface farming ammonia, amino acids and other nitrogenous compounds. Thus with the decrease in the quantities and the amount of nitrogen fixed in presence of light is much greater than that obtained in the dark. In all these experiments, the numbers of Azotobacter, total bacteria and fungi are always much smaller in presence of light, which is harmful to micro-organisms, than in the dark, although the nitrogen fixed per gram of the carbon of the energy material oxidized in light is much greater than in the dark. In presence of calcium phosphates, the nitrogen fixation is greatly enhanced.

Dung has been used as a manure from time immemorial. Our experiments show that it not only supplies the plant nutrients it contains but it also fixes atmospheric nitrogen and thus markedly improves the nitrogen content of land all over the world. It has been stated that 14000 million tons of manure are produced in the world and when ploughed it not only supplies 7 or 8 million tons of nitrogen the manure contains but it can also fix the same amount of nitrogen of the air and thus enriches the soil considerably.

In our experiments with sucrose and other soluble carbohydrates there is marked increase of ammonical nitrogen as well as total nitrogen in a short time but with cellulosic materials like straw, the liberation of ammonia from the fixation of atmospheric nitrogen takes longer time. Consequently interval of 3 to 6 months is needed between the incorporation of straw or materials rich in cellulose and lignin in the soil and the sowing of the crop depending chiefly on the soil temperature. In this process basic slag being alkaline helps in the partial oxidation of the organic substance and the liberation of ammonia and formation of nitrate.

CALCIUM PHOSPHATES INCREASE NITROGEN IN SOIL

In enriching fields by growing legumes, it has been frequently stated that under normal conditions one cwt. that is, 112 pounds of nitrogen are added per acre but usually the amount varies from 40 to 60 pounds per acre. In our experiments with straw recorded in Table-2, 0.5 percent carbon was used as straw and in presence of light and calcium phosphate, a nitrogen fixation of 215 Ibs per acre was observed. Hence by ploughing in straw mixed with calcium phosphates like basic slag, soft phosphate rocks, nitrogen addition of the same order as in legumes or more can be readily obtained in cultivated lands of the world.

In Allahabad, by mixing municipal wastes with or without basic slag to a field soil containing 0.5% organic carbon and 0.04% total nitrogen, the results obtained after one year are given in Table 5.

Table – 5. Analysis of different soil samples from the same field

Treatment	Organic carbon %	Total nitrogen %	C/N Ratio
No slag	1.9	0.172	11.0
Tata basic slag	1.77	0.331	5.3
Tata basic slag	2.01	0.270	7.4
Tata basic slag	1.89	0.279	6.7

These results show that in Allahabad where the average surface soil temperature is 26°C, organic matter incorporation increases soil fertility markedly and is further enhanced by adding basic slag as well and bumper crops are produced. Similar results are obtained by mixtures of animal dung or wheat straw and North African soft Phosphate rock and basic slag. Our experiments and those of others show that phosphate-rich soils are rich in nitrogen and very fertile and their C/N ratio is usually smaller than 10.

Nitrogen Fixation by Kans (*Sacchram Spontaneum*)

Recently we have obtained marked nitrogen fixation using smaples of Kans (*Sacchram Spontaneum*) with soil, specially in presence of phosphates and light. The *Kans* contained : 40.5% C; 0.7% N; 1% FeO_3; 435% P_2O_5; 0.76% CaO; 0.142% MgO and 0.87 K_2O.

Soil + 1.5% C (*Kans*) Temperature : 25°

	Period of exposure in days	Total carbon %	Total nitrogen %	NH_3–N %	NO_3–N %	Efficiency	Azotobacter in million per gram of soil
Light	0	4.5654	0.2576	—	—	—	1.33
	45	3.8806	0.2901	0.0058	0.0087	47.4	2.85
	90	3.4241	3.3168	0.00908	0.0130	51.8	14.2
Dark	0	4.5654	0.2576	—	—	—	1.33
	45	4.0998	0.2696	0.00366	0.00712	25.7	3.95
	90	3.9263	0.2756	0.00636	0.00879	28.1	35.4

(Contd.)

	Period of exposure in days	Total carbon %	Total nitrogen %	NH_3–N %	NO_3–N %	Efficiency	Azotobacter in million per gram of soil
			Soil + 1.5% C (Kans) + 0.5% P_2O_5 (Tata basic slag)				
Light	0	4.3553	0.2435	—	—	—	1.33
	45	3.1707	0.3104	0.0102	0.0084	56.4	2.88
	90	2.6132	0.3445	0.0137	0.0155	58.0	8.55
Dark	0	4.3553	0.2435	—	—	—	1.33
	45	3.6236	0.2691	0.0058	0.0084	34.9	4.37
	90	0.3101	0.2812	0.0067	0.0098	36.1	36.0

Fixation of nitrogen by mixing soil with lucerne (*Medicago sativa*) soil + 0.5% carbon as lucerne

	Period of exposure in days	Organic carbon %	Total nitrogen %	Efficiency
Light	0	0.901	0.0643	—
	90	0.724	0.0718	42.3
	180	0.658	0.0743	41.2
Dark	0	0.901	0.644	—
	90	0.768	0.0673	21.7
	180	0.712	0.0682	20.1
		Soil + 0.5% carbon as lucerne + 0.25% P_2O_5 as $CaHPO_4$		
Light	0	0.902	0.0644	—
	90	0.703	0.0781	68.8
	180	0.640	0.0820	67.1
Dark	0	0.903	0.646	—
	90	0.732	0.0706	35.0
	180	0.690	0.0718	33.7

Similar results were obtained with other phosphates and the results are summarized below :

	Efficiency after 90 days	
	Light	Dark
No Phosphate	42.3	21.7
0.25% P_2O_5 as $Ca(H_3PO_4)_3$	55.1	28.4
0.25% P_2O_5 as $Ca(H_2PO_4)_3$	68.8	35.0
0.25% P_2O_5 as $Ca_5(PO_4)_2$	61.0	31.4
0.25% P_2O_5 as $FePO_4$	45.4	25.2
0.25% P_2O_5 as $AIPO_2$	44.8	23.6

Karraker working in the U.S.A. obtained the following results showing marked nitrogen fixation by a mixture of manure and phosphate.

Average of three field treatment	Nitrogen in soil per acre (Ib/acre)	Corn yield (bushels/ acre)
No manure	1600	17
Manure	1760	36
Manure + phosphate	1990	51

It is well-known that the Rothamsted, England, by ploughing in 14 tons of farmyard manure containing 200 pounds of nitrogen per acre and growing wheat every year since 1843 when the soil total nitrogen was 0.122 per cent, the total nitrogen has gone up at present 0.274 per cent. Whilst by ploughing in 86 or 129 pounds of nitrogen as ammonium sulphate or sodium nitrate and growing wheat every year there has been a soil deterioration shown by decrease of total nitrogen. Similar results showing fertility improvement by dung and not by ammonium sulphate or a nitrate were recorded in the U.S.A., Denmark and other countries.

Botanists have estimated that approximately 13750 million ton of organic cabron are added per year to the earth by photosynthesis as cellulosic substances. Assuming that only 40% of the carbon introduced by photosynthesis in the world soils is oxidized per year and there is a fixation of only 20 milligrams of nitrogen in sunlight per gram of carbon oxidized, the amount of nitrogen fixed on the surface of the world soils would be approximately 110 million tons per year, half of which is caused by sunlight absorption. Hence this nitrogen fixation seems to be the chief source of soil nitrogen and crop production in the world.

INCREASE IN PHOSPHATE RESERVE OF LAND VITAL FOR PERMANENT AGRICULTURE

Our experimental results show that a mixture of organic substances like farmyard manure, straw, plant residues etc. and calcium phosphates when incorporated in the soil can build up soil fertility permanently by fixing atmospheric nitrogen and supplying available phosphate, potash, trace element, humus and maintaining soil neutrality. Hence for a number of years we have been emphasizing that the calcium phosphate reserve of soils in permanent agriculture must be increased by utilizing cheap phosphate sources like Thomas slags, soft phosphate rocks etc. It is gratifying to note that this is being done is some countries as will be evident from the following lines : "Workers in Denmark and the Netherlands stress the need to maintain supplies of soil phosphorus at a satisfactory level so that phosphorus deficiency does not limit crop growth. .....If phosphate fertilizers are used to maintain soil phosphorus reserves, their residual effects are of as great importance as the immediate effects. Satisfactory phosphates for "investment manuring should be cheap and also be effective over a period of years : slow acting material may be quite suitable" (Cooke 1956).

So far, man has utilized organic matter and phosphates separately but from our experiments we are convinced that the two together are very profitable in fertility increase. This conclusion is strongly supported by the following experimental results obtained in the U.S.A. (Thomson. 1957).

Effect of manure (10 tons/acre) and superphosphate (500 lb. 0-20-0) on yield of tomatoes in pots with different soils :

	Yield tomatoes (in gms) per pot		
Soil type	**Materials applied separately**	**Materials applied together**	**Increase in yield by applying together**
Wood bridge loam	8.6	29.7	21.1
Vaiden clay	14.1	27	13.9
Worthington loam	29.9	38.3	8.4
Vergennes clay loam	40.4	47.6	7.2
Addison clay loam	47.1	51.6	4.5
Merrimac sand loam	54.0	58.5	4.5

Moreover, when leys are dug up for reseeding, the organic materials ploughed in are benefited by adding phosphates, because the two together can fix atmospheric nitrogen and supply plant nutrients and produce more and better grasses and legumes. This is evident in the following observations :

150 lbs. of 20 per cent superphosphate was mixed with torn up sod of experiment pastures in Iowa. U.S.A. Average annual production of beef in pounds per acre (Stalling, 1957) is as follows :

Treatment	**Pounds gained per acre**
Untreated	105
Limed and reseeded	147
Limed, phosphated and reseeded	155

It is good for world agriculture that G. Bjälfve of the Royal College of Agriculture, Sweden, has also observed marked nitrogen fixation more in light than in the dark by incorporating straw with soil or sand, and that calcium phosphates largely increase this nitrogen fixation. Bjälfve believes that this photochemical and thermal nitrogen fixation may be of greater importance all over the world than legumes which are difficult to grow. It is interesting to note that crop production in many countries without manures and fertilizers and the marked fertility of prairie lands can be satisfactorily explained from the viewpoint of nitrogen fixation observed by us from the oxidation of plant residues and grasses incorporated in the soil.

As large amount of plant materials are photosynthesized on the earth's surface, there is no dearth of organic matter. Moreover, the estimated world reserve of rock phosphate deposits are of the order of 21000 million tons. The world steel industry is producing increasing amounts of phosphate. Hence large amounts of nitrogen fixation and land fertility improvement on a large scale are possible by adopting the methods worked out by us.

LOSS OF HUMUS FROM THE SOILS OF U.S.A.

J. H. Stalling of the U.S.A. (*Soil-use and Improvement*, 1957) has recorded that 35 million acres of cultivated land of U.S.A. cannot grow food and have been abandoned as worthless and $1^1/_2$ million acres are being worn out every year. Moreover, in the most productive lands in the mid-west and great plains much of the organic matter has been lost and the natural fertility is going down. There is no doubt that the organic matter content of a soil is a fair index of its productive power and durability. It has been frequently observed in different countries that the graph of the yield from increasing doses of nitrogen shows a higher maximum when straw is added than in its absence.

The following observations on corn cultivation and soil erosion at Ohio Agricultural Experiment Station at Wooster, Ohio, are of interest in this connection.

Crop every year	Fertilizer treatment	Soil loss in inches 1894-1935	% of Organic matter remaining in soil in 1935	Average yield in bushels	
				1894–1935	1931–1935
Corn	None	10.3	37	26.3	6.5
Corn	Complete (500 lbs. of 19–5–10 per acre)	11.1	35	44.4	28.9
Corn	Manure at 5 tons per acre	9.5	53	43.1	30.0

The mannure is effective in decreasing erosion and maintaining the humus.

Soil productivity depends on structure, aggregation, texture, micro-organic life and all these are created by organic matter. The humus content of the corn belt lands of the U.S.A. is declining due to inadequate replacement of organic matter and the yield is decreasing as seen in the above table. In various parts of the world either the organic matter has been returned to the land in insufficient amounts or humus oxidation has been promoted by too frequent cultivation and application of heavy doses of nitrogen fertilizers. There is nothing more important than a good sod of grasses and legumes to hold the soil in place.

Professor E. Truog in his article on "Liming in Rotation" to avail ability of Native and Applied phosphates, has reversed the proverb.

"lime and line without manure
Makes both farm and farmer, poor",

read as follows

"Manure and fertilizer without lime
Will ruin both farm and farmer in time".

From the consideration and results discussed in this Address it appears that manure and fertilizer can be profitable in permanent agriculture even in temperate countries, because manure always supplies fair amounts of calcium carbonate and fixes atmospheric nitrogen in the soil and also protects the soil nitrogen and humus.

In the U.S.A. the corn belt area and in other parts, lands rich in humus and a favourable climate form the basis of crop production. By the application of Science and Technology crop production has been pushed up enablihg this country to export approximately 10 per cent of the food produced. But the great natural advantage of this country is the large amount of land under cultivation and even today about 3 acres are available per capita (520 million acres for 180 million persons). It is interesting to note that on an average the amount of nitrogen applied per acre in the U.S.A. is low and is of the order of 4 to 5 lbs. per acre. If the nation is unable to conserve the humus capital of their land the fertility is bound to fall.

Prof. R. H. Bradfield, President of the VIIth International Soil Science Congress took exception to my statement. "No nation, certainly no large nation has ever truly conquered hunger, the oldest enemy of man". I had to point out to him that as the population is increasing fast the surplus of 10% may not last long and that various parts of this great country are still poor, as will be evident from the following lines, "New England crop farmers by and large have had a struggle just to get along almost from colonial times. The southern Appalachians seem to be a permanent poor house. Topography, obselete methods, lack of capital and possibly lack of a diet adequate to supply the requisite energy and thought, all conspire to make this region sad indeed. Throughout the south where cotton and tobacco have depleted the soil, rural poverty is rampant. Farther south-west Texas has areas of almost continuous poverty. In New Mexico and Arizona particularly amongst the Spanish American and Indians, poverty is the rule. Before world war II, we stood arraigned as the most wasteful people in all history. Nowhere else had a people taken such a rich virgin territory and in a short three centuries ruined large parts of it for all time and semi-destroyed other parts, while busily trying to do away with the rest" (L. Haystead & G. C. Fite, 1958). Similarly, in Oklahoma, Virgina, Alabama, Georgia, Kentucky, North and South Carolina, farmers are not well off. In a recent article Prof. W. B. Bollen has stated that more crops are being produced in the U.S.A. but lands are losing fertility.

NITROGEN IN CROP PRODUCTION

It has been frequently stated that nitrogen is the key element in crop production. This is evident in the following table which shows the yield in different countries expected by an application of 1 kilogram of plant nutrient :

Estimated average increase in yield in kilograms in tillage and grass lands from 1 kg. of plant nutrient

Country	Crops in rotation			Permament pastures		
	N	P	K	N	P	K
Norway	9	3	5	11	6	4
Sweeden	14	11	7	14	11	7
Denmark	18	4	2	12	5	3
U.K.	16	5	5	—	—	—
Ireland	20	8	8	—	—	—
Netherlands	19	6	3	10	6	4
France	19	5	2.1	—	—	—
Germany	19	8	4	9	10	5
Switzerland	18	8	4	9	10	5
Greece	15	5	3	—	—	—
Italy	11	3	—	12	4	3
Average	16	5	4	11	7	4

It seems that there is a close relationship between climatic conditions and the effect of nitrogen. The lowest nitrogen influence has been observed in Norway, Sweden, Italy and Greece. Lack of water has been very often a factor which restricted the production. The influence of phosphate and potash on crop yield is much lower than that of N.

In the *Oxford Economic Atlas of the World* (Oxford University Press 1959) the following results regarding increased yield are recorded.

Increase in yield to 1 kg. of N per hectare

	Wheat	Rice	Potatoes	Grass (of hay)
kg per hectare	17	17	84	17

It has been stated that yield increases of this order are obtained when the use of N is not excessive. After a point, successive increments of fertiliziers bring diminishing increments of yield.

The United Nations Korean Reconstruction Agency in their report *"Agriculture, Forestry and Fisheries in South Korea"*, New York, Columbia University Press, 1954, pages 99–102, have started that 1 kg of N as ammonium sulphate can produce 12–14 kilograms of brown rice and 14–28 kgs of rough barley in South Korea. Similarly, 1 kg of P_2O_5 from superphosphate can yield 14 to 18 kilograms of brown rice in some places, whilst in other places 4 to 5 kilograms of brown rice are produced per kg of P_2O_5.

POSSIBILITIES OF INCREASED USE OF FERTILIZERS OVERESTIMATED

In the U.S.A. the following results in the increase of yields have been reported in *"Economic and Technical Analysis of Fertilizer Innovations and Resource Use"* edited by Baum, Heady, Pesek and Hildreth, Lowa Stte College Press, 1957, page 139

		Locations on Portsmouth soil				Location on Norfolk soil			
	Pounds per acre	506	507	508	510	553	554	555	558
N	0	40.9	102.9	56.5	54.1	38.6	9.9	24.8	32.5
	63	84.9	101.0	80.2	69.1	77.4	39.7	66.3	47.9
	125	95.2	99.5	92.3	74.4	92.9	43.2	93.3	50.1
	188	93.3	104.6	86.6	72.6	93.3	35.4	94.6	44.8
	250	91.2	96.8	80.5	71.9	87.0	49.7	87.8	40.1
P_2O_5	0	85.2	107.7	82.6	62.5	96.0	41.9	82.4	44.2
	38	90.9	100.7	82.5	66.9	85.9	40.0	78.8	47.1
	75	95.2	99.5	92.3	74.4	92.9	43.2	93.3	50.1
	113	87.5	104.8	84.3	74.8	84.8	35.0	82.0	45.7
	150	79.0	94.3	92.4	84.1	89.8	36.8	92.0	43.5
K_2O	0	93.4	98.7	57.6	84.8	91.7	39.9	91.3	53.9
	38	90.8	104.3	82.0	72.0	84.1	38.1	80.8	47.9
	75	95.2	99.5	92.3	74.4	92.0	43.2	93.3	50.1
	113	87.2	101.0	84.8	69.7	87.6	36,7	79.9	44.5
	150	90.7	102.4	95.5	74.2	92.9	38.9	87.9	44.5

The Indian Council of Agricultural Research has reported that on an average the rice production in India is 10 times the amount of N applied when the dose is not large.

The average yield of shelled corn At 15.5% moisture for selected location of fertility trials in 1955.

The author have conculated as follows,

"Response to Nitrogen"

Large increases in yield due to application of nitrogen were obtained on both soil types. The increase was larger, on the average for the Norfolk than for Portsmouth soil. *No increase from application of nitrogen was obtained for rates above 125 lbs. per acre. There was some evidence that 188 and 250 lbs. rates of nitrogen depressed the yield slightly below that obtained with 125 lbs. rates at location 508, 553 and 558.*

"Response to Phosphorus"

The effect on yield of application of both phosphate and potash fertilizer were of much smaller magnitude and also more erratic than the effect of applications of nitrogen. At location 510, each increment of 38 lbs. of P_2O_5 increased the yield approximately 5 bushels per acre. The yield also was slightly increased by applications of phosphates at locations 506 and 558. *There were indications of a depression of the yield below the maximum by high rates of phosphates at locations 506 and 554.*

"Response to Potash"

At locations 508 the first increment of 38 lbs. per acre of K_2O increased the yield 20 bushels per acre, with smaller additional increases for higher rates of potash. *Evidence of a slight depressive effect by applications of potash was obtained at location 558.*

In another part of the publication in the article "Overall Economic Considerations in Fertilizer Use" by E. L. Baum and Earl O. Heady, page 125 the following viewpoints have been recorded, "Even if the total increase in crop production in the U.S.A. by applying artificial fertilizers is 25%, it is remarkable that this portion of a wealthy nation's food product comes from the resource fertilizer. The social significance of fertilizer in the nation's producing plant and economic growth processes, fertilizer is becoming an extremely important substitute for labour, land and other particular forms of capital. Fertilizer, thus is one of the potential elements of further economic growth in the U.S.A."

In the O.E.E.C. Publication: *"The Effective use of Fertilizers Including Lime"* (April 1957), on page 87, Prof. K. A. Bondorff, director, State Laboratory, Lyngby, Denmark, has reported: "I will only say that the consumption of fertilizers could profitably be increased by 60% thereby causing an increase in yields of 4%.

"I think we can easily agree that there must be such a thing as a maximum profitable consumption. But how to calculate this quantity? I should like to stress that the answer is a very important one. It is important to the single farmer, who, of course, wants to benefit as much as possible from the use of fertilizers. It is important to the national economists and to the politicians, who want to estimate to what extent their country can supply itself with food. And last but not least, it is important to the manufactures of fertilizers wanting to know the maximum quantity they can hope to sell. The question is as difficult to answer as the answer is important. But I think the answer will be important in still another way. The answer might be useful to people including many politicians, who know too little about agriculture. When it is emphasized that agriculture in the future will have increasing difficulties in meeting the demand of food, these people point to the role fertilizers have played and believe that by increasing the use of fertilizers every demand can be met. Looking backwards this point of view can be understood. But looking forward the picture is quite different. The possibilities of an increased use of fertilizers are, in the opinion, often overestimated, the law of diminishing return too often neglected".

On pages 84 and 85 Prof. Bondorff stated as follows, "The phosphoric acid condition and the potash condition of the soil has to be in order, i.e. sufficient quantities of these two nutrients have to be available in the soil for plants in order that they can fully utilize the expensive nitrogenous fertilizer and the water etc.... In other words, it does not pay to have the yield determined by the relatively cheap phosphoric acid and potash nutrients. Then one should give as much phosphoric acid and potash as will be sufficient for the plants".

NITROGEN REQUIREMENTS OF CROPS IN THE WORLD AND SOME COUNTRIES

Excluding the U.S.S.R., the world production of cereals in 1956 was as follows :

	In million tons
Wheat	159
Rye	20
Barley	76
Oats	52
Maize	165
Millet & sorghum	71
Rice, paddy	216
	759

This production has appreciably increased in 1956 because it was 627 million tons between 1948-1952.

The cereal production in the U.S.S.R. is of the order of 161 millions tons, consequently, the world cereal production can be roughly taken to be 1000 million at present. Other food materials like pulses, potatoes, sugar etc. are produced to extent of 700 million tons. Consequently, 1700 divided by 16, i.e. approximately 100 million tons of nitrogen are necessary for producing the world food materials. But the chemical industry is supplying only 7 million tons of nitrogen and legumes 5 million tons.

Nearly 150 million tons of cereals are produced in the U.S.A. at present and 85 million tons of other food materials. Hence, the nitrogen requirement of the food materials produced in the U.S.A. is of the order of 15 million tons. But 1.5-2 million tons of chemical N, 2 million tons of legume N and perhaps 1 million ton of farmyard manure nitrogen are applied to the 520 million acres of agricultural land in the U.S.A.

It is interesting to record here that approximately 10% of the food produced in the U.S.A. is exported to other countries.

In the U.S.S.R. the total N requirement for producing the cereals and other food is of the order of 14-16 million tons per year. In recent years Soviet farm production has increased due mainly to the increased acreage. In 1958 in the U.S.S.R. 12.4 million tons of mineral fertilizers were produced. But nitrogen formed approximately 1 million tons. Russia is planning to triple her output of mineral fertilizers in the next 5 years and produce 70% more crops. By 1965, 35 million tons of mineral fertilizers are expected. But the N content of the mineral fertilizer would be of the order of 3 million tons. However, the amount of nitrogen necessary for the increased crop production in the U.S.S.R. is likely to be 20 million tons.

In India the cereal production in million tons in 1956 was as follows: Rice 31.6; millet 18.4; sorghum 16.7; wheat 12.3; maize 3.7; barley 3.4.

This makes a total of 86.1 million tons per annum and, hence, the N requirements is of the order of 6 to 7 million tons. On the other hand, the expected N productions in million tons in 1960-61 are:

Sindri 0.1189; South Arcot (Neyveli) 0.0203; Nangal 0.0406; Rourkela 0.0741 and private firms 0.0366, making a total of 0.2875 million tons. But in 1956, 0.155 million tons of N were used in crop production in India.

It is of interest to note that Japan expects to produce 1.3 million tons of N as early as possible. Moreover, at present, there is an enormous demand for nitrogenous fertilizer in China and the application of chemical fertilizers is going up.

But China is also the largest user of organic materials & utilizes 70% of the 200 million tons of available night soil. 50% of agricultural land receives night soil and stable manure, 20 to 30% compost and 10 to 15% green manure. It has been estimated that the Chinese utilize over a million ton of N, $^{1}/_{2}$ million ton of K and $^{1}/_{4}$ million ton of P as organics per year. Their crop production is higher than in many countries although the lands have been cultivated for thousands of years. This is possible because in China the quantities of plant nutrients introduced in the soil along with humus in the form of organics exceed the amounts applied as commercial fertilizers.

Similarly in Japan, along with large doses of artificials, a great amount of humus is produced by organic manures and utilized in crop production. The amounts of plant food normally recommended in Japan are :

Organic matter	**3,711 to 4,640 lbs. per acre**
N	105 to 131 „ „ „
P	35 to 44 „ „ „
K	56 to 70 „ „ „

Rice is produced at the rate of 80 bushels per acre and the manuring is as follows :

		Pounds per acre		
		N	P	K
Manure compost	5291	26.4	5.9	27.1
Green manure, soybeans	3306	19.2	1.1	19.6
Soybean cake	397	27.8	1.7	6.4
Superphosphate	198	—	12.8	—

For growing barley the following plant nutrients are applied :

Manure compost	6613	33	7.4	33.8
Rape seed cake	330	16.7	2.8	3.5
Night soil	4630	26.4	2.6	10.2
Superphosphate	132	—	9.9	—
Total for the year	20897	149.5	44.2	100.6

It appears that in intensive cultivation a large dose of organic matter is absolutely necessary for crop production with increasing amounts of chemical fertilizers. This is being realised all over the world.

In the O.E.E.C. report on "Collection & Disposal of Town Refuse — Street Cleansing", 1953, pages 97-98, Prof. Franz Popel of Heidelberg has stated that soil rich in humus and containing trace elements is national wealth. Refuse converted into compost can be used for increasing humus.

GREATER EFFICIENCY OF NITROGEN IN CROP PRODUCTION IN COUNTRIES USING SMALL AMOUNTS OF COMMERCIAL FERTILIZERS

In the following table the total agricultural areas, total nitrogenous fertilizers used (1956-57), amounts of nitrogen in kg applied per hectare of land under cultivation and cereal productions in various countries have been recorded.

If we assume that only 50% of the nitrogenous fertilizer applied in the above countries is used in cereal production and divide the amounts of cereal produced by the quantities of nitrogenous fertilizer utilized for growing the cereals, we obtain some interesting figures recorded in the last column of the foregoing table. They show that in countries where larger amounts of nitrogenous fertilizers are applied per unit area, small values are obtained as the ratio of cereal: N as recorded in the last column of the above table. These ratios are recorded in increasing order in various countries—Netherlands (17), Norway, (24), Belgium (38), East Germany

Country	Total agricultural area in 1000 hectares	Nitrogenous fertilizers used in million tons	Commercial nitrogen in Kg. applied	Cereal production per hectare tons	Cereal/N in million
U.S.S.R.	486,400	1.5	3.3	160	214
U.S.A	444,236	2	4.8	140	140
China	287,350	0.120	0.4	100	168
India	169,496	0.154	1.0	72	934
Turkey	53,818	0.006	0.12	11.5	3800
France	33,668	0.403	13.0	19.0	94
Spain	29,549	0.169	6.1	7.8	92
Pakistan	24,404	0.031	1.3	18.3	1202
Italy	20,936	0.268	13.2	13.6	102
Poland	20.404	0.153	8.0	12.2	158
U.K.	19,364	0.311	17.3	8.3	54
Yugoslavia	15,933	0.067	4.2	5.9	176
West Germany	14,416	0.527	39.5	1-2.0	50
Greece	8,703	0.055	6.3	1.95	72
Thailand	7,793	0.003	0.4	8.4	5600
Philippines	7,588	0.033	4.3	4.26	280
Hungary	7,266	0.025	3.4	5.3	424
Czechoslovakia	7,377	0.021	2.8	5.5	520
East Germany	6,474	0.218	36.4	5.3	48
Japan	6,404	0.587	92.0	17.1	58
Portugal	4,868	0.047	9.5	1.5	64
Ireland	4,726	0.0145	3.0	1.3	176
Bulgaria	4,537	0.081	18.0	3.45	84
Sweden	4,436	0.09	20.0	3.0	66
Austria	4,088	0.037	9.0	1.91	100
Denmark	3,117	0.0978	31.3	3.81	77
Finland	2,869	0.044	15.3	1.27	56
Switzerland	2,708	0.011	4.2	0.44	80
Egypt	2,618	0.123	46.5	5.5	90
Netherlands	2,305	0.189	86.4	1.57	17
Belgium	1,730	0.087	55.1	1.58	38
Ceylon	1,523	0.0212	15	0.54	49
Norway	1,032	0.045	48.6	0.54	24
Taiwan	936	0.084	96.8	2.27	54
Luxembourg	141	0.0037	28.3	0.111	60

(48), Ceylon (49), West Germany (50), U.K., Taiwan (54), Finland (56), Japan (58), Luxembourg (60), Portugal (64), Sweden (66), Greece (72), Denmark (77), Switzerland (80), Bulgaria (84), Egypt (90), Spain (92), France (94), Austria (100), Italy (102), U.S.A. (140), Poland (158), China (168), Ireland, Yugoslavia (176), U.S.S.R. (214), Philippines (280), Hungary (424), Czechoslovakia (520), India (1934), Pakistan (1202), Turkey (3800) and Thailand (5600). On the other hand, the decreasing amounts of commercial nitrogen used per hectare of land in kg. under cultivation in various countries are as follows—Taiwan (96.8), Japan (92), therlands (86.4), Belgium (55.1), Norway (48.6), Egypt (46.5), West Germany (39.5), East Germany (36.4), Denmark (31.3), Luxembourg (28.3), Sweden (20), Bulgaria (18), U.K. (17.3), Finland (15.3), Ceylon (15), Italy (13.2), France (13), Portugal (9.5), Austria (9), Poland (8), Greece (6.3), Spain (6.1), U.S.A. (4.8), Philippines (4.3), Yugoslavia and Switzerland (4.2), Hungary (3.4), U.S.S.R. (3.3), Ireland (3); Czechoslovakia (2.8), Pakistan (1.3), India (1), China, Thailand (0.4), Turkey(0.12).

From the foregoing observations, it appears that in countries not using larger doses of commercial fertilizers the nitrogen response to cereals is very marked and that the law of diminishing return, which is often neglected in modern agriculture by applying heavy doses of commercial fertilizers, is in actual operation in countries like Netherlands, Belgium, Norway etc. But in countries like Japan, China, Taiwan where a lot of composts, plant and animal wastes are utilized along with commercial fertilzers, better crop yields per unit of nitrogen applied are still obtained. It is of interest to record here that several experiment stations in the U.S.A. have found that yield of wheat and corn are increased by producing greater amounts of organic matter through rotations. If all crop refuse is utilized and if legumes are grown in rotation, organic matter level is fairly well-maintained. But in drier areas legumes have to replaced by grasses for building organic matter.

NITROGEN REQUIREMENT OF WORLD GRASSLANDS

It is difficult to form a correct estimate of the production of grasslands of the world, a rough approximation seems possible. In the O.E.E.C. publication on "Pasture & Fodder Productions in North-west Europe", Paris, November 1954, it has been recorded that the glassland productions (including clover and lucerne) in million ton fodder unit are—

Norway 2.65; Denmark 4.3; U.K. 26.3; Ireland 10.4; Netherlands 6.3; Belgium 2.9; France 37.4; W. Germany 20.2; Austria 4.5. The total makes 114:8 million fodder units, which are equivalent to 80 million tons of starch. The cereal productions in these 9 countries are:—

Norway 0.54; Denmark 3.81; U.K. 8.3; Ireland 1.3; Netherlands 1:57; Belgium 1.58; France 19; W.Germany 12; Austria 1.9, making a total of 50 million tons per annum. If we assume that all over the world the amount of grassland production goes hand in hand with cereal production, we can obtain a rough idea of the world grassland production. It has already been stated that the world cereal production is of the order of 1000 million tons and, hence, the world grassland production may be of the order of 1000 × 80/50, i.e. of the order of 1600 million tons. The N requirement of the grassland production is approximately 1600/11-155 million tons per annum. It has been stated that 5 million tons of N are fixed by legumes in the world soils, hence, not less than 150 million tons of N are partly supplied by the photochemical fixation of N in the solar oxidation of grass organic matter on the surface of the soil and partly by the soil humus for the grassland production of the world. It is interesting to record here that in the U.S.A. out of a total of 520 million acres of land under cultivation 280 million acres are in hay and pasture. But these pasture lands receive only 3% of the N requirement from nitrogenous fertilizers. Consequently, there is no doubt that for the production of cereals, other food materials and grass, the world supply still comes mainly from the humus of the land and the thermal and photochemical fixation of atmospheric nitrogen caused by the oxidation of organic substances incorporated in the soil.

VALUE OF HUMUS AND PHOSPHATES IN SOIL FERTILITY

Regarding, the value of humus in agriculture, Prof. Bondorff, has emphasised the fertilizers do not add any organic matter to the soil and do not ordinarily create humus in the soil and this is a huge problem arising out of the application of fertilizers which undoubtedly increase the breakdown of humus. Hence, on farms without livestock the humus decreases but this is a slow process in humid temperate countries. In the well-known Askov experiments starting from 1894, the 4 year rotation including clover and grass supplied enough organic residues to make up partially for the loss of humus from 2.95 to 2.6% in 20 years observed in the unfertilised field. This is evident in the following table.

Nitrogen and humus in the askov experiments per cent in dry soil

Nitrogen	Unfertilized	Commercial fertilizer	Farmyard manure
Askov loam soil 1942	0.106	0.118	0.130
Askov sandy soil 1942 Humus (C×2)	0.066	0.076	0.086
Askov loam soil 1942	2.60	2.86	3.04
Askov sandy soil 1942	1.58	1.92	2.18

There is reason to believe that the humus was 3.45% when the experiments started in 1894 and in a century would drop to 1%.

Similarly, in the Rothamsted continuous wheat experiments the original total nitrogen content was 0.122% in 1844 when the experiments started. In 100 years it dropped to 0.09% in the un-manured and to 0.11% in the fertilized plots, whilst by adding 14 tons of farmyard manure per acre every year, the nitrogen status improved to 0.25%.

The value of phosphates and organic matter in land regeneration was recognised in the U.K. during the second world war in increasing food production. This is clear the following lines recorded in the "'*History of the Second World War — Agriculture*" by Sir Keith Murray, 1955, page 162: "The supply of phosphates was critical, particularly since their use became more necessary as inferior grassland was ploughed up. Between 1938-39 and 1941-42 the use of phosphatic fertilizers, in terms of P_2O_5, increased from 170500 to 287400 tons, the use of superphosphate rose from 428000 to 841000 tons, whilst basic slag went up from 387000 to 551000 tons and 59000 tons of triple phosphate were used in 1941–42." Again, on pages 205-206, Murry stated: "There was no certainty that the supply of machinery and of fertilizers-particularly of phosphates, which was so essential both for the regeneration of exhausted arable land and for the newly ploughed grassland — could be increased to an adequate extent."

T. W. Wright (*Journal of the Science of Food & Agriculture,* Dec. 1959, Vol. 10, pp. 645-650) has recorded that the Belgian practice of putting a mixture of soil and basic slag down the planting hole in the aforestation of deep peat is utilised in the U. K. by the Forestry Commission. The best forms of phosphates are mineral phosphates and basic slag containing 16% P_2O_5.

According to H. B. Van der ford *(Managing Southern Soils,* 1959, page 205) basic slag containing 8-10% P_2O_5 has been used extensively in the Southern States of the U.S.A. as a source of lime and phosphate. On page 261 he has stated: "By getting of the necessary nitrogen from organic matter, a farmer saves on commercial fertilizers. Nitrogen is the most expensive plant nutrient the buys and one of the most deficient elements in Southern soils."

In West Germany there is a Government subsidy of 20% for fertilizer consumption and its application is fairly high, still the production and application of farmyard manure is not adversely affected by the subsidy. It is realised that fertilizers and manures supplement each other. Agricultural Engineers are simplifying and improving-farmyard manure production in Germany.

In France the use of basic slag, which is cheap, is increasing and taking the place of superphosphate. Natural permanent grass received little fertilizer since grazing is thought to be sufficient to feed the soil. This leads to poor yield due to deficiency of P_2O_5. The application of basic slag or ground phosphates improves and doubles the yield by liberating available nitrogen and phosphate.

Prof. F. Scheffer of Görtingen, in his paper on "The Effective Use of Fertilizers Including Lime" (O.E.E.C. publication, Paris, April 1959, page 69) has stated that "An intensification of fertilisation on light soils, as required by fallow crops, can only be carried out in association with heavy humus and phosphate fertilisation. The phosphoric acid not only serves as a plant nutrient but also, in association with humus, serves to increase the buffer reaction and also promotes as well an improvement of the chemical and biological properties of the soil and, consequently, an increase of soil fertility".

For tropical soils sufficient humus is of the utmost importance as only thereby basic condition for successful fertilizers application is created. In tropical soil the clay materials with a high buffer effect are very often lacking. In addition, the regulating effect of phosphoric acid is prevented by the presence of large quantities of sesquioxides".

According to Prof. Steenbjerg of Denmark, basic slags, raw rock phosphates and bone meal respond well when applied to humus soils of low pH value. In the "Standard Fertilisation" method of crop production of Dr. Alf Aslander of Stockholm, a heavy dose of farmyard manure along with calcium nitrate and superphosphate are applied with profit. There is no doubt that farmyard manure can be combined with fertilizer profitably in crop production.

CARBOHYDRATES FIX NITROGEN AND PRESERVE SOIL NITROGEN

There is no doubt that the carbonaceous compounds present in the dry substance of the plants, e.g., cellulose, lignin, non-cellulose polysaccharides, polyuronic hemicellulose, pectins, gums, mucilages etc, help in the formation of humus in the soil and improve the soil properties. But, they also fix atmospheric nitrogen and protect the soil nitrogen from loss in the process of nitrification of the proteins, amino acids and other nitrogenous compounds. It is well recognised that carbohydrates and fats in the animal body protect the body proteins from loss. In the soil also, the carbohydrates from the plant residues as well as from dung can fix atmospheric nitrogen in the process of their slow oxidation, but also preserve the soil nitrogen by acting as negative catalysts in the oxidation processes involved in nitrification, which is mainly an oxidation reaction. Consequently, for the retention and protection of the soil nitrogenous compounds, the presence of carbohydrates is absolutely necessary and, hence, plant residues and farmyard manure have to be applied to save the nitrogenous fertilizers added and the fertility of land, which is associated with the nitrogen status. Moreover, grasses can readily contribute organic matter to soil and form humus and help in the fixation of atmospheric nitrogen.

In his critical examination of the experimental results obtained in the classical Rothamsted and Woburn experiments with chemical fertilizers and farmyard manure, Russell has come to the conclusion that soil deterioration takes place not only in continuous cultivation but in rotations as well when chemical fertilizers are used without any farmyard manure application. This clearly shows that the roots and stubbles left after the harvesting of the crops cannot supply the adequate amounts of carbohydrates necessary for the protection of the soil nitrogenous compounds, although, the amounts of roots and stubbles left in the fertilized fields are greater than in the unfertilized ones. On the other hand, in fields receiving per acre 14 tons of farmyard manure during the 4 year rotation, there was no soil deterioration. In the 14 tons of farmyard manure, the amount of total nitrogen added was 200 lbs. and the carbon: nitrogen ratio of the farmyard manure is usually 22 : 1 or 20 : 1, the amount of carbon introduced as carbonaceous compounds in the 4 year period is of the order of 4000 lbs. Consequently, in temperate countries having an average surface soil temperature of 8°–10°C, approximately 1000 lbs. of carbon per acre (1119.4 kgs. per hectare) must be applied over and above the plant roots and stubbles for maintaining the fertility and the humus status. In other words, approximately 3.5 to 4 tons of farmyard manure per acre annually has to be applied for this purpose. If the amount of carbonaceous compounds is less, the humus will be broken up by oxidation and there will be a slow fall of soil fertility.

The estimated availability of plant nutrients from manures and chemical fertilizers in kilograms per hectare of land under cultivation in some European countries were as follows in 1949-50.

	Plant nutrients			
Country	**Manure**	**Commercial fertilizers**	**Plant nutrients total**	**Percentage in manure**
Benelux	110	163	273	40
Germany	86	91	177	49
Denmark	111	71	182	61
U.K.	90	75	165	55
Austria	83	26	109	76
Ireland	84	13	97	87
Sweden	63	45	108	58
France	60	35	95	63
Greece	59	11	70	84
Italy	47	19	66	71
Portugal	43	18	61	70

It appears that the carbon introduced as manure per hectare in all these countries is much less than that required (i.e. 1119.4 kgs.) to avoid the loss of humus and soil fertility on cultivation. Hence, there is the danger of decrease of soil humus and crop yield in modern agriculture all over North-west Europe, specially in countries like Holland, Belgium, Germany, Denmark, U.K. and Norway where increasing amounts of nitrogenous fertilizers are being applied. When nitrogenous compounds are added to the soil in cultivation, the following chemical changes take place :

$$\text{Proteins} \rightarrow \text{Aminoacids} \xrightarrow{+O_2} \underset{\text{amines}}{\overset{NH_3}{NH_4\text{-salts}}} ; \quad \underset{\text{amines}}{\overset{NH_3}{NH_4\text{-salts}}} \xrightarrow{+O_2} NO_2 \xrightarrow{+O_2} NO_3$$

It is well-known that nitrates are produced in the soil as the final stage of nitrification and in this process there is the intermediate formation of the unstable substance—ammonium nitrate (NH_4NO_2). This material is very unstable and breaks up readily into nitrogen gas and water with evolution of heat as in the equation

$$NH_4NO_2 = N_2 + 2H_2O + 718 \text{ k. Cals.}$$

Carbohydrates and other organic compounds retard this process of nitrification and partial loss of N in the gaseous state and, hence, humus, which is ligno-phospho-protein, is not only a source of N but a protector of nitrogenous compounds as well. In case large amounts of nitrogenous fertilizers are applied to land as in intensive cultivation in Holland, Belgium, there is always the production of large quantities of nitrates, which being oxidising agents, react with the humus and break it down causing loss of fertility. This has been observed in the classical Rothamsted experiments using 86–129 lbs. of N, as well as in Scotland, where over 100 lbs. of N have been applied per acre. This loss can be minimised by applying large amounts of farmyard manure, composts etc. As the amount of N applied in Holland for the grains is over 100 lbs. per acre they have to apply town refuse composts as the amount of farmyard manure available is only 3 tons per acre, which is less than the amount required for the protection of the humus and reaction with the nitrates formed in nitrification.

NITROGEN AND HUMUS LOSS FROM SOLIDS RECEIVING LARGE DOSES OF FERTILIZERS

Moreover, in many countries quantitative results are accumulating in favour of the view that application of mineral N in fairly heavy doses accelerates the loss of the humus as is evident in the observations in Rothamsted and in Scotland. Hall has recorded the following values of nitrates in Broadbalk in lb. per acre in wheat soils October :

Plot No.	5 No N minerals as only	6 Minerals + 43 lb. N as $(NH_4)_2SO_4$	7 Minerals + 86 lb. N as $(NH_4)_2SO_4$	8 Minerals + 129 lb. N $(NH_4)_2SO_4$	16 Minerals + 86 lb. N $NaNO_3$
As nitrate in soil up to 90 inches	25.2	52.6	74.3	107.3	144.2
Excess of nitrate over Plot 5	”	27.4	49.1	82.1	119
Nitrogen in crop, excess over Plot 5	”	8.7.	12.9	14.8	11.7
N accounted for in soil and crop, excess over Plot 5	”	36.1	62.0	96.9	130.7
N supplied in fertilizer	”	43.0	86.0	129.0	86.0

The foregoing results show clearly that in Plot 16, 86 lb. N has been added per acre as sodium nitrate but the N existing as nitrate and that taken by the crop in excess of the plot without any nitrogenous fertilizer has the value 130.7 This result shows that about 44 lbs. of extra N come out of the soil humus when 86 lb. N as $NaNO_3$ was applied per acre in the Rothamsted heavy soil containing 0.122% total N. The value of the nitrate content up to the depth of 90 inches in Plot 16 was calculated from the actual figures recorded up to 72 inches depth.

Also these Rothamsted results show definitely that the recovery of N is less than the amount added when ammonium sulphate is the fertilizer applied; this is due to the loss of N gas from the soil in the process of nitrification of ammonium sulphate in the soil caused by the formation and decomposition of the unstable substance—ammonium nitrate — according to the equation :

$$NH_4NO_2 = N_2 + 2H_2O + 718 \text{ k. Cals.}$$

This loss has been studied extensively and emphasised by Dhar and co-workers since 1931.

J. Hendrick, in lysimeter experiments, has also reported that the amount of nitrate derived from the soil is greater in soils receiving large quantities of chemical fertilizers than in unmanured soils. The amounts of ammonium sulphate added per acre in lb. over a period of 15 months were:

	No fertilizer	$(NH_4)_2SO_4$ added	$(NH_4)_2SO_4$ + Superphosphate	$(NH_4)_2SO_4$ + superphosphate +KC1
Total nitrate in crop and drainage water	193	N 774(175)	792	776
Nitrate supplied by fertilizer	"	N 475 (107)	475	475
Nitrate from soil	193	N 299 (67.6)	317	N 301 (67.8)

It can be concluded here also from the above results that the addition of about 100 lb. N per acre as ammonium sulphate alone or with superphosphate and potassium chloride, there is marked depletion of humus nitrogen and loss of soil fertility.

Due to the introduction of tractors and other machines in modern agriculture, animals are fast decreasing in modern farms and not much farmyard manure is available for supplying the carbohydrates for fixing nitrogen and decreasing the N loss from soils. Man has always utilized the humus created by trees in forests and by grass in his agriculture and he has early found that animal dung is quite good for his crop and used it till the beginning of the present century. At present farmers are applying larger amounts of chemical fertilizers than before and in Holland 150 lbs. of N per acre for grain crops and in U.S.A. for corn and in France for cereals, large amounts are being applied. But as already reported, the recent U.S.A. experiments show a depressing effect of N at doses higher than 125 lbs. per acre. Moreover, marked loss of humus by the reaction of nitrates added or produced in the soil on the organic substances in humus may lead to humus oxidation and deterioration of soil fertility is observed in the classical Rothamsted and Woburn experiments and other parts of the world. Hence, for steady crop production and maintaining soil fertility farmyard manure, grasses, straw, plant residues, composts have to be added in larger amounts aided by calcium phosphate for increasing the fixation of atmospheric N in soil and humus content and decreasing the loss of N. When chemical N has to be used in modern agriculture, the amount should not exceed one hundred pounds of N per acre and always be fortified by farmyard manure, straw, composts and other organic substances.

IMPORTANCE OF LIME IN SOIL FERTILITY

Due to the washing away of calcium carbonate by the formation of calcium bicarbonate from temperate country soils, the application of chalk, marl and lime has played an important part in agriculture. As a matter of fact in the last century lime and dung were largely applied in plant production. It is of interest to note that the lime content of the Rothamsted heavy clay soils was approximately 5% when the classical experiments were started in 1843, whilst the light Woburn soils contained much less lime in 1876. It has been stated that the present lime status in Rothamsted is about 3% and in Woburn less than 0.3%.

According to Hilgard for obtaining best results in crop production sandy soil should possess not less than 0.1% and heavy clay soils 0.6% calcium carbonate and, in general, the presence of 2.3% calcium carbonate provides the optimum condition for most soils. Farmers generally believed in the truth of the adage that "A lime country is a rich country". In Germany and other parts of Europe it was believed that—

"Lime and lime without manure.
Makes both farm and farmer poor".

The chief functions of calcium carbonate and lime are the following :

1. Supply of the important plant nutrient calcium;
2. Neutralizing the acidity of most temperate country soils;
3. Forming soluble calcium salts which readily coagulate the negatively charged silicic acid sol, silicates and the humus and this leads to the increase of porosity and improvement in the texture of the soil;
4. Being feebly alkaline, help in the oxidation of the humus and liberation of ammonia, nitrate, phosphate ions;
5. In fixing atmospheric nitrogen from the slow oxidation of carbohydrates;
6. Liberates phosphates from aluminium, iron and titanium phosphates, forming calcium phosphates.

Hence, liming helps to provide the conditions which are conductive for plant growth and effective utilization of plant nutrients. When a very large amount of lime is added, the nitrification of the proteins present in the soil humus becomes quick and there may be loss of nitrate by leaching before the plants can take it up. Moreover, the available potash and trace elements become immobilized. This explains the reasons of an overdose of lime as stated in the above proverb.

NITROGEN FIXATION IN GRASSLANDS

It has been quantitatively estimated by a British Govt. Committee that 2 tons of roots, stems etc. are lost by oxidation from grassland annually per acre. There is no doubt that this forms the chief source of the increased fertility of land under grass. The oxidation of organic matter derived from grasslands leads to nitrogen fixation in soil. The reported increase of N in grasslands in Rothamsted and other places can be readily explained. When phosphated, the grass root oxidation @ 2 tons per acre may fix a fair amount of nitrogen every year. The carbon oxidized in 2 tons of roots and stems is approximately 0.8 ton per year. If we assume that 25 milligrams of N are fixed per gram of carbon oxidized, the N fixation per acre per year is 40 lbs. In Rothamsted land under grass without legumes fixes 43 lbs. of N per acre. But when adequate amounts of basic slag or ground phosphate rock are added, there may be a fixation of 80-100 lbs. of N per acre. When grasslands are ploughed up and phosphated with basic slag there is always a probability of fixation of 200 lbs. of N per acre as the quantity of carbohydrate available for oxidation on the soil surface is much greater. This is the reason why phosphating of ploughed-up grassland produced excellent results in the U.K. and other countries. In the famous Cockle Park experiments the basic slag added to grasslands not only helped the increased growth of white clover as explained by the Cockle Park workers but the grass-root-material oxidation creates more nitrogenous matter than the legume fixation, because, frequently in pastures and leys, grass is more abundant than legumes. There is reason to believe that the fertility of prairie lands all over the world is chiefly due to the fixation of nitrogen by the oxidation of organic matter aided by sunlight and phosphates.

The grasslands in the U.S.A. are as follows :

66 million acres of crop land used as pasture. There are 633 million acres of pasture and grazing

land and 301 million acres of pastured woodland. Hence, the total land under grass in the U.S.A. is approximately 990 million acres. Assuming a nitrogen fixation of 40 lbs. per acre in the pasture lands in the U.S.A., 1.32 million tons of N are expected from the 66 million acres. Taking 20 lbs. per acre from the pasture and grazing land, 6.33 million tons of N fixation is possible in the 633 million acres. Similarly, 301 million acres of pastured woodland can fix 3.01 million tons of N. Hence, the possible N fixation in the 990 million acres of grass and pasture lands in the U.S.A. can be 10.66 million tons. But nearly 10 million tons of available N are lost from the fields of the U.S.A. producing corn, wheat and other cereals, fodder, fibre, cotton, tobacco etc. Because in crop lands the N absorbed by the plants has to be in the available form, nitrogen from composts, plant roots and residues. All these forms of N seem to be less readily available than the chemical and precipitation nitrogen.

ORGANIC MATTER AND PHOSPHATES — STORE OF AVAILABLE NITROGEN AND OTHER PLANT FOOD MATERIALS

With 5°C as soil temperature in Uppsala (Sweden) the available nitrogen is only $^{1}/_{2}$ per cent of the total N. According to Sir John Russell the available N in the Rothamsted fields (8-9°C average temperature) is of the order of 1-2% of the total N. In our soils (26°C average temperature) we obtain 8-30% in the available condition. In our composts the available N varies in the beginning from 5-8% of total N, but in course of time it increases. When the C : N ratio of the organic matter is of the order of 10 the proteins undergo oxidation and nitrification and produce available nitrogen, its rate depending on the soil temperature. Thus, humus in the soil or the compost behaves as a steady supplier of available N, P_2O_5, K_2O, trace elements etc. Lady Eve Balfour reports that 5 tons of compost per acre are adequate in crop production. If the compost contains 0.5% N, 5 tons of compost can supply 50 lbs. of total N out of which 30-35 lbs. can pass into the available form and feed the crop. There is no doubt that a supply of available N always comes from the soil nitrogen. Assuming that the soil nitrogen is of the order of 0.1% in the first 6 to 7 inches, the 5000 million acres of land under cultivation in the world can supply 5500 million tons of total N and, perhaps, 55 to 110 million tons of available nitrogen to the world crops. If we can increase the available nitrogen from the soil humus, the need for other sources of available N decreases. This can be accomplished by adding basic slag, which is a great boon specially to temperate country agriculture.

In many American publications it has been stated that it is useless to increase largely the humus content of land under cultivation. But this viewpoint is incorrect. The Rothamsted fields receiving 14 tons of farmyard manure annually are much richer in humus (0.256 to 0.274% total N) and produce crops more steadily than those treated with commercial fertilizers. These lands are more amenable to cultivation processes than the chemically treated fields. Similarly, Mr. Henderson of the U.K., using large amount of farmyard manure and crop residues, considerably increased the humus content of his fields, making cultivation easy and profitable, without artificial fertilizers. Humus-poor lands, when fed with artificials, are uncertain regarding yields. This seems to be the chief reason for adding large amounts of dung, compost etc. in vegetable and crop production in temperate countries.

Empirically man found that his animal dung, when compostated and applied to fields, produced more crops. Similarly, fish, blood, guano etc. were found to be profitable. We now know that organic compounds with a C: N ratio smaller than 10 undergo oxidation and nitrification fairly readily in all soils and supply ammonium salts, nitrates, phosphates, lime etc. ... Similarly, composts from animal and plant residues with a C: N ratio of

10-14 help in crop production. They supply ammonium salts, nitrates, phosphates, potash, lime and other plant nutrients slowly to the growing crop. But organic materials with a C : N ratio greater than 15 have not been added directly to crop production because the soil available N is believed to decrease. But our studies in nitrogen fixation by incorporating organic matter in soils show that the time interval of 100 to 150 days can fix N in the soil and produce humus richer in N than the original material. We have always observed that the efficiency of N fixation in our method of direct incorporation of organic matter to soil is greater than in composting of the same organic matter. In this process phosphates are of great importance. Only through organic matter, which is a product of solar light, can light energy be utilized in fertility improvement as discovered by us and can explain steady crop production in many countries, without manures and fertilizers. Hence, carbohydrate manuring aided by basic slag seems to be of supreme importance to mankind all over the world.

It seems that at least 250 million tons of available N are necessary for the food, fibre and fodder production of the world. But only 3% of it comes from artificials, 2% from legume N and 2-3% from precipitation, and about 2% from farm yard manure, but the rest comes from the soil, the nitrogen of which appears to have been derived from the thermal and photochemical oxidation of carbohydrates photosynthesized. Hence, carbohydrate manuring aided by different calcium phosphates must be well organized all over the world to supply 90% of the nitrogen need of crops.

In our extensive researches on alkali land reclamation we have obtained excellent results by applying a mixture of bone meal and straw or molasses in Rajasthan, Mysore, U.P. and Bihar. Similarly, in composting of plant residues and city refuse basic slag and rock phosphates have been found to increase the N fixation. The unphosphated compost contains 0.5 to 0.8% nitrogen, whilst the N content of the phosphated compost is of the order of 1 to 2%, and the available N and phosphate also increase readily. We have discovered that sunlight is utilized in composting for increasing the nitrogen content of composts.

There is no doubt that vegetation aided by light and phosphates is the saviour of soil and can readily improve land fertility and crop production. In many of our Govt. farms, 25 to 30% of crop yield increase has been recorded by applying straw mixed with basic slag. In Suffolk (England) Lady Eve Balfour obtained an yield of 30.4 cwt. of barley grains per acre from a land manured by barley straw, mixed with 99 lbs. of P_2O_5 from basic slag against 20.6 cwt. per acre from a field fertilized by. 112 lbs. of nitrogen as ammonium sulphate. The control plot produced 14 cwt. barley grains per acre. Moreover, the land to which straw and slag was applied contained the largest amount of total and available N.

Dr. O. Arrhenius of Sweden and others have obtained a growth of 4.5 cubic metres of timber by applying 1 kg. of powdered rock phosphate against 2.8 cubic metres from the control tree.

In this Address, I have attempted to show that industrial N is unable to cope with world food production but organic matter aided by calcium phosphates and light can meet the situation and improve land fertility permanently.

EXPERIMENTATION — KEY OF EUROPEAN PROSPERITY

It is tragic that the majority of human beings in the world are still poor, ill-fed, ill-clad and uneducated. In India, Pakistan, Ceylon, Burma, China, Japan, most parts of South America, Egypt, Turkey, Italy, and Greece, the caloric intake per capita per day varies from 1620 to 2500. The daily animal protein consumption ranges from 5.6 to 20.5 gms. per person, while the normal physiological need is 2800 calories and 40 gms. of animal protein. Even in the U.S.S.R. the average animal protein intake is below the standard. Today the economics of the majority of the nations especially in the East is the Science of human misery as stated by Karl Marx a century ago. Countries like the U.K., Belgium, Holland, Switzerland, Finland, etc., are unable to produce the food required by them. But they have the means of importing their requirements, only during war periods there is food shortage in these countries.

During the 15th and the 16th centuries the experimental method of Science was gradually established in Europe by Paracelsus, Bacon, Boyle, Palissy and many others. They were followed by Black, Scheele, Priestley, Newton. Cavendish Davy, Berzelius, Pasteur, Ross, Koch and others who made tremendous sacrifice in pursuing scientific endeavour and experiments. They applied Science to all problems of life and developed their natural resources, improved their agriculture and made Europe prosperous. There was marked progress of Science and Technology for nearly 500 years. The European was taught to depend on experiments and he truthfully and rigidly carried on experiments and drew correct conclusions and was successful in mastering nature.

After the 8th century A.D. we in this country never carried on experiments and never accepted the experimental method of Science. This seems to be the main reason why we are backward and not so honest in our efforts and actions as an European who has developed more method and honesty in everyday life. We have been very unlucky because invaders came repeatedly to our land and enslaved us. Instead of following the path of truth, progress and Science we succumbed to moral and mental slavery and I am sorry to say that this mental slavery seems to be persisting. Instead of working hard on scientific and correct lines we try to get on by saluting, propaganda and saying "yes" to the man in authority who may not be sound.

The age of modern Science in India is approximately 60 years whilst in Northwest Europe scientist have toiled for nearly 500 years. Hence, we have to be patient and work hard for our national uplift. I am concluding this Address with the following lines written by the immortal Lavoisier just before he was guillotined by the French Republicans in 1791.

"We shall close this memoire with a consoling reflection. It is not required, in order to merit well of humanity and to pay tribute to one's country, that one should participate in brilliant functions that relate to the organization and regeneration of empires. The scientist in the seclusion of his laboratory and study may also perform patriotic functions. He can hope by his labours to diminish the mass of ills that afflict the human race and to increase its enjoyment and happiness; should he by the new paths which he has opened, have helped to prolong the average life of man by several years or even by only several days, he can aspire to the glorious title of benefactor of humanity".

Pontius Pilate asked Jesus Christ "Are you the king of the Jews"? If Christ Answered 'No' he would have been saved. But the follower of truth replied "My kingdom is not of this world" and courted violent and ignominious torture and death. All his disciples manfully welcomed sufferings and death in preaching the gospel of their master. The present Christian civilization which is rulling the world is based on the sacrifice of Christ and millions of his followers. The progress of this civilization has certainly been ensured by the tremendous sacrifice and devotions of numerous scientists. I am convinced that this ancient land of Gautum Buddha, Asoka, Vivekananda, Rabindra Nath and Gandhiji cannot fail to produce sacrificing and devoted men of Science for the uplift of the starving millions.

TEA : A MIRACLE OF A TEA CUP

Jyoti. D. Vora* and Prerna. K. Chawla**

Tea is the agricultural product of the leaves, leaf buds, and internodes of the *Camellia sinensis* plant, prepared and cured by various methods. "Tea" also refers to the aromatic beverage prepared from the cured leaves by combination with hot or boiling water, and is the common name for the *Camellia sinensis* plant itself. After water, tea is the most widely-consumed beverage in the world. It has a cooling, slightly bitter, astringent flavor which many enjoy.

HISTORY

It is said that tea was discovered accidentally by Emperor Shen Nung back in 2700 BC. After a large meal one day, he was relaxing in the garden with a cup of boiling water. At that time some leaves from a nearby tree fell into the cup. Unnoticed he consumed the drink. He enjoyed the taste of the tea and the pain relief of the drink was so much. Like this the cup of tea was born.

The Indian legend tells how in the fifth year of a seven year sleepless contemplation of Buddha he began to feel drowsy. He immediately plucked a few leaves from a nearby bush and chewed them which dispelled his tiredness. The bush was a wild tea tree.

By the early 1900's tea was being cultivated in most of the countries of the world.

MANUFACTURE

Tea manufacture is the process of converting young fresh tea shoots into dry black tea. This involves a number of processes from plucking to packing. At the plucking stage, only the top leaf tips are picked every 6 to 7 days. The tip leaves are younger and finer which produced a better quality tea. The fresh green leaves now need to have the moisture removed from them. This is done by blowing air through the leaves for upto 14 hours, leaving a soft and pliable leaf. There are then two ways of treating the tea.

TYPES OF TEA :

The different types of tea found in the market are made from the same bushes and processed differently, and, in the case of fine white tea, grown differently.

- **White Tea :** non-oxidised
- **Green tea :** non-oxidised
- **Oolong Tea :** semi oxidised
- **Black Tea :** fully-oxidised

The term "herbal tea" usually refers to an infussion or tisane of leaves, flowers, fruit, herbs or other plant material that contains no *Camellia sinensis.*

WHITE TEA

White is similar to green tea but with a noticeable difference in taste. The flavour is described as light, and sweet. You should steep white tea in water that is below the boiling point.

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There is also considerably less caffeine in white tea than the other varieties (15 mg per serving, compared to 40 mg for black tea, and 20 mg for green). Some studies have also shown that white tea contains more active cancer-fighting antioxidants than green tea. White teas are produced mostly in China and Japan, but the Darjeeling region of India also produces some fine white teas.

GREEN TEA

Green tea is nothing more than the leaves of the *camellia sinensis* that have been processed a certain way. Green teas, like white teas, are closer to tasting like fresh leaves or grass than the black or oolong. They are also lower in caffeine and have higher antioxidant properties.

First, the green leaves are seen how much oxidation should take place before drying them out. Tea leaves have enzymes in their veins. When the leaf is broken, bruised, or crushed, the enzymes are exposed to oxygen resulting in oxidation. The amount of oxidation depends upon how much of the enzymes are exposed.

OOLONG TEA

Oolong teas are the most difficult of the four types of teas to process. The best way to describe oolong tea is that they are somewhere in between green and black tea. This is because they are only partially oxidized during the processing.

Oolong tea is gently rolled after picking, allowing the essential oils to react with the air and slowly oxidize. The process turns the leaf darker with time and produces distinctive fragrances. The resulting tea can be anywhere between a green and a black, depending on the processing method. This tea is handcrafted, undergoing a labor intensive process.

BLACK TEA

Black teas are the most consumed of the four types of teas. They are the highest in caffeine. Black tea is the most popular tea in the world. It is the tea most widely used in making iced tea and English tea. Since the process of making black tea consists of three main stages, 'cut', 'torn' and 'curled' it is also known as C.T.C tea. After cutting, the leaves are first spread on shelves called withering racks. Air is blown over the leaves to remove excess moisture, leaving them soft and flexible. These withered leaves are then crushed between the rollers of a machine to release their flavored juices. In the tearing process the cells of the leaves are exposed and the oxidation process begins. They are then taken to the fermenting room where under controled temperature and humidity, they change into copper colour. Finally they are dried in ovens, where they are curled by heat and become brownish black.

Like other forms of tea, it also contains caffeine, a stimulant that acts to invigorate our senses immediately. It also contains other important ingredients like polyphenols, vitamins, etc. Black tea is also referred to as a tea which is completely devoid of milk.

SCENTED TEA

Scented or Flower tea is either green or white tea that has been infused with certain flowers, which impart a delicate and interesting taste, and of course a wonderful aroma. As with black tea and milk or sugar, flowers were added to green tea originally to disguise a less than favorable taste in the poorer varieties. This is still the case with many commercially produced flower teas, which hide the taste of very cheap tea behind a strong flowery presence. Flower teas, in particular the delicious jasmine, have gained such popularity both in Asia and the Western world, that many people only drink this variety.

A TEA FOR EVERYONE : HEALTH BENEFITS

- Contains 1/3 less caffeine than coffee or cola
- Helps reduce fatigue
- Maintains mental alertness
- Stabilizes fluid levels

- Is fat free and calorie free
- It's a refreshing step in the right direction. The antioxidants in a single cup of tea equal those in one serving of vegetables.
- Tea is rare source of natural fluoride which inhibits growth of the oral bacteria and enzymes responsible for dental plaque.
- Tea is also a rich source of manganese, necessary for healthy bones, and of potassium which regulates the heartbeat.

  Other valuable vitamins and minerals found in tea include vitamins B_1, B_2, B_6, folic acid, and calcium.
- **Heart Benefits :**

  Tea consumption may help heart disease patients. Tea's flavanoids prevent heart disease by
- Reducing Blood clotting
- Lowering Blood pressure
- Lowering Cholesterol (black tea)
- Maintains the health of the body's circulatory system of arteries and veins

A study conducted by researchers found that those who consumed one or more cups of black tea per day had more than 40 percent lower risk of having a heart attack compared to non-tea drinkers.

- **Cancer Prevention :**

The antioxidants in tea helps in preventing cancers of the mouth, stomach, pancreas, lungs, esophagus, colon, breast and prostate.

Green tea could help stop stem esophageal cancer. Green and black tea can slow down the spread of prostate cancer. Green tea and white tea fight colon cancer and may lower stomach cancer risk. Hot tea may lower risk of some skin cancers.

Tea may protect against cancer caused by smoking.

Immunity-Boosting Benefits

Tea is believed to boost the body's defense. A green tea component helps kill leukemia cells.

Tea may reduce the risks of various other diseases like Alzheimer's, hypertension, AIDS etc.

HEALTH RISKS OF TEA :

1. Carcinogens in tea bags

Some tea bags are made using a wet paper strength reinforcing coating using epichlorohydrin, which is known to be carcinogenic. Uses are not limited to tea bags, as coffee filters and sausage/ salami casings can have the same issues. The problem can be avoided by using loose-leaf tea or tea bags which do not use the coating.

2. Effects of fluoride

All tea leaves contain fluoride ; however, mature leaves contain as much as 10 to 20 times the fluoride levels of young leaves from the same plant. White tea contains less flouride than green tea and black tea, because it is made of buds and young leaves only.

The fluoride content of tea depends directly on the fluoride content of the soil in which it is grown; tea plants absorbs this element at a greater rate than other plants. Care in the choice of the location where the plant is grown may reduce the risk.

3. Effects associated with caffeine

Caffeine is an addictive drug and overuse of tea can result in harmful side effects, such as an increased likelihood of certain sleep disorders. Decaffeination reduces total catechins in both black and green dry teas by about 15 times and 3 times respectively.

Tea, particularly black tea, is a source of caffeine, although most teas contain less than the average cup of coffee. Some people are particularly susceptible to the effects of caffeine and can experience anxiety, palpitations, and elevations in blood pressure even at lower doses. One way to reduce levels of caffeine is to drink white tea which is much lower in caffeine or buy naturally decaffeinated black and green tea.

4. Oxalates

Oxalates are natural organic acids that can combine with calcium to produce calcium oxalate kidney stones. Although oxalates in tea are unlikely to be a problem for most people, in certain susceptible individuals too much oxalate could increase the risk of kidney stones. People who have a history of kidney stones should limit the amount of tea they drink and reduce other dietary sources of oxalate. It may as well as soak up free calcium and other minerals in the body.

5. Tannin

Tannins are a form of polyphenols found in tea that can give it a better, astringent taste when present in high quantities. Tannins can reduce the absorption of certain minerals such as iron. In some people, this could result in anemia. The way to prevent this problem is to avoid drinking tea with meals. Another way is to add a few drops of lemon to tea before it's drunk. The vitamin C in the lemon helps to offset the negative effects of tannins of mineral absorption.

6. Hot drinking temperature

Hot tea cousumption has been linked to a higher risk for esophageal cancer ; In a case-control study, risk for esophageal cancer was increased for drinking hot tea...or very hot tea...vs. lukewarm or warm tea. Risk was also significantly increased for drinking tea 2 to 3 minutes after pouring...or less than 2 minutes after pouring...vs. drinking tea at least 4 minutes after being poured.

7. Risks against faulty storage and packaging

Due to faulty storage techniques tea leaves may develop fungal growth which may not even be distinguishable from normal tea leaves. This fungal growth may get dissolved in water while tea preparation. These if consumed, may cause various illness or allergies.

CONCLUSION

Whenever someone mentions the word "tea", normally people will just treat it as a kind of beverage drunk by elderly. This is certainly not the truth. It is found that tea has been one of the most popular drinks throughout ages and we could find tea-related products everywhere. For instance, scrumptious green tea cake, green tea ice-cream, iced lemon tea, etc, can easily be found in most shops or supermarkets.

Apart from the tastiness of the tea food, it can also help with our digestive after meals. Tea leaves are able to clear away the grease in meat and get away the fishy smell of the sea food too. Of course, it brings along its unique fragrance.

To get the most health benefits out of your teas, choose high-quality loose leaf teas from your local or online tea shop. Brew it up and enjoy. And of course, don't throw out the idea of enjoying instant or bottled teas when you're on the go. You just might have to drink a little more.

Don't wait any longer. Sip, savor, and fight disease today. It's never too late to enjoy the many health benefits of tea !

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CORPORATE SOCIAL RESPONSIBILITY TOWARDS ENVIRONMENT PROTECTION IN INDIAN ECONOMY

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In order to have competitive advantage, industries have to adopt a more holistic and inclusive business model, which has a direct correlation with business performance covering economic, social and environmental considerations. Companies are now expected to discharge their stakeholder responsibilties and societal obligations, along with their shareholder-wealth maximization goal. This paper discusses various mechanisms implemented by different industries towards energy conservation and sustainable development in Indian economy.

INTRODUCTION

The indian corporate sector spent US$6.31 billion on social expenditure during 2007-08, up from US$ 3.68 billion spent during the previous fiscal. The Steel Authority of India Ltd (SAIL) spent US$ 21.05 million on CSR last year; Tata Steel Ltd, which runs a 850-bed hospital and rural projects in 800 villages around Jamshedpur, spends about US$ 31.58 million as part of its annual revenue expenditure. Bharat Petroleum and Maruti Udyog were ranked as the best companies in India under Public Sector Undertakings (PSUs). Bharat Petroleum and Maruti Udyog came on top with 134 points each, followed by Tata Motors (133) and Hero Honda (131).

KEY AREAS OF CORPORATE SOCIAL RESPONSIBILITY

Focusing on three key areas for Corporate Social Responsibility can help create a cohesive map for the present and future :

- Community Relations,
- Training and Development, and
- A Cohesive Global Corporate Social Responsibility Platform

Encouraging Community Relations through HR team includes implementing reward programs, charitable contributions and encouraging community involvement and practices. Training and Development programs to explain the relationship between the company's core products or services and the society at large, their value to the local community and ways in which employees can get involved in appropriate CSR projects would sustain and direct these initiatives.

Global Corporate Social Responsibility policy is important to acknowledge successes and measurements according to accepted standards. Central to measuring and communicating these results is the use of a Web-based Human Resources Information System (HRIS) to be made available globally to employees and managers with any Web browser[3].

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CSR INITIATIVES TOWARDS ENVIRONMENT PROTECTION : THE WORLD SCENARIO

Texas Instruments (TI) implementing energy consenation projects :

Texas Instruments (TI) has established energy reduction goals on a worldwide basis, and has identified and implemented thousands of conservation projects.

TI encourages the use of mass transportation and flexible working solutions. At some sites. TI offers employees transportation assistance, including financial incentives for using mass transportation or carpools[1].

North-East Sustainable Energy Association (NESEA) incorporating sustainable and energy-efficient elements into buildings :

Northeast Sustainable Energy Association (NESEA) organizes an annual event in conjunction with the American Solar Energy Society's National Solar Tour. Sustainable energy features were on display at private homes, businesses, public buildings, schools, farms, colleges, and nature centers. Green buildings can reduce heating costs over traditional buildings ; slow the pace of global warming ; reduce pollution-induced increases in asthma-related illnesses ; reduce the incentive to drill for oil and gas in pristine landscapes ; and even generate surplus clean energy to power other buildings.

Sun Microsystems encouraging eco responsibility activities :

Sun Microsystems's Linlithgow's Scotland project's eco responsibility activities have been focusing on electricity, natural gas and water use, and waste management. Since October 2005, the Linlithgow facility has used 100% renewable energy—wind and hydro power—for its electricity. Building management control systems have been installed around the Linlithgow campus. These include temperature and lighting controls. Light fixtures have also been fitted with energy-efficient bulbs[2].

World Bank grants US $441 million loan to China's energy sector

The World Bank has approved three energy sector loans, totalling US$441 million, for China. The three projects are energy efficiency financing, desulphurization in Shandong and infrastructure in medium-sized cities in Liaoning, respectively. The loan is granted to these three projects with the purpose of helping China promote the more efficient use of energy and reduce the emissions from power plants. The goal of the energy efficiency financing project is to help China's Export-Import Bank. Huaxia Bank and other Chinese commercial banks develop sustainable energy-saving loan services and support energy-saving investment projects of large and medium enterprises.

Goodyear Tire & Rubber Company awarded for excellence in energy conservation in Maharashtra (India)

The Goodyear plant in Aurangabad, received a first place award for excellence in energy conservation and management by the Government of Maharashtra. A national award for energy efficiency was also earned by the Goodyear plant in Ballabgarh, India.

Swire implemeting energy management tools in industries :

Swire Pacific has established recycling and efficiency measures at its Shatin production plant to reduce energy consumption. These include using recycled bottle-rinsing water to cool the refrigerant in its air-conditioning systems, and employing a heat exchange system to transfer waste heat from one production line to another. The plant uses air blowers to generate low-pressure compressed air to dry bottles with less use of energy. Solar panels are now used to heat water for boilers. In the UK, the Swire Group Charitable Trust has recently contributed £100,000 to the National Oceanographic Centre in Southampton to fund research into levels of dissolved CO_2 in the world's oceans.

Ashok Leyland Ltd encouraging rainwater-harvesting projects :

Rainwater-harvesting projects are implemented extensively to improve the ground water table and the saved water used during summer to prevent depletion of ground water.

ABB helping people with disabilities to obtain jobs

ABB Ltd India won the prestigious Helen Keller award in 2005 for its innovative projects to help people with disabilities to obtain jobs.

Blue Star assisting in disaster management :

Blue Star factories take active participation in providing temporary shelters and essentials for the victims of an earthquake, sponsoring health check-ups and health education programs in local schools.

Bajaj Auto Ltd working towards environmental protection

Bajaj Auto Ltd had launched ecologically friendly CNG engines for three wheelers in Delhi. The company has been committed to its social and environmental responsibilities both within and outside the company, reiterating that a happy workforce is a productive workforce.

Dena Bank encouraging rural development and self-employment training

Dena Bank has developed an Institute for imparting training to unemployed rural youth and women for capacity building. The bank has introduced a novel scheme "Dena Laxmi Shiksha Protsahan Yogana" to sponsor the education of a girl child in the villages served with a bank.

Indian Oil implementing community welfare and development program :

Every year, Indian Oil reserves a fixed portion of its profits for a comprehensive community welfare and development program. About 20% of the community development funds are spent on the welfare of Scheduled Caste and Scheduled Tribe beneficiaries.

Infosys Technologies Ltd enriching rural life :

Infosys Foundation has initiated several activities to benefit the rural and urban poor by constructing hospital wards, donating hi-tech equipment and organizing health camps.

Jindal Steel & Power Ltd installing latest pollution control systems

The company has implemented Total Productive Maintenance (TPM) for preventive maintenance and better process control, by installing latest pollution control systems.

Jain Irrigation Systems Ltd encouraging conservation of natural resources

The main theme of the company is to have optimum utilization of raw materials, energy, water and other inputs in the manufacturing process to continually reduce all types of pollution, conservation of natural resources like water and wood through promotion of plastic pipes and micro irrigation system for water management.

ONGC Videsh Ltd implementing recycling of resources and utilization of wastes :

The company is adopting technology ensuring energy economy, environmental safeguards, recycling of resources and utilization of wastes, to control releases of hydrocarbons, chemicals and other materials to safeguard flora and fauna, eliminating releases containing viruses, pathogenic bacteria and parasites from entering marine waters.

***Zensar Foundation* empowers students towards formal education :**

Zensar Technologies in association with Thermax, Forbes Marshall, Confederation of Indian Industries—Young Indians (CII–YI) and Pune Municipal Corporation aim to empower students who have discontinued formal education for various reasons.

CONCLUSIONS

Apart from improving the overall quality of life, corporate social responsibility, sustainable development and good human resource practices can help improve India's long-term international competitiveness in attracting 'socially responsible investment'. Environmental, social and governance (ESG) compliance is helping Indian industries to become stronger and more attractive to issuers from other emerging markets. CSR has become increasingly prominent in the Indian corporate scenario because organizations have realized that besides growing their businesses it is also vital to build trustworthy and sustainable releationships with the community at large.

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FROM LIVING TO NONLIVING : BARCODING LIFE

Veena Sharma and Khushbu Goel*

DNA sequences from a uniform area on genomes can be a barcode of life for identifying and characterizing species. As a master key opens all the rooms in a building, the barcode of life provides an additional master key to unfold the deep secrets of ancient and ever evolving species. Faster and easier sequencing, will make this barcode key increasingly practical and useful technique.

INTRODUCTION

One of the most important feature of modern life is "Barcode"-machine readable digital tag, usually a series of stripes which encodes information about the item to which it is attached, 'DNA Barcoding' was first used in 1993. The golden age of DNA barcoding began in 2003. **"Consortium For The Barcode of Life"** (CBOL), an international initiative which supports the development and research in DNA barcoding. The DNA barcode sequence includes about 650 DNA "base-pairs" represented by the letters [A, C, G and T]. DNA barcode is a very short, standardized DNA sequence in a well known gene. The COBOL is promoting international partnerships that will enable people in all countries to better understand and protect their biodiversity.

Similarly 'DNA Barcoding' is a standardized approach for the identification of animals and plants species from minimal sequences of DNA available. DNA barcoding offers taxonomists the opportunity to expand and complete the globally scattered pieces of life's diversity. Utilisation of advances in electronics and genetics will help people easily identify and recognize known species from minute fragments and works for all stages of life.

The primary aims to taxonomy are to name, circumscribe, describe and classify species. A DNA barcode system is likely to be able to achieve the three scientific goals of taxonomy and thus support a broad spectrum of taxonomic identification which uses a standard short genomic region that is university present in target lineages and has sufficient sequence variation to discriminate among species[3].

IDENTIFICATION AND CHARACTERIZATION

With the morphological identification of species, DNA barcoding too, might enhance biodiversity inventories by being faster and cheaper. Assessment through the identification of taxa from the traces of DNA present in environmental samples such as soil, water, sediments etc. Identification of sample via barcoding includes the processes of DNA extraction, DNA amplification, purification of PCR product and sequencing using capillary

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electrophoresis. For routine identification, dozens of taxonomists can be replaced by single technician in DNA barcoding. The biodiversity of environments with low accessibility can also be estimated with this new technique, as demonstrated by the study of the microbial biodiversity in deep sea.

Barcoding is generating a global, open access library of reference barcode sequences which enables non-taxonomists to identify specimens. The barcode of an unidentified specimen can be compared with the reference barcodes to find the matching species. For Barcoding projects have already generated hundreds of thousands of reference barcodes for tens of thousands of species. These species have been selected because they are of special interest to users who need the ability to identify species economic or social importance. The Consortium For The Barcode of Life is creating partnerships among government agencies, local researchers, and NGOs that design and implement the highest priority barcoding projects.

Other important use for such a tool are—

- Ecosystem studies
- Identification of fragment of excavated plant and animal material
- Evolutionary studies
- Forensic analysis
- Characterization of Herbal drugs

An ideal DNA barcoding should be variable, standardized, phylogenetically informative, extremely robust and short.

LIMITATIONS OF DNA BARCODING

DNA based species identification depends on distinguishing intraspecific genetic variation. The ranges of these types of variation are unknown and may differ between groups. It may be difficult to resolve recently diverged species or new species that have arisen through hybridization. There is no universal DNA barcode gene, no single gene that is conseved in all domains of life and exhibits enough sequence divergence for species discrimination. The validity of DNA barcoding therefore depends on establishing reference sequences from taxonomically confirmed speciments. This is likely to be a complex process that will involve co-operation among a diverse group of scientists and institution. What genes are appropriate targets for DNA ?

This is likely to be a complex process that will involve co-operation among a diverse group of scientists and institutions. What genes are appropriate targets for DNA barcoding ? The ideal gene target is sufficienty conserved to be amplified with broad-range primers, yet divergent enough to resolve closely related species.

For animals, mitochondrial genes are attractive targets because they are shared across diverse taxa and do not contain introns that can complicate amplification using the polymerase chain reaction (PCR). The availability of broad-range primers for amplification of mitochondrial COI from diverse invertebrate phyla stablishes this gene as a particularly promising target for species identification in animals.

CONCLUSION

Many criticisms of barcoding are not made in the defense of morphological characters, but rather to emphasize the important of multiple sources of data, including the use of multiple genes, and morphological and/or ecological characters in an analysis. DNA barcoding has devloped in concert with genomics based investigations[5]. Both emphasize on large scale genetic data acquition offering information beyond the range of traditional disciplines. Database and sequence search strategies are two deciding factors affecting working of barcode markers. Algorithms used in a multiocus barcode will also require new strategies than those commonly used in the databases Gen Bank and the Barcode of Life Database (BOLD). Kress and Erickson 2008 are of the view that... "DNA barcoding has great potential for enhancing ecological and evolution investigations if the right genetic markers are selected."[4,5]

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E-WASTE IN INDIA : A NEW THREAT TO THE ENVIRONMENT

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Electronic and electrical wastes, commonly known as e-waste, are posing a serious threat to the global environment. The problem has become acute due to the rapid obsolescence rate of electronic goods. E-waste contains various harmful and hazardous chemicals that come into the environment due to its improper recycling. Instead of proper disposal, developed countries are now trading waste in the name of reuse or recycling and sending it to the developing countries. In a country like India, the problem of accumulation of e-waste is more acute because the developed countries are exporting the e-waste by using the ambiguity in national and international laws.

INTRODUCTION

Environmentalists find that the rising trend of electric wastes, commonly known as 'e-waste' is posing a serious threat to the global environment. E-waste is the term used to describe old, end-of-life electronic appliances such as computers, laptops, TVs, DVD players, MP_3 players, and mobile phones etc. which have been disposed by their original users.[1] The electronic and electrical goods are largely classified under three major heads, as : 'white goods', comprising of household appliances like air conditioners, dishwashers, refrigerators and washing machines; 'brown goods', comprising of TVs, camcorders, camera etc and 'gray goods' like computers, printers, fax machines, scanners etc. Each of the above items contains the following 26 common components viz. metal, motor/compressor, colling, plastic, insulation, glass LCD, rubber, wiring/ electrical, concrete, transformer, magnetron, textile, circuit board, fluorescent lamp, incandescent lamp, heating element, thermostat, brominated flame retardant (BFR)- containing plastic, batteries, CFC/ HCHC/HHC/HC, external electric cables, refractory ceramic fibers, radioactive substances and electrolyte capacitors (over L/D 25 mm). These products contain many neurotoxic and carcinogenic substances that are leached into the soil and water-bodies and enter the air due to burning as dust. Thus since the 70's there has been a trend to export the used products for reuse and e-scape for recycling from developed countries to developing countries. Many reports assert that the dumping of e-waste into landfills poses an environmental risk and trans-boundary transportation.[2] Unlike the traditional wastes, environmental impacts of e-waste mainly arise due to inappropriate processing, rather than inherent toxic content. In many cases it is difficult to segregate the waste, the secondary goods intended for reuse. In India, recycling of e-waste is almost entirely left to the informal sector, which does not have adequate means to handle either the increasing quantities or certain processes, leading to intolerable

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risk for human health and the environment. The aim of this article is to spread awareness through our readers about the various issues involved in generation and management of e-waste, particularly in the Indian context.

GROWTH IN WASTE GENERATION

The sustained growth in Information and Communication Technology (ICT) in India requires a special attention to the environment. Annually about 12 million personal computers (PC) and 4 million printers are sold with a healthy growth rate (20%) of software industry. Table -1 shows the per capita expenditure of ICT in different developed and developing countries for the year 2000 and 2001, clearly projects its significant contribution in the product market.

Table–1
Information and communication technology expenditure per capita (in US $)

Serial No.	Country	Expenditure in 2000	Expenditure in 2001
01	Switzerland	3,482	3,618
02	Japan	3,118	3,256
03	United States	2,926	2,924
04	Denmark	2,778	2,912
05	UK	2,187	2,319
06	Hong Kong	2,085	2,110
07	France	1,916	2,048
08	Canada	1,911	1,960
09	Germany	1,798	1,880
10	Brazil	289	287
11	Ex-Russian Federation	63	68
12	China	46	53
13	India	18	19

Besides this, the recent culture and attitude (exchange offer, loan fair etc). of the people have increased the inflow of new products by dumping the old one. In India the problem has become very acute for using the unbranded and assembled units at higher rate without the authenticity of their origin. Similarly, due to the rapid technology upgradation, the discarded peripherals find their way to landfills. The changing lifestyle of people, coupled with the urbanization has led to increase in the rates of consumption of electronic products. Table-2 showing the probable discard rate of some electronic items may help to judge how fast e-waste is generated.

Table–2
Discard rate of electronics items

Serial No.	Item	Discard/ Replace rate
01	Cell phones	1 to 3 years
02	Personal Computers	Every 2 years
03	Camera	3 to 5 years
04	Television	10 to 15 years
05	Refrigerator	10 to 15 years
06	Washing machine	10 to 15 years
07	IT Accessories	Frequent

Although many of these products can be reused, refurbished or recycled, yet, the electronic discard is one of the fastest growing segments of our nation's waste stream.

DYNAMICS OF E-WASTE GENERATION

It is difficult to answer the question as to how much e-waste is being generated around the world, and from where and to where is going ? A primary constrain is that flow of secondary and waste products are by and large invisible to national statistics on production, sales and trade in goods.

E-wate researchers in Switzerland have collected results from different sources to estimate the total generation of electronic waste per year in selected countries. Their data are shown in Table-3.

Table–3

E-waste generation in different countries in different years

Serial No.	Country	Year	E-waste generated/ year in tons
01	Switzerland	2003	66,042
02	Germany	2005	1,100,000
03	UK	1998	9,15,000
04	USA	2000	2,124,400
05	Taiwan	2003	14,036
06	Thailand	2003	60,000
07	Denmark	1997	1,18,000
08	Canada	2005	67,000

Although there are variations in considering e-waste in different countries, yet in economic terms, global production of electronics grew 4.4% in 2002 and 6.8% in 2003.[5] Similarly, the Manufacturers' Association for Information Technology (MAIT) has collected the following statistics on the growth of IT and electronic equipments in India. More than 7.3 million units of PC's were sold during the year 2007-2008, with a growth rate of 16 percent. Consumer electronic market is growing at the rate of 13-15 percent annually that has installed a base of 120 million TV's, while the installed base of cellular subscriber is estimated to cross 300 million mark by 2010.[6] Due to the unprecedented growth of IT industries in India during last decade, and high rate of obsolescence due to continuous innovation, e-waste generated in India was around 3,32,979 metric tons in 2007, out of which 50,000 metric tons entered the country by the way of import. However, the total e-waste available in 2007 for recycling and refurbishing was 1,44,143 metric tons of which only 19,000 metric tons were processed. Table-4 shows the e-waste generated in some state and cities in India.

Table–4

E-waste generated in top ten states and cities in India

Serial No.	State	E-waste in tons	City	E-waste in tons
01	Maharashtra	20270.59	Ahmedabad	3287.5
02	Tamil Nadu	13486.24	Bangalore	4648.4
03	Andhra Pradesh	12780.33	Chennai	4132.2
04	Uttar Pradesh	10381.11	Delhi	8730.3
05	West Bengal	10059.36	Hyderabad	2833.5
06	Delhi	9729.15	Kolkata	4025.3
07	Karnataka	9118.74	Mumbai	11017.1
08	Gujrat	8994.33	Nagpur	1768.9
09	Madhya Pradesh	7800.62	Pune	2584.2
10	Punjab	6958.46	Surat	1836.5

Remember that, India IT industries have a growth rate much higher than that of developed countries. India's target of 5 PC/500 by 2008 people and 1 PC/50 eventually. This figure would represents a vast amount of equipment that has to be added to the waste stream.

HEALTH AND ENVIRONMENT IMPACTS

Electronic goods are composed of different harmful and harmless materials some of which have high value. Valuable materials like, gold, platinum, silver, copper etc. can be recovered from e-waste and this motivate recyclers who process the waste with regard for the environment. Some wastes containing toxic substances have an adverse impact on human health. Often, these hazards arise due to the improper recycling and disposal processes used.[7] Waste from the white and 'brown' goods is less toxic as compared with'gray' goods. 50% weight of an average desktop computer contains plastic, iron and aluminium. Percentage of precious metal like gold is higher in e-waste than in the naturally occurring mineral ore. Table-5 shows the percentage of different precious metal in a typical desktop computer.

Table–5

Composition of a typical desktop computer weighing-27 kg

Serial	Name of material	% of total weight	Weight of material
01	Plastic	23	6.26
02	Lead	6.3	1.72
03	Aluminium	14.2	3.86
04	Iron	20.5	5.58
05	Gold	0.0016	< 0.1
06	Copper	6.9	1.91
07	Arsenic	0.0013	< 0.1

Recycling of printed circuit board generates the most serious pollution problem if these are disposed in water bodies. For removing IC chips from the printed circuit board and needs to melt the adhered lead by heating. Printed circuit board still contains precious metals like copper and gold after the IC chips have been removed. To recover the copper and gold, workers use very strong liquid acid and this process releases very toxic wastewater. Halogenated substances such as dioxin and furans are generated as a consequence of recycling electronic wastes. Incineration of e-waste emits highly toxic gases.[8] Table-6 indicates the toxic emissions from processing of e-waste.

Table–6

Toxic emissions in the processing of e-waste

No.	Processes	Subs. emitted	Release to	Health effect
01	Copper on printed circuit board	Sulfuric acid	Land	Skin & eye
02	Open burned plastic	Zinc oxide	Air	Inhaled toxic
03	Gold refining	Mercury	Air	Blood toxic
04	Open burning & incineration	Dioxin, furan	Air	Carcino-genic
05	Waste water treatment	Toxic sludge	Water, land	W. pollutant

Much of the recycling activity is in the nature of backyard operation using rudimentary technology in an environment where labour is totally exploited. In India, the recycling units that are located in dingy lanes, behind closed doors survive because of local political patronage. However, the pricing is a poor reflection of the hardships and working conditions of the recycling workers or the environmental damage that occurs. Electronic and electrical equipments seem efficient and environmentally-friendly, but there are hidden dangers associated with them when they become e-waste. It poses a real danger to human health if the abandoned products are not properly processed prior to disposal. Electronic products like computers and cell phones contain a lot of different toxins. Cathode ray tube (CRT) of computer monitors contains heavy metals viz. lead, beryllium and cadmium, which can be harmful to health if they enter the water system. These materials can cause damage to human nervous and respiratory systems. Brominated flame retardant plastics used in electronic casings release particles that can damage human endocrine functions. Table-7 lists the names of hazardous substances, their source of occurrence in the e-waste and toxic effect in human organs.

Table–7

Harmful substances in e-waste, their soruce and toxic effect

No.	Name of substances	Occurance in e-waste	Toxic effect
01	Polychlorinted biphenyls	Condenser & transformer	Cancer
02	Chlorofluoro-cabron	Cooling unit	Skin Cancer
03	Polyvinyl chloride	Cable insulation	Respiratory problem
04	Arsenic	Light emitting diodes	Lung cancer
05	Cadmium	Printer ink, toner	Fever, headache, chills
06	Chromium VI	Floppy disk	DNA damage
07	Beryllium	Rectifier	Affect lungs
08	Mercury	Fluoresecent lamp in LCD	Brain & liver damage
09	Lead	CRT screen	Appetite loss, fatigue

RECENT THREAT

In 1970s and 1980s hazardous wastes exported from developed countries to developing countries caused serious environmental pollution. In order to stop this trans-boundary movement of hazardous wastes and their disposal the 'Basel Convention' was put into effect in 1992. It is the world's most comprehensive environmental agreement on hazardous and other wastes and it states that the governments are expected to minimize the generation of hazardous wastes, treat and dispose of waste as close as possible to their place of generation and reduce the quantities for transporation. So the proper implementation of the Basel Convention would ensure that the hazardous e-waste be managed in an environmentally sound manner as it provides the tools for recycling and recovery. But in order to bypass the spirit of the convention, most of the developed countries are now trading wastes for reuse and recycling instead of trading waste for final disposal. Developed countries like the United States have not ratified the 'Basel Convention' even to date. Moreover, the US government policies appear to be designed to promote sweeping the e-waste problem out the Asian back door. In fact the US government has intentionally exempted e-waste materials, within the resource conservation and recovery Act, from the minimal laws that do exist to protect importing countires.[9] In India there are several acts and regulations for different specific purposes (a) Hazardous Wastes (Management & Handling) Rules 1989/2000/2003; (b) DGFT (Exam Policy 2002-07); (c) MoEF Guidelines for Management and Handling of Hazardous Wastes 1991; (d) The Public Liability Act, 1991; (e) The National Environmental Tribunal Act, 1995; (f) Municipal Solid Wastes (Management and Handling) Rules, 2000 and 2002. Unfortunately, none of these regulations deal directly and specifically with e-waste. As per rule 11 of the hazardous waste rules of 1989, the import of e-waste may be allowed for processing and reuse as raw mateiral with the permission of Ministry of Environment and Forest through the proper examination of the state pollution control board. Under rules 13 (3) the importer should have eco-friend technology for reprocessing and he has the capability to handle the reprocess and adequate facilities for treatment and disposal of e-waste. By passing these laws millions of tons of e-waste are being dumped in our country for reprocessing and reuse without having suitable technical know-how. The import of hazardous wastes into India is actually prohibited by a Supreme Court directive in 1997, which reflects the 'Basel Ban'. The developed world, however, finds it more convenient and also economical to export the waste to the third world country like India, rather than managing and incurring high environmental and economic cost. Even as the United State pushes India to relax its restrictions on importing used computers and parts, shiploads of illegally imported equipments from the US and other developed countries are swamping India, contributing to a growing e-waste problem. India and US are engaged in tough negotiations over import of second hand computers and parts, with the US insisting India to allow more liberal importation of 'pre-used' hardware, according to reports. India prefers to stick to its norm of importing hardware that has at least 80% residual life left. Unlike the developed countries, there are no set norms for handling of electronic waste, and secondly, cheap labour not only makes disposal cost-effective and profitable for local traders but also encourages the develped countries to push electronic wastes to countries like India.

The economics of the backyard recycling unit is complicated where the workers health and environmental conditions are compromised. So in India, the reprocessing/recycling of e-waste is going on merrily at the cost of ill paid labour and contaminated environment by using the lack of clarity and ambiguity of the existing Acts, Laws and Regulations.

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SHORT COMMUNICATION

ANTARCTIC TREATY : FIFTY YEARS OF THE FIRST INTERNATIONAL TREATY TOWARDS EARTH-CARE

Bhupati Chakrabarti

The signing of the Antarctic treaty was no doubt the culmination of some high level political and diplomatic manoevre but science had a very significant role in the whole exercise.

It was barely fifteen years after the World War II came to an end. In the politically polarized world of the late 1950's, with two superpowers staring at each other with lot of a caution and reservation, a very special initiative silently rolled in. It was an initiative to earmark a region on the globe as a zone where no military activities could be undertaken. It should be a permanent peace zone, free from the political control of any particular nation and it should be a place for only scientific research be open to all. The realization of such a need for a virtually unspoilt region on globe was by no means an easy task.

The region under discussion is the vast ice covered continent lying south of 60°S latitude ; the Anatarctic region. It is more than 1.5 times in area than that of United States, more than 90% ice of whole world is lying here covering all but 1% area of the continent. Strong gale is always blowing over this inhospitable terrain whose temperature goes down to as low as–88° C. There are some marine lives like seals in this otherwise non-habitable vast area with the geographic South Pole lying roughly at its central zone.[1] The basic objectives stated in the treaty were : (a) to demilitarise Antarctica, to establish it as a zone free from nuclear tests and the disposal of radioactive waste, and to ensure that it is used for peaceful purposes only : (b) to promote international scientific co-operation in Antarctica ; (c) to set aside the disputes over territorial sovereignty.[2] The then two most powerful nations, the USA and the USSR joined hands through an international treaty to keep Antarctic region free from all sorts of nuclear tests, military activities and of course from political control. The icy continent was declared as the property of the humankind on earth and to be used for scientific research only. It was December 1, 1959 the Antarctic Treaty, as it is now known, was signed at Washington DC. Signatories included apart from the USA and the USSR, a small group of other nations.

The signing of the Antarctic Treaty was no doubt the culmination of some high level political and diplomatic manoeuvre but science had a very significant role in the whole exercise. In the year

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1957-58, on the occasion of International Geophysical Year (IGY) a joint team of scientists from different discipline, from twelve nations undertook some scientific study on the land of a newly identified continent know as Antarctica. It was the first multi-nation scientific activity carried out at Antarctica. These scientists univocally said that Antarctica being a very special place on earth should be kept free from political and military activities. It can only be used for scientific research, as that will simultaneously serve two distinct purposes. First, that will help to protect the unique delicate character of Antarctica and, second, that will help the scientists to carry out collaborative research on some very special fields that may only be possible on that cold, barren and rather unfriendly terrain of Antarctica. The region consists of a very special ecosystem where in spite of extreme cold environment some life forms do survive. The thick ice sheet has kept covered some very old forms of rock, which have not suffered atmosphere weathering. A study of these is likely to reveal information about the early earth surface. Some of the Antarctic ice has kept some old air trapped inside it. This air, if compared with the today's air may provide us with the information on the pollutants that have gone into the air over the years. Incidentally the first 12 signatory nations for the Antarctic Treaty were those who sent their team of scientists in Antarctica during the IGY. So it was by no means a small achievement from the standpoint of the scientific community. It must be mentioned in this connection that the Antarctic Treaty came into force on June 23, 1961 when the first twelve nations then active in Antarctica ratified it.

And it was not an easy task however novel the idea may be. The number of countries with geographical proximity to the different parts of the Antarctica were very much eager to claim their respective territorial control over atleast some part of the huge ice covered region. These nations were possibly more interested to explore the region for its hidden natural resources lying underground. New Zealand, Argentina, South Africa and Chile were some of those important nations who initially did not like the international initiative on a region that according to their opinion could have been their territory. So by all means it was a tough task to arrive at a consensus regarding the fate of the continent.

But things have changed. Till the end of the year 2008 forty-four nations have agreed to the Antarctic Treaty. However, only twenty-seven of them can participate in the decision making process. These twenty-seven countries include the original twelve signatories and fifteen other members and the whole set of nations are referred to as Consultative Parties. Apart from the original signatories who hold the unconditional Consultative status the other countries of the group are given conditional Consultative status. These 15 nations are choosen from those who have not only acceded to the treaty but have shown proven interest in conducting scientific research in Antarctica and have contributed in the Antarctica based scientific reseach. Only the Consultative Parties can participate in the decision-making process at the Antarctic Treaty Consultative Meetings (ATCM) but the most important aspect is that every decision requires a consensus of the 12 original signatories (Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, Poland, Russian Federation, South Africa, United Kingdom, USA) consultative status and the 15 other states.[3] India now enjoys this Consultative status for its contribution in Antarctica based research. However, the nations that plan to conduct scientific research on the continent may request for the Consultative status. The capability of a country to take part in the research activities over Antarctica is reviewed and if found suitable the country is in the top bracket. India which became a part of the Treaty in 1983 started taking part in the research activities there-in immdeiately afterwards.

India has participated by sending teams from time to time which have conducted research in

Atomospheric sciences, ozone layer, Glaciology, oceanography Biology, Earth Sciences, Meteorology, Cold region Engineering, Communication, Human Physiology and Medicine and some more relevant branches of science to have a better understanding of nature and life from under difficult stressful conditions. India has set up a permanent research station in Antarctica and has named it a Dakshin Gangotri. Starting from 1984 till now 26 Indian expeditions to the ice covered continent have taken place. There is now a permanent Indian Research Station; Maitri in Schimacher Oasis (Hill) area, East Antarctica and it was established in 1988-89. The Geological Survey of India (GSI) has recommended a site for India's Third Antarctic Station and the planning for this is complete.[4]

No activity in Antarctica is simple and it demands special planning for execution. For example, the USA has shifted its research base to a newly constructed base, a huge building that took 20 year and a whopping cost of $174 million. The special design has the whole building raised over 36 steel columns of 4 metre over the surface. Lots of aerodynamic analysis have gone into the design to make the gull force winds to deposit snow on a side that does not put the building under difficulty and people inside it under stress. Interestingly, the station has so many facilities like full size volleyball and basketball courts, exercise rooms for 750 people that it can accommodate. Moreover, all the 750 people would be provided with private rooms with telephone and internet connection. Yet they are allowed shower only twice a week, a stark reminder of the ground realities.[5] After all, with either 24 hours of sunlight or 24 hours of darkness that make the continent the most inhospitable terrain, there need to be always some special arrangements.

A closer look at the treaty will reveal that the concept of environmental protection was still not in the minds of the world leaders in the form that we talk about today. Initially, they actually did not think in terms of protecting the very special and unique environment of Antarctica. Rather they wanted to keep the zone out of bounds of any military activity by the other nations or by the members of the rival groups. After all, the epoch making book 'The Silent Spring' by Rachel Carson considered to be the first modern book that comprehensively drew the attention of the mankind towards the evil effects of environmental pollution came out only in 1962, three years after the Antarctic Treaty came into being. However, subsequently this treaty has acted as a model for different international treaties, conventions, protocols for the protection of the environment and earth-care. Different nations with divergent views on a number of issues have joined hands to show their concern for the environment. Lot of debates and arguments have delayed a number of these treaties seeing the light of the day but possibly the success of the first such treaty has remained a landmark and a great example for extending international cooperation of any scientific programme and no global environmental issues. It has remained as a role model. And quite naturally the Antarctic Treaty is considered to be the first international treaty for the environmental protection and Earth-care.

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KNOW THY INSTITUTIONS

CENTRAL FUEL RESEARCH INSTITUTE, DHANBAD

The foundation stone of the Central Fuel Research Institute was laid on 17th November 1946, by the Hon'ble Shri C.H. Bhaba, Minister for Works, Mines and Power of interim Government of India led by Pt. Jawaharlal Nehru, the Prime Minister of India. The institute was established in 1945 with a small nucleus of staff members temporarily in a barrack in the premise of Indian School of Mines and Applied Geology, Dhanbad, with Dr J.W. Whitaker as its first Director. The institute was officially inaugurated at its present site in Digwadih on 22nd April 1950 by Dr. Rajendra Prasad, the first president of the Republic of India.

Central Fuel Research Institute (CFRI) celebrated its Diamond Jubilee Year on 16 Nov. 2006. One year long celebration was started from 17 Nov. 2005 and was concluded on 16 Nov. 2006 with an internal workshop on "Atmamanthan". This institute has its own last breath on 4 April 2007, when a letter came from CSIR, New Delhi for merging the CFRI with the other institute CMRI, situated at the main city of Dhanbad. Now it is known as Central Institute of Mining and Fuel Research, Digwadih Campus.

EARLY OBJECTIVES OF INSTITUTE

Central Fuel Research Institute was established with the following objectives : (a) Chemical and Physical survey of Indian Coal. (b) Processing and preparing coal with special reference to metallurgical coke. (c) Low temperature carbonization.

After 60 years of long span of time institute has seen many glorious days with its increasing capacities of well qualified scientists devoted for coal research. Because of their effort institute has earned name and fame world wide in the field of coal science.

The fuel research is synonymous for work on coal, since 1930s and 1940s. Coal was the only source of energy. Coal was used to run locomotives, to drive ships and to generate electricity, and for any factory the source of fuel was only and only coal. So coal means fuel and fuel means coal. The name of this research institute still continues with same name. But now fuel means not only coal, but it includes any matter, which can provide energy to carryout work. It may be in the form of solid, liquid, gas and so on.

SCOPE AND FUNCTION OF THE INSTITUTE

Institute was established with the aim of all aspects of research, both fundamental and applied, on solid, liquid and gaseous fuels, although for the present, the activities of the institute must necessarily be confined to a large extent to solid fuels, coal in particular. Later work were also carried out on liquid and gaseous fuels. But after some years, Indian Institute of Petroleum at Dehradun was created for liquid fuels. And for mining research, Central Mining Research Station at Dhanbad was also created.

In beginning the institute had comprehensive scheme of research on Indian Coal. The programme was divided into

(A) Short term programme include : A quick physical and chemical survey involving determination of the following properties of the major producing coal seams

(a) Proximate Analysis (b) Coking Properties (c) Total Sulphur (d) Calorific Value (e) Determination of Carbon and Hydrogen contents (f) Washability

(B) Long term Programme : (a) Distribution of Sulphur (b) Phosphorus in ash (c) Total Chlorine (d) Ultimate Analysis (e) Complete low temperature assay (f) Fusion point of ash

PRESENT ACTIVITIES OF CFRI

At present CFRI has following departments: (1) Coal Preparation (2) Coal Carbonisation (3) Coal Gasification (4) Coal liquefaction (5) Power Coal & Coal Combustion (6) Coal Quality Assessment (7) Coal Geology & Petrology (8) Fuel Science (9) Environment Management & Waste Utilization (10) Non Conventional Energy Sources (11) Mineral Technology & Value added products (12) Coal Chemicals & Liquid Fuels (13) Research Planning and Business Development & Monetary Evaluation (14) Technical Information (15) General Engineering.

COAL PREPARATION

Upgradation of coal quality is considered to be a prerequisite for efficient utilization of indigenous resources. Pioneering work at the institute on beneficiation of high ash 'difficult to wash coals'contributed significantly to the generation of the basic process know-how for all the operating coking coal washeries in India. Novel concept of multistage beneficiation has been developed for treating the large reserves of LVC coals that could not be economically washed in the existing coking coal washeries.

The institute has Fine Coal Treatment Pilot Plant. The unit is fully equipped with modern laboratory facilities and state of the art pilot plants with on line instrumentations and control to develop process flow sheet for beneficiation of coking and non-coking coals as per the requirements of different end uses. CFRI renders expertise for (i) Full scale washability studies of coal and interpretation of results, (ii) Developing flow sheet/ beneficiation circuit for a given coal with trial runs in state of the art pilot plant, (iii) Technical audit and improvement/computerization of existing washeries, (iv) Consultancy service for designing and installation of commercial Washeries and (v) R&D for noncoking and coking coals including flotation on Novel Washing Techniques.

Application of simulation and optimization software developed at CFRI can predict optimum recovery at specified ash content under variable proportions of known linked coals and cost of clean coal for non-coking coal washeries.

Jig washer of 20-50 tph capacity designed by CFRI has already entered the market. Coal Slurry Beneficiation technology of different capacities (10-20 tph) has been successfully commercialized.

COAL CARBONIZATION

CFRI has successfully evaluated the coking potentialities of Indian coals that led to the selection of coking blends for the coke ovens of the existing steel plants under Public Sector. For possible improvement in the quality of coke for utilizing maximum non-coking / semi coking coals in an environment friendly way, technologies for pre heating of coal charge, stamp charging of coal, etc. are being studied and suitable designs of the relevant machinery are developed. CFRI has successfully developed designs of energy efficient and environment friendly heat recovery Coke Oven of different capacities for production of metallurgical/industrial grade coke.

COAL GASIFICATION

R&D activities in the area of coal gasification were initiated during late fifties and continued till mid seventies in the institute. Different modes of gasification such as, powered coal gasification, pressure gasification with steam and oxygen, fluidized bed etc., in pilot scale level, were installed with a view to study the potential behaviours of inferior grade Indian coals towards complete gasification for its commercial exploitation. Rapid industrial growth in the post independence era needed increasing use of gas as fuel and basic raw material for chemicals and fertilizer synthesis.

Keeping in view the need for efficient gasification of high ash Indian coals through IGCC route research programmes have been initiated. The focus would be to generate kinetic data from high pressure high temperature TGA followed by tests in 50kg/h continuous PFBG reactor.

COAL LIQUEFACTION

The Institute has been carrying out investigation for the development of technological knowledge regarding conversion of the country's major commercial energy source, the coal or its derived product, into liquid fuels and chemicals.

POWER COAL & COAL COMBUSTION

Coal combustion has been an important area of pursuit since inception. Extensive studies were carried on Fluid bed combustion for development of FBC boiler, generation of hot air from agro-wastes, coal and lignite and inert gas generation. Improved designs of domestic ovens for smokeless burning of raw coal had been made for the benefit of the rural sector.

The present initiatives are focused studying the impact of coal quality on the different aspects of pulverised coal combustion. The limitation of traditional parameters for reliable assessment of combustion and emission behaviour call for additional characterization data like distribution of macerals and their association, surface area and porosity, mineral compositions etc. Modern test facilities of different scale and under different flow conditions like Drop Tube Furnace and Fuel Evaluation Test Facility would provide valuable insight on the role of different quality parameters on carbon burnout, flame stability and slagging & fouling propensities. Blending of coals for power generation is another area, which is being, studied extensively with emphasis on the issues related to the effect of blending of dissimilar coal on the milling, burn out and ash depoit problems.

COAL GEOLOGY AND COAL PETROLOGY

Study on Gondwana coal basins of Peninsular

India reveals that in these Gondwana grabens over 70 separate coal basins are now located and distributed in a radical pattern along five well–defined basin belts (1) Damodar-Koel Valley, (2) Rajmahal-Deoghar-Itkhori, (3) Sone- Mahanadi Valley, (4) Pench-Kanhan Valley, and (5) Wardha – Godawari Valley. The heterogenous character of these coals of the penisular India is well defined by the characteristic petrographic make up of each coal seam and the varied petrographic comments in the different coal basins. Various studies have been carried out in the institute for coal geology and coal petrology.

COAL CHEMICALS & LIQUIED FUELS

Coal hydrogenation, Coal for chemicals, Fisher-Tropsch Synthesis, Operation of high pressure plant, Development of process on pyridine based chemicals and benzenoid hydrocarbons are the areas.

MINARAL TECHNOLOGY AND VALUE ADDED PRODUCTS

Process for development and standardization for manufacturing improved building materials eg. Bricks / blocks, aggregates tiles etc. utilizing locally available waste and industrial waste. Study of effect of durability of the developed building material under different environmental conditions.

NON-CONVENTIONAL ENERGY SOURCES & INSTRUMENTATION

Development of non-conventional energy systems, fuel management for fuel cells and development of infrastructure for testing and characterization of Fuel cell, Calibration of Instruments.

RESEARCH PLANNING & BUSINESS DEVELOPMENT – MONETORY EVALUATION

Marketing of Technology know-how. Project planning providing customer service for testing and analysis.

TECHNICAL INFORMATION

Publication of Annual Report, Newsletters, Technical Books, Pamphlets, Brochures, Information leaflets, Posters, Organising exhibition and participations in exhibition/Science festivals / melas etc.

GENERAL ENGINEERING

Boiler operation, civil engineering, construction and maintenance, construction of laboratory ovens and furnaces, fabrication of equipments and structures.

TECHNOLOGIES AND KNOW-HOW AVAILABLE

A. **Proven Technologies :** (1) Improved Beehive Coke Oven with pusher system (0.1-0.3) million tpy (2) Oven for Production of Soft Coke (50 to 100 tpd) (3) CFRI-TISCO Design Beehive Coke Oven (50 to 100 tpd) (4) Formed Coke (20 – 50 tpd) (5) Briquetted Fuel for Domestic Users from Low Grade Coking Coal/Washery By-products (20-50 tpd) (6) Domestic Cook Stove (Chullah for 5 to 10 members family) (7) Mini Washery for Coal Slurry Beneficiation (5 to 20 tph) (8) Oil Agglomeration Process for Recovery of Additional Cleans from Inferior Coals (2-10 tph) (9) Jig for Coal Washing (20 tph) (10) Oleo-Flotation Process for Integrated Beneficiation and Dewatering of Coking Coals (20 tph) (11) Building Bricks from Fly Ash (12,000 to 80,000 bricks/day) (12) Bulk Use of Fly Ash for Soil Amendment and Waste Land Reclaimation (13) Beta-naphthol from Napthalene (1000 tpy) (14) Synthesis of Resorcinol (300 tpy)

B. **Technical Processes Developed In Laboratory Scale :** (1) Synthesis of INH from 4-Cyanopyridine (2) Ammoxidation of 3-Methyl pyridine to 3-cyanopyridine (3) Ammoxidation of 4-Methyl pyridine to 4-cyanopyridine (4) Synthesis of Nicotinamide from 3-cyanopyridine (5) Synthesis of Pyridine and Picolines

C. **Technologies ready for Commercialization :** (1) Process for stabilized coal-water slurry (1000 – 1500 kg/h) (2) Inert Gas Generator for combating Mine Fire (10000–15000 Nm3/h (3) Lignite Devolatilizer (50–100 tpd) (4) Nicotinamide from 3-cyanopyrdine (5) 9-10 Phenanthraquinone from phenanthrene

CFRI has developed more than 150 technologies. CFRI is releasing its Annual Report every year on the 26th September, the Foundation Day of CSIR. Annual Report is covering the R&D findings of all projects taken up during the financial year. Besides this, R&D papers published, presented patents filed and other activities are also given of the concerned financial year. Annual Report is authentic document to use for various purposes. The last Annual Report of CFRI was of the year 2006-07. Now this institute is known as Central Institute of Mining and Fuel Research, Digwadih Campus.

Contact : Dr. Rajesh Kumar

Scientist,

Publication & Information

CIMFR Digwadih Campus,

P. O. FRI,

Dhanbad–828108, Jharkhand

Conferences / Meetings / Symposia / Seminars

International Conference on Climate Change Perspectives and Projections : A Systems Approach. 9-11 December, 2010, Osmania University, Hyderabad-500 007, India.

THEMES OF THE CONFERENCE :

1. Climate Change : Earth and Atmosphere Systrems
   - (a) Natural Resources
   - (b) Carbon Footprint, Carbon Capture and Storage
   - (c) Green House Gases
   - (d) Marine Systems
2. Climate Change : Biological Systems
   - (a) Biodiversity
   - (b) Agro-forestry
   - (c) Genetic Implications – Public health
   - (d) Ecological Equilibrium
   - (e) Crop Productivity
3. Climate Changes Vs Technology
   - (a) Fuel Cells
   - (b) Biofuels
   - (c) Nuclear Technology and Biotechnolgoy
   - (d) Green and Clean Technology
   - (e) Nano and Information Technology
4. Sustainable Economic Development and Human Security
   - (a) Renewable and Non-renewable energy policy
   - (b) Protection of Biodiversity
   - (c) Industrialization Vs Climate
   - (d) Anthropogenic activities and sustainable economic development
   - (e) Pollution – Mitigation
5. Climate Change : Governance and Policy Perspectives
   - (a) Environmental Protection and Law : International and National approaches
   - (b) Dimensions of Governance and Strategies of Development
   - (c) Management of Natural Resources : Water and Land Resources
   - (d) Meteorology : Appraisal and Assessment

Contact : Prof. K. Janardhan Reddy, Principal, University College of Science, Osmania University, Hyderabad–500 007, Phone : +9140 2702 4078, 2709 8176 Tel Fax : + 91 40 2707 4078 Mobile : -093931212172, Email : coordinator.ucs@osmania.ac.in; kjreddy50@yahoo.co.in **Webside:** www.osmania_iccc2010.org

S & T ACROSS THE WORLD

ANTI-MALARIAL DURGS

The scientists of the University at Reading's Department of Chemistry, aim to make anti-malarial drugs more affordable in third world countries where more than 1.5 million people die of the disease every year. University's new Chemical Analysis Facility (CAF) facilitates this research. Using the CAP's facilities, the scientists produce artemisinin from Chinese wormwood plant. It is an antimalarial drug effective against quinine-resistant malaria. This fundamental research will help pharmaceutical companies to mass-produce artemisinin in a more cost effective way.

(*The Medical News, Apr 24, 2010*)

CHOLESTEROL AFFECT BONE MARROW

Progenitors of blood cells develop in the bone marrow, where they mature in specific microenvironments, called niches, before exiting into peripheral blood in a highly controlled fashion. It is well estalished that external stimuli affect these niches and in turn the production of mature blood cells. For example, patients with high cholesterol levels (hypercholesterolemia) have more peripheral blood cells and increased platelet levels (thrombocytosis). Researchers in Portugal show that high levels of cholesterol can affect the microenvironment of the bone marrow, so that more cells move from the bone marrow to peripheral, circulating blood. Sometime cholesterol may be responsible for acute leukaemia as cholesterol empties cells from the bone marrow microenvironment by which it may create more space for malignant leukaemia cells to come into the bone marrow.

These findings for the researcher have implications for transplants and bone marrow malignances.

(*Instituto Gulbenkian de Ciencia, May 11, 2010*)

COMPUTATIONAL MODEL FOR GENE ACTIVITY

The human genome contains instruction for making all the cells in our body. An individual cell's make-up (e.g. muscle or blood) depends on how these instructions are read. This is controlled by gene regulatory mechanisms. Uncovering these mechanisms holds a key to greatly improving our understanding of biological systems.

One important regulatory mechanism is based on genes that actively promote or repress the activity of other genes. The new research addresses the problem of identifying the targets these regulator genes affect.

The new method, presented in *Proceedings of The National Academy of Sciences (PNAS)*, is based on carefully modelling of times series measurement of gene activity. It combines a simple biochemical model of the cell with probabilistic modelling to deal with incomplete and uncertain measurements.

Researches from the University of Manchester (UK), Aalto University (Finland) and the European Molecular Biology Laboratory, Heidelberg (Germany), say the new method identifies targets of regulator genes.

(*University of Manchester, Apr 26, 2010*)

SMARTPHONE ADD-ON WILL BRING EYE TESTS TO THE MASSES

Having trouble reading your cellphones's screen? If that's because you need glasses, your phone itself could be used to tell you what strength lenses you need.

Ramesh Raskar of the Camera Culture group at the Massachusetts Institute of Technology has devised a method of providing basic eye tests using only a smartphone and a specially designed eyepiece. It could provide a home-based eye test for million of people who cannot easily access regular optometry services.

Raskar's Near-to-Eye Tool for Refractive Assessment (Netra) consists of a viewer that fits over a celphone's screen combined with software running on the phone. To test a person's eyesight, the phone displays an image which the eyepiece converts into a virtual 3D display.

The user is then asked to focus on the image and use the phone's keyboard to adjust the lines so that they merge. Based on the amount of adjustment needed, the software will show the strength of the corrective lenses required, measured in dioptres.

Unlike a traditional 3D display, which presents a slightly different view to the left and right eyes, Netra presents different views of different parts of the same eyes simultaneously. If the user has perfect eyesight, these images will overlap and appear as a single image, says postdoctoral researcher-Ankit Mohan, who worked on the design. If their vision needs correction, they will see parallel lines that the will need to adjust.

Cellphones have reached remote villages in Asia, Latin America and Africa, making them ideal diagnostic devices, says D. Balasubramanian, the director of research at the L.V. Prasad Eye Institute in Hyderabad, India.

In its current form, Netra needs phones that can be programmed and have a high-resolution display, which are less common in remote areas, Balasubramanian adds.

(*New Scientist 3 July, 2010*)

ROBOTS FALL INTO LINE WITH THE HELP OF SPARSE ARRAY ANTENNA

When you are in hostile territory, it pays to stick together-especially if you are a robot. Falling into line will be easier with an innovative communication system that combines the clout of robots' individual radio antennas, making sure they stay in touch with their headquarters.

Communicating with robots on the ground gets harder once they move beyond the line of sight, but equipping a group with the "sparse antenna" technology improves communications by extending the radio range. The technology eliminates dead spots, where contact is lost completely, and minimises interference from large buildings or potential signal jammers.

It could make it easier to communicate with robots working in hard-to-reach environments, such as urban disaster areas.

The robots are the product of a joint project. Garret Okamoto of Adaptive Communications Research in San Diego, California, is leading the antenna work. On the robotics side is Christopher Kitts at Santa Clara University, also in California.

To form the sparse array antenna the robots are programmed to arrange themselves—usually in circular patterns or grids—at roughly equal intervals, from 10 centimetres to several metres apart. The signal-processing software then turns the robots' radio-controlled antennas into a powerful transmitter. The software uses the individual robot's position and the properties of its radio signal to enhance the overall signal. That super-signal is then funnelled through one robot to communicate with HQ.

With the robots arranged in a smart antenna array you get what's called diversity gain, says Okamoto. "This enables the signals from the different antennas to be added constructively," he says. So you don't get "multipath fading", which happens when radio signals reach the receiving antenna by two or more paths and the resultant interference causes dead spots, he adds.

With eight robots, says Okamoto, signal gain is equivalent to a 60-fold increase in signal strength. However, there is a limit to how much you can reduce the multipath fading, so the benefits improve for upto about 12 robots before tailing off.

The transmission-sharing software and manoeuvre-control for the robot formation are complete, and the robots needed for an integrated demonstration should be complete within three months, says Kitts.

"In principle, this idea has some merit," says Chris Melhuish, director of the Bristol Robotics Laboratory at the University of Bristol, UK. "The trick will be to get the robots to position themselves and then maintain their relative position within the tolerances of the transmission media."

(*New Scientist 3 July, 2010*)

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m=ôg;t fle N;| yth m=ôgt fle ÂJNMtÂ"fÙth/Terms of Membership and Privileges of Members :

mÔ:t fle m=ôg;t WI mCe jtdt fÙ ÂjY Fj| n| st ôlt;fÙ gt Wmfl mbtI ô;h vh NGÂKfÙ gtÉg;t ysI fÙh afÙ n| yth Âsàn Cth; ÂfÙ ÂJÒttI fÙ ;h¢fle b ÁÂa n›

Membership of the Association is open to person with *Graduate or equivalent academic qualification* and interested in the advancement of science in India.

1. **JtÂMfÙ m=ôg &** st ôgÂÿ| Ig Áv m JtÂMfÙ m=ôg;t dnK fÙhlt atn;t n| Wm JtÂMfÙ m=ôg;t NÔf Á 200/- fÙ mt: C;e NÔf Á 50/-* (ÂJ=ÂNgt fÙ ÂjY** U.S.$ 70) btºt =I vzd› JtÂMfÙ m=ôg;t NÔf ŒÂgfÙ JM fÙ 01 yŒj fÙt =g nt stYdt› st Ce 15 sjtR fÙ Ce;h yvIe m=ôg;t NÔf Ine y=t fÙh vtYdt Jn Wm mtj fÙ ÂjY yvIe Jtx =I fle Gb;t m JÂa; nt stYdt yth/gt Jn Wm JM fÙ ÂjY mÔ:t fÙ fÙtgtjg fÙt Ce ÂIgºtK Iné fÙh vtYdt› YfÙ m=ôg st JtÂMfÙ m=ôg NÔf ydj mtj fÙ bta fÙ y; ;fÙ Iné = vtYdt Wmfle m=ôg;t mbtË; nt stYde›

   m=ôgdK yvIt vvh fÙtdm mºt fÙ mbg vN fÙh mfÙ; n› Wàn JtÂMfÙ ÂJÒttI fÙtdm mºt fle fÙtgÂJJhK fle YfÙ ŒÂ; ÂcItbÔg b ŒtË; nt mfÙ;e n› RmfÙ mt: J mÔ:t fÙ htsItbat IIYJhebIm mtRm00 Ce ÂcItbÔg Wvjç" fÙh mfÙ; n›

1. **Annual Member :** A person willing to be enrolled as new Annual Member has to pay an annual subscription of Rs. 200/- along with an admission fee of Rs. 50/-* (for foreign** U.S.$ 70) only. The annual subscription of a Member shall become due on the 1st April of each year. Anyone who fails to pay the subcription on or before the *15th July* in any year shall lose the right of voting and/ or holding any office of the Association for that year. A member failing to pay the annual subscription by the end of March of the following year shall cease to be a Member.

   Members may contribute papers for presentation at the Science Congress. They will receive, free of cost, reprints of the Proceedings of the Session of any one section of their interest and also the bi-monthly journal of the Association "Everyman's Science".

2. **mºt m=ôg** & gÂ= fA fthKt m JtÂMf m=ôg yvle m=ôg;t Wm JM f 15 sjtR f y=h =tnhtlt Cj stY ;t Wlfe m=ôg;t mºt m=ôg;t f Áv b Âclt Jtx ztjl fe Gb;t b meÂb; fh Â=gt stYdt› JtÂMf m=ôg yvle m=ôg;t =tctht ydj mtj Âclt C;e NÖf Â=Y yvle m=ôg;t NÖf ft Xef mbg vh =f vl& Œtt; fh mf;t n›

2. **Sessional Member :** If for some reasons, Annual Members fail to renew their Membership by remitting subscription prior to 15th July each year, their Membership for the year would be restricted to Sessional Membership without voting right. Annual members can renew their Membership without paying the admission fee in the next year by remitting subscriptions in time.

3. **Atºt m=ôg** & st ôgÂÿ ôlt;f ô;h f lea vZtR fh hnt n Jn JtÂMf m=ôg;t NÖf Á 100/- btºt =l vzd› yvlt ltb Atºt m=ôg f Áv b ÂjFJt mf;t n cN; Wmf ytJ=l vºt vh Wmf Œtatg/ ÂJCtdtŒgG/mô:tl f Œ"tl f nô;tGh nt› Yf Atºt m=ôg ft gn yÂ"fth Â=gt stYdt Âf Jn yvlt vvh ftdm mºt f mbg vN fh mf cN; Jn vvh Jn Âfme JtÂMf m=ôg gt mô:t f ftR yJ;Âlf m=ôg f mt: vN fh› Wm Jtx fhl ft gt ftgtjg ft ÂlgºtK fhl ft yÂ"fth Œtt; lné ntdt› Atºt m=ôg ft ÂJCtdt f ôgJmtg cXft yth mt"thK cXft b Ctd jl fe gtÉg;t Œtt; lné n›

3. **Student Member :** A person studying at the under-graduate level may be enrolled as a Student Member by paying an annual subscription of Rs. 100/- only provided his/her application duly certified by the Principal/Head of the Institution/Department. A student member shall have the right to submit papers for presentation at the Session of the Congress of which he/she is a member, provided such papers be communicated through a Member, or an Honorary Member of the Association. He/she shall not have the right to vote or to hold any office. A student member shall not be eligible to participate in the Business meetings of the Sections and the General Body.

4. **ytseJl m=ôg** & Yf m=ôg yvl CÂJíg fe mthe ctÂMf m=ôg;t NÖf Yf cth b Áv 2000/- (ÂJ=ÂNgt f ÂjY U.S.$ 500) btºt y=t fhf vt mf;t n› Yf ôgÂÿ st 10 mtj gt Wmm yÂ"f ÂlgÂb; Áv m m=ôg;t Œtt; fh aft n, Wm Wmfe mgÿ m=ôg;t NÖf f Wvh ŒÂ;JM Á 50/- fe Ax =e stYde, cN; Âf Wmfe mgÿ NÖf Á 1,200/- m lea l nt (ÂJ=ÂNgt f ÂjY U.S.$ 12.50 yth U.S.$ 300 fbN&)› Yf ytseJl m=ôg ft Wmf vh seJl ftj b m=ôg;t fe mthe ÂJNMtÂ"fth Œtt; ntd›

4. **Life Member :** A Member may compound all future annual subscriptions by paying a single sum of Rs. 2000/- (for foreign** U.S.$ 500) only. Any person who has been continuously a member for 10 years or more, shall be allowed a reduction in the compounding fee of Rs. 50/- for every year of such membership, provided that the compounding fee shall not be less than Rs. 1,200/- (for foreign** U.S.$ 12.50 and U.S.$. 300 respectively). A life Member shall have all the privileges of a member during his/her lifetime.

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* C;e NÖf Á 50/- ÂmV Yf lg JtÂMf m=ôg f ÂjY sÁhe n› gn mºt m=ôg/ytseJl m=ôg/mô:tl m=ôg/Atºt m=ôg/=t;t f ÂjY sÁhe lné n›

* Admission fee of Rs. 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.

** (Yfl ÂJ=Ne m=ôg flt y: n st Cth;JM fl ctnh flt ltdÂhfl nt)›

** (A Foreign Member means one who is normally resident outside India).

5. **mô:tl m=ôg &** Yf mô:tl st Á 5,000/- m=ôg;t NÔf fl Áv b = Jne mô:t fl mô:tl m=ôg cl mfl;t n (ÂJ=ÂNgt fl ÂjY U.S.$ 2,500)› Rmb Jn ÂcÒttl fltdm fl JtÂMfl mºt b yvl Yfl ÔgÂÿl flt ltb ltbtÂfl; flh mfl;t n st WlfIt ŒÂ;ÂlÂ" nt› Yfl mô:tl m=ôg flt JtÂMfl ÂJÒttl fltdm mºt fle fltgÂJJhK fle Yfl vK ŒÂ; ÂcltbÖg b ŒtË; nt mfl;e n› Rmfl mt: J mô:t fl htslltbat llYJheblm mtRm00 Ce ÂcltbÖg Wvjç" flh mfl; n›

5. **Institutional Member :** An Institution paying a subscription of Rs. 5,000/- (for foreign** U.S.$2,500) only, can become an Institutional Member of the Association. It shall be eligible to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional Member shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also a copy each of the Association's journal "Everyman's Science".

6. **=t;t &** fltR Ce ÔgÂÿl st Yflmt: Á 10,000/- (ÂJ=ÂNgt fl ÂjY U.S.$ 5000) btºt = Jn mô:t fl =t;t cl mfl; n› Yfl ÔgÂÿld; =t;t flt Jn mthe yÂ"flth yth ÂJNMtÂ"flth Âbjd st Yfl m=ôg flt Wmfl vK seJl fltj b ŒtË; nt; n› Yfl mô:tl st Yflmt: Á 50,000/- (ÂJ=ÂNgt fl ÂjY U.S.$ 25,000) btºt = Jn mô:t fl mô:tl =t;t cl mfl;t n, Âsm Yfl ÔgÂÿl flt ltbtÂfl; flhfl Wm yvl mô:tl fl ŒÂ;ÂlÂ" fl Áv b ÂJÒttl fltdm fl JtÂMfl mºt b Cs mfl; n› Yfl mô:tl/ÔgÂÿld; =t;t JtÂMfl ÂJÒttl fltdm fl fltgÂJJhK yth mô:t fl htslltbat llYJheblm mtRm00 Ce ÂcltbÖg Wvjç" flh mfl; n›

6. **Donor :** Any person paying a lump sum of Rs. 10,000/- (for foreign **U.S. $5000) only, can become a Donor of the Association. An ***INDIVIDUAL DONOR*** shall have all the rights and privileges of a member during his/her lifetime. An Institution paying a lump of Rs. 50,000/- (for foreign U.S. $25,000) only, can become an ***INSTITUTIONAL DONOR*** of the Association, which shall have the right to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional/Individual Donor shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also the Association's journal "Everyman's Science".

(y) **vvh vN flhlt &** Yfl vK vvh fle ŒÂ; Wmfl mt: ;el mthtN fle ŒÂ; st 100 Nç=t m ßgt=t l nt yth Âsmb fltR ythF gt Vlbjt l nt, Jn ŒÂgfl JM 15 Âm;öch fl y=h bntmÂaJ (bÏgtjg) ;fl vna stlt atÂnY›

(A) **Presentation of Papers :** A copy of complete paper accompanied by an abstract in triplicate not exceeding one hundred words and not containing any diagram or formula, must reach the General Secretary (Hqrs) latest by September 15, each year.

(c) mCe Jdt fl m=ôg st ÂJÒttl fltdm mºt b Ctd jl fl vëat; jtx; mbg fl Âxflx b Âhgty; ŒtË; flh mfl;t n cN; Âfl WIfle gtºtt fl Fa flt :tzt Ce Ctd mhflth (flŠeg gt htßg), fltR fltlle mútt gt fltR ÂJëJÂJ'tjg gt fltR ldhvtÂjflt l WXtY›

(B) Members of all categories are entitled to railway Concession of return ticket by the same route with such conditions as may be laid down by the Railway Board for travel to attend the Science Congress Session provided that their travelling expenses are not borne, even partly, by the Government (Central or State), Statutory Authority or an University or a City Corporation.

(m) mô:t fl vô;fltjg b mCe Jdt fl m=ôg flt vZl fle mÂJ"t mcn 10,00 cs m Ntb flt 5.30 cs ;fl mCe fltb fl Â=lt b (NÂlJth yth hÂJJth) flt Atzflh Œtë; ntde›

(C) Members of all categories are entitled to reading facilities between 10.00 a.m. to 5.30 p.m. on all weekdays (except Saturdays & Sundays) in the library of the Association.

(z) mbg mbg vh mô:t Ãtht ;g fle dR bÔg vh ÂJ¶tbdn, mCtdth ytÂ= mÂJ"tyt fle ŒtÂË; Ce mCe Jdt fl m=ôg vt mfl; n›

(D) Members of all categories may use Guest House facilities, Lecture Hall hiring at the rates fixed by the Association from time to time.

(R) CÂJíg b Cth;eg ÂJÒttl fltdm mô:t Ãtht ytgtÂs; vÂhmJt=, möbjl yth JtÂMfl fltdm b mCe Jdt fl m=ôgt Ãtht Ctd jl fl ÂjY yvle-yvle m=ôg;t vºt flt jtlt sÁhe n›

(E) Members of all categories should bring the Membership Card always for attending any Seminar, Conference and Annual Congress organized by ISCA in future.

Ægtl = & mCe cfl ztÜx "Treasurer, The Indian Science Congress Association" fl ltb m ne ÂjFt stY yth fltjflt;t fl Âflme Ce NtFt b =g nt› m=ôgt m gn ÂlJ=l Âflgt st hnt n Âfl J yvle m=ôg;t mÏgt flt W¨F Cth;eg ÂJÒttl fltdm mô:t fl fltgtjg fl mt: vºttath fl Ôgÿl yJëg flh›

Note : All Bank Drafts should be drawn in favour of "Treasurer, The Indian Science Congress Association" Payable at any branch in Kolkata. Members are requested to mention their Membership No. while making any correspondence to ISCA office.

Cth;eg ÂJÒttl fltdm mô:t

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JcmtRx/Website	:	http://sciencecongress.nic.in			iscacal_2004@yahoo.com

m=ôg;t fl ÂjY ytJ=l - vºt/Application Form For Membership :

mJt b/To

bntmÂaJ (bÏgtjg)/ The General Secretary

Cth;eg ÂJÒttl fltdm mô:t/The Indian Science Congress Association

14, ztO ÂchN dnt ôxex/14, Dr. Biresh Guha Street,

fltjflt;t - 700 017/Kolkata - 700 017

bnt=g/Dear Sir,

b Cth;eg ÂJÒttl fltdm mô:t flt ytseJl m=ôg/JtÂMfl m=ôg/mºt m=ôg/Atºt m=ôg/mô:tl m=ôg/ =t;t/ yvlt ltb ÂjFJtlt atn;t / atn;t n›

I like to be enrolled as a Life Member/Annual Member/Sessional Member/Student Member/Institutional Member/Donor/of The Indian Science Congress Association.

b Rmfl mt: Á ________ m=ôg;t NÖf fl Áv b lfl=/cfl ztÜx mÏgt ___________ Â=ltÂfl; __________ Œatjfl cfl ____________ 01 yŒj —— m 31 bta —— ;fl Cs hnt/hne n›

I am sending herewith an amount of Rs. ———— in payment of my subscription by Cash/Bank Draft No. ———— dated ———— issuing bank from the year 1st April —— to 31st March ——.

b ÂlölÂjÂF; ÂJCtd b ÁÂa hF;t/hF;e n (Âflme Yfl b flvgt ÂlNtl jdtY)/ I am interested in the following section (Please tick any one).

ÂJCtd/Section

1. flÂM yth JlÂJ't ÂJÒttl/Agriculture and Forestry Sciences
2. vN, vNÂaÂflÂmt yth bÂôg ÂJÒttl/Animal, Veterinary and Fishery Sciences
3. btlJNtôºteg yth ytahK ÂJÒttl (Âsmb mÂöbÂj; n vht;ÀJ-ÂJÒttl yth bltÂJÒttl yth NÂGfl ÂJÒttl yth mlt ÂJÒttl/Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Sciences & Military Science)
4. hmtgl ÂJÒttl/Chemical Sciences

5. C-võÂ; ÂJÒttI/Earth System Sciences
6. yÂCgà;t ÂJÒttI/Engineering Sciences
7. Jt;tJhK ÂJÒttI/Environmental Sciences
8. maIt yth mathK ÂJÒttI yth Œt'tÂdfle (flövxh ÂJÒttI mÂöbÂj;)/Information and Communication Science & Technology (including Computer Sciences)
9. CtÂ;fl ÂJÒttI/Materials Science
10. dÂK; ÂJÒttI (mtÂÏgfleg mÂöbÂj;)/Mathematical Science (including Statistics)
11. ÂaÂflÀmt Ntô°t (Nheh ÂJÒttI mÂöbÂj;)/Medical Sciences (including Physiology)
12. Igt seJÂJÒttI (seJ hmtgI, seJ CtÂ;fle yth ytKÂJfl seJÂJÒttI yth seJ-Œt'tÂdfle mÂöbÂj;)/ New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)
13. CtÂ;fleg ÂJÒttI/Physical Sciences
14. JIôvÂ; ÂJÒttI/Plant Sciences

(flvgt xÂfl; flh gt çjtfl yGht b Ch/Please type or fill up in Block Letters)

Itb/Name (çjtfl yGht b/in block letters) : __________ __________

flj Itb/Surname Œ:b Itb/First Name

____

bÉg Itb/Middle Name

NtGÂKfl gtÉg;t/Academic Qualifications :
(ŒbtK sbt flhIt n/Evidence to be submitted)

v=Itb/Designation :

mövfl flt v;t/Address of communication :
(htßg, Nnh/Idh yth ÂvI fltz mÂn;/including state, city/town and pin code)

=hCtM mÏgt yth R-bj/Phone No. & E-mail :
(ydh fltR/if any)

ô:tge v;t/Permanent Address :

ÂxËvKe (ydh fltR)/Comments (if any)

CJ=eg/Yours Faithfully

Â=Itfl/Date : nô;tGh/Signature

Ågtl =& (i) mCe cfl ztÜx "Treasurer, The Indian Science Congress Association" fl ltb m ne Âj Ft stY yth fltj flt;t fl Âflme Ce NtFt b =g nt›

Note : (i) All Bank Drafts should be drawn in favour of "Treasurer, The Indian Science Congress Association" Payable at any branch in Kolkata.

(ii) *10 yÿlch, 2004 fl fltgtÂhKe mÂbÂ; fl Œô;tJ fl ylmth Cth;eg ÂJÒttl fltdm mô:t fle m=ôg;t fl Âj Y ytJ=l b Âflme yàg ôgÂÿl fl lbtVl;0 flt mtbtàg;& n;tÂmtÂn; Âflgt dgt n› vh; ÂVlh Ce gÂ= ytJ=lvºt b lbtVl;0 flt v;t Â=gt hndt ;t Wmb Âsm ôgÂÿl flt ltb Â=gt hndt Wmfl nô;tGh Ce sÁhe n›

(ii) *As per resolution of Executive Committee in its meeting held on October 10, 2004 application for membership of ISCA in 'Care of' of some other person is generally discouraged. However, if in the application from "care of" address is given then there should be also signature of the person in whose name "care of" is given.

(iii) *C;e NÔf Á 50/- ÂmVl Yfl lg JtÂMfl m=ôg fl Âj Y sÁhe n› gn mºt m=ôg/ytseJl m=ôg/mô:tl m=ôg/Atºt m=ôg/=t;t fl Âj Y sh‡he lné n›

(iii) *Admission fee of Rs. 50/- is needed only for becoming a new annual member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.

(iv) m=ôgt m gn ÂlJ=l Âflgt st hnt n Âfl J yvle m=ôg;t mÏgt flt W¨F Cth;eg ÂJÒttl fltdm mô:t fl fltgtjg fl mt: vºttath fl Ôgÿl yJëg flh›

(iv) Members are requested to mention their Membership No. while making any correspondence to ISCA office.