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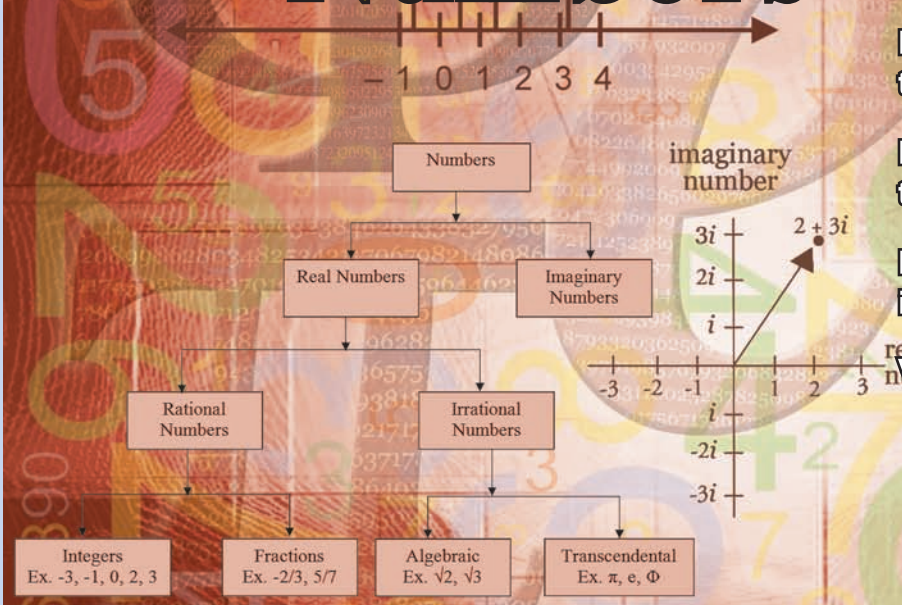
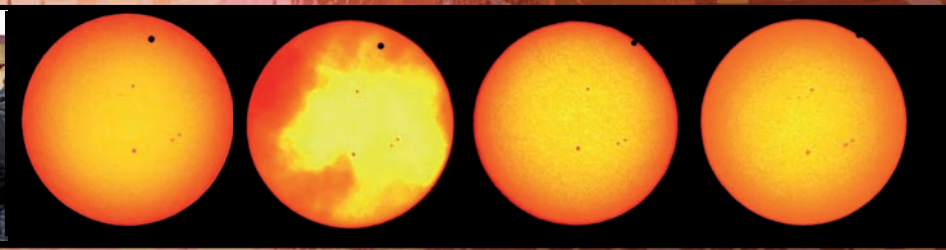
# Niceties of Numbers





... think scientifically, act scientifically... think scientifically, act scientifically... think scientifically, act...

# Centenary Celebration of Indian Science Congress Association

Dr. Subodh Mahanti

The Indian Science Congress Association (ISCA) will hold its 100th Session at Kolkata in January 2013. The ISCA is one of the oldest scientific organisations in the country which has played a very significant role in shaping Indian science. The centenary celebration of the Indian Science Congress provides a unique opportunity to know more about this great institution.

The Indian Science Congress was initiated by two British chemists – Professor P. S. MacMahon of Canning College, Lucknow and Professor J. L. Simonsen of Presidency College, Chennai (then Madras). They thought that an annual meeting of research workers somewhat on the lines of the British Association for the Advancement of Science would help in stimulating scientific research in India. MacMahon and Simonsen worked jointly as Honorary Secretaries of the Congress till 1921. Professor C V Raman replaced MacMahon in 1921.

While commenting on the object and scope of the Indian Science Congress Association, Sir Asutosh Mookerjee, the first President of the Indian Science Congress in his Presidential remarks in January 1914 had stated that ISCA was formed "… to give a stronger impulse and a more systematic direction to scientific enquiry, to promote the intercourse of societies and individuals interested in science in different parts of the country, to obtain a more general attention to the objects of pure and applied science and the removal of any disadvantages of a public kind which may impede its progress." Mookerjee was an eminent mathematician, jurist and educationist. As Vice Chancellor of Calcutta University he played a pioneering role in encouraging post-graduate teaching and research in science.

The first Science Congress was held during 15-17 January 1914 in the premises of the Asiatic Society, Kolkata. The Asiatic Society was established in 1784 by Sir William Jones "with a dream that visualised a centre for Asian studies including almost everything concerning man and nature within the geographical limits of the continent". It helped in many ways to shape the advancement of scientific inquiry in the country. One hundred and five scientists from different parts of India and abroad took part in the first Science Congress. Thirty-five papers were presented in six different sections namely, Botany, Chemistry, Ethnography, Geology, Physics and Zoology. Since then there has been a steady increase in the size and scope of the activities of the Congress. Today ISCA has 14 sections: Agricultural and forestry sciences; Animal, veterinary and fishery sciences; Anthropological and behavioural sciences (including archaeology and psychology and educational sciences); Chemical science; Earth system science; Information and communication science and technology (including computer science); Material science, Mathematical science (including statistics); Medical science (including physiology), New biology (including biochemistry, biophysics and molecular biology and biotechnology); Physical science, and Plant Science. There is also a Committee on Science & Society.

The Science Congress has witnessed the growth of Indian science in the deliberations made in its different sections year after year. The successive Prime Ministers of India (since 1948) and most eminent scientists of India shared their dreams and visions on what science can do for India at the venues of the Science Congress. They again and again underlined the role of science in the advancement of human civilisation. For example, Acharya Prafulla Chandra Ray, the founder of modern school of chemistry in India, in his Presidential Address at the 7th Indian Science Congress (1920) observed, "considered from every point of view the progress of scientific knowledge is imperatively necessary to our individual and national growth. For the accomplishment of this object the whole-hearted co-operation of both the Government and the people is indispensable." Mokshagundam Visvesvaraya, one of the most celebrated engineers of the country, in his Presidential Address to the 10th Session of the Science Congress (1923) said: "Advance in science has rightly become the criterion of a nation's standing. It is now axiomatic that no nation can hope to maintain its progress if it is backward in the cultivation of science and its adaptation to the ends and purposes of everyday life…Today we are in the grip of science, the struggle for existence cannot be waged with any success without science, and civilisation itself cannot be sustained without it." Inspired by these visionaries, Indians started believing that it was science alone which could ensure a better future for them. Pandit Jawaharlal Nehru (then Vice-President of the interim Government), who presided over the 34th Session of ISCA held in January 1947 on the verge of India's independence, declared, "Science in India too coming of age, it would try to solve the problems of the New India by rapid, planned development of all sectors and try to make her more and more scientifically-minded." The Science Congress has served as an important yearly forum for intense debates on scientific and public issues. It is a forum where eminent scientists, school and college teachers, and general public mingled together. One of the important features of the Science Congress is the participation of the Nobel Laureate scientists from abroad. The scientific exhibition organised at the venue is important attraction for general public.

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The annual sessions of the ISCA are organised in different parts of the country. Describing the reasons behind the decision taken for organising the Science Congress in different parts of the country its first President had stated: "…it was felt by many men of experience that the pressure of heavy official duties under which many investigators here carry on their scientific work, the climatic conditions which prevail in this country, and the long distances which have to be traversed, constitute practical difficulties of no mean order in the way of the immediate formation of a peripatetic association, designed to meet periodically, in turn, in all the different centres of scientific activity." Since its inception the Indian Science Congress has been held in the following 34 places including Lahore in undivided India (the number of Congresses held in a particular place is given in the bracket): Kolkata (12), Bengaluru (8), Chennai (8), Delhi (8), Hyderabad (6), Lucknow (5), Mumbai (5), Nagpur (4), Varanasi (4), Baroda(3), Chandigarh (3), Lahore (3), Pune (3), Ahmedabad (2), Allahabad (2), Bhubaneswar (2), Indore (2), Patna (2), Agra (1), Cochin (1), Cuttack (1), Goa (1), Jaipur (1), Kharagpur (1), Madurai (1), Mysore (1), Patiala (1), Ranchi (1), Roorkee (1), Shillong (1), Thiruvananthapuram (1), Tirupati (1), Visakhapatnam (1), and Waltair (1).

The Britishers who were made General Presidents of the ISCA before India attained independence were: William Burley Bannermann (1915), Colonel Sir Sidney Gerald Burrard (1916), Alfred Gibbs Bourne (1917), Gilbert Thomas Walker (1918), Lt. Colonel Sir Leonard Rogers (1919), Charles Stewart Middlemiss (1922), Thomas Nelson Annadale (1924), Dr. Martin Oslo Forster (1925), Albert Howard (1926), Dr. John Lionel Simonsen (1928), Col. Samuel Rickard Cristophers (1930), Lt. Col. Robert Beresford Seymour Sewell (1931), Sir Lewis Leigh Fermor (1933), Sir James Hopwood Jeans (1938, in place of Lord Rutherford of Nelson who died prematurely).

Indians who were elected General Presidents of the ISCA before independence were: Sir Asutosh Mookerjee (1914), Acharya Prafulla Chandra Ray (1920), Sir Rajendra Nath Mukerjee (1921), Mokshagundam Visvesvaraya (1923), Jagadis Chandra Bose (1927), Chandrasekhara Venkata Raman (1929), Shiv Ram Kashyap (1932), Meghnad Saha (1934), Upendranath Brahmachari (1936), R B Thiruvaiyaru Sambasiva Venkatraman (1937), Jnan Chandra Ghosh (1939), Birbal Sahni (1940), Ardeshir Dalal (1941), Darashaw Nosherwan Wadia (1942 and 1943), Satyendra Nath Bose (1944), Shanti Swarup Bhatnagar (1945), Muhammad Afzal Husain (1946), and Jawaharlal Nehru (1947).

In the history of the ISCA, D. N. Wadia, the eminent geologist is the only scientist who presided over the Science Congress twice (1942 and 1943).

In 1976, the concept of a Focal Theme of national relevance to be taken up for discussion by the Congress was introduced by M. S. Swaminathan, the then General President of the ISCA. Since 1976 the following themes have been covered: 'Science and integrated rural development'; 'Survey, conservation and utilisation resources'; 'Science education and rural development'; 'Science and technology in India during the coming decade(s)'; 'Energy strategies for India'; 'Impact of the development of science and technology on environment'; 'Basic research as an integral component of self-reliant base of science and technology'; 'Man and the ocean - Resource and development'; 'Quality science in India - Ends and means'; 'High-altitude studies'; 'Role of science and technology in environmental management'; 'Resources and human well-being – Inputs from science and technology'; 'Frontiers in science and technology'; 'Science and technology in India: Technology missions'; 'Science in society'; 'Coping with natural disasters: An integrated approach'; 'Science, population and development'; 'Science and quality of life'; 'Science in India: Excellence and accountability'; 'Science, technology and industrial development in India'; 'Science and technology for achieving food, economic and health security'; 'Frontiers in science and engineering and their relevance to national development'; 'Science and technology in Independent India: Retrospect and prospect'; 'New bioscience: Opportunities and challenges as we move into the next millennium'; 'Indian S & T into the next millennium'; 'Food, nutrition and environmental security'; 'Health care, education and information technology'; 'Frontier science and cutting-edge technologies'; 'Science and society in the twenty-first century: Quest for excellence'; 'Health technology as fulcrum of development for the nation'; 'Integrated rural development: Science and technology'; 'Planet Earth'; 'Towards a knowledge based society using environmentally sustainable science and technology'; 'Science education and attraction of talent for excellence in research'; 'Science and technology challenges of 21st Century – National perspective'; 'Quality education and excellence in scientific research in Indian universities'; and 'Science and technology for inclusive innovation - Role of women'.

In 1980, a permanent Task Force was set up by the Department of Science and Technology for following up various recommendations on the Focal Themes.

Following the initiative taken by the ISCA under the General Presidentship of K Kasturirangan, the speeches of the 89 General Presidents of the ISCA have been brought out in three volumes by Universities Press (India) Private Limited. As Kasturangan pointed in his Preface to these volumes: "The speeches made by the past 89 General Presidents in the annual sessions provide vision, hope, anguish, successes, achievements, gap areas and perspectives for the future—and when these are read through they become a moving picture of the history of science in India."

There is no doubt that the centenary celebration of the Indian Science Congress will be a great event in the history of Indian science. It will be presided over by the Prime Minister of India Dr. Manmohan Singh, the first Prime Minister to be appointed as General President of ISCA. The theme of the 100th Year of Science Congress is "Science for shaping the future of India". The Prime Minister graced the occasion of the inception ceremony of the ISCA centenary held in Kolkata on 2 June 2012. The media reports indicate that various events and new initiatives have been planned for the centenary celebration of the Science Congress. The Prime Minister expressed the hope that "scientists could use the centenary year celebration to reflect on how we can frame the science and technology policy that reflects our aspiration for making science a spearhead of development in our country".

The opportunity of the centenary celebration of the Science Congress should be utilised by all to create an interest in science, particularly among the youth, to enhance the public appreciation of significance of science in their daily life and to spread scientific temper in all sections of the society as visualised by Pt. Jawaharlal Nehru, the first Prime Minister of India. The event should usher in a mass movement for spreading scientific awareness in the country. Science communicators can and should play an important role in this direction.

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# Niceties of Numbers

**Rintu Nath**
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This summer we decided to spend our holidays in our ancestral village. It was indeed a very nice experience. Far away from the hustle and bustle of city, the tranquillity and freshness of village life captured my mind. My mathematician uncle and I used to take a long walk across the muddy road of the village in early morning. The gentle cool breeze, the mesmerising chirping of birds, the intoxicating smell of wet soil, the eye-catching greenery of crops and the blue sky in the horizon all added together to give an invigorating and enthralling experience.

One such morning, my uncle and I were walking down the village path. I could hear that my uncle was humming a song. I tried to guess the song, but could not get it. I could not hide my curiosity about the unfamiliar song that he was humming.

'What are you singing, uncle?' I asked.

'Let's put it this way: it's a singular mathematical song,' my uncle replied.

It was expected that my mathematician uncle will think about mathematical problems. But it was a little surprising to me that he would sing a mathematical song. I was interested to know what the song could be.

'I thought so – it should be something mathematical,' I quipped.

'My dear Googol, you didn't get it. What's the word that connects the expression *singular mathematical song*?', my uncle asked with a smile.

I was little puzzled. No doubt, it was his very characteristic cryptic clue.

'Number,' uncle gave a short reply.

'I can see the connection of number with mathematics, and other connections also look plausible,' I was trying to put together the clues in the puzzle.

'Yes, you're getting there. A *number* is a grammatical classification of words that consists typically of singular and plural. The number system, as you know, is an important component of mathematics. And you might have heard that sometime a song, dance or other musical item is referred to as a number.'

'Yes, I got it now. So what was that mathematical song?'

'Well, I just made a song out of a nice mnemonic poem on pi that gives thirty-one decimal places of pi.'

'Please tell me the poem.'

'Sir, I bear a rhyme excelling / In mystic force, and magic spelling / Celestial sprites elucidate/ All my own striving can't relate / Or locate they who can cogitate / And so finally terminate. Finis.'

'Hmm, that's fascinating. The number of letters in each word is giving the value of pi: 3.141592, etc. I will try to memorise it later. But uncle, please tell me more about the number system. The other day you mentioned this to me.'

Sir, I bear a rhyme excelling
3 1 4 1 5 9
In mystic force, and magic spelling
2 6 5 3 5 8
Celestial sprites elucidate
9 7 9
All my own striving can't relate
3 2 3 8 4 6
Or locate they who can cogitate
2 6 4 3 3 8
And so finally terminate. Finis.
3 2 7 9 5

Thirty-one decimal places of π:
π = 3.14159 265358 979 323846 264338 32795

'The number system dates back to very early age of mathematical thinking. Greek philosopher and mathematician Pythagoras and his followers believed that numbers are the prime cause behind everything in the world, from the musical harmony to the motion of planets and the formation of the Universe. By 'number' they meant natural numbers', uncle replied.

'But how can numbers be the prime cause behind everything?' I wanted to know.

'Well, that's what Pythagoreans believed. However, they were not far from reality. Numbers may not be the cause, but they are required to explain everything. Numbers are the soul of mathematics and without mathematics there will be no understanding of the world around us.'

'Uncle, you said natural numbers – what are they?'

'The natural numbers are the ordinary whole numbers used for counting; for example, five fingers, two apples, etc.'

'Is zero a natural number?'

'Tricky question! In fact, there is no universal agreement whether to include zero in the natural number set. Some mathematician define natural numbers as the set of only positive integers like {1, 2, 3....}, while other mathematicians say it is the set of non-negative integers {0, 1, 2, .....}'.

*Integers can be thought of as discrete, equally spaced points on an infinitely long number line.*

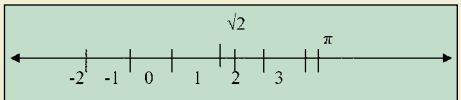
'What is an integer?'

'In Latin, 'integer' means 'untouched', therefore one can say a whole number. The word 'entire' comes from integer. Integers are a subset of the real numbers – they are numbers that can be written without a fractional or decimal component, and fall within the set {...,–3, –2, –1, 0, 1, 2,3, ...}. For example, 7, 39, and –431 are integers; 9.75, –5½, and $\sqrt{2}$ are not integers.

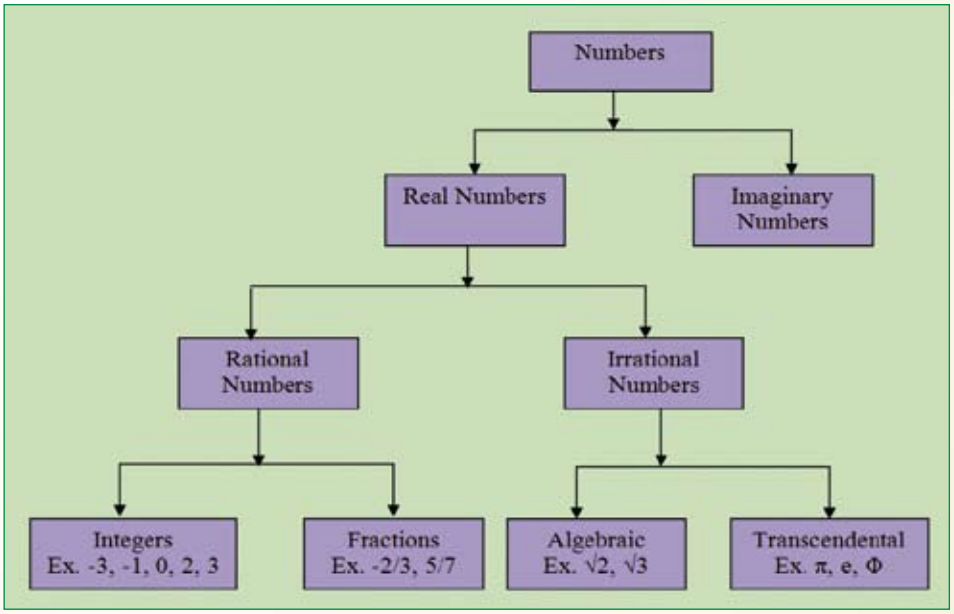
'Uncle, you said integers are subset of real numbers, does it mean real numbers include numbers that are not whole numbers?'

'Yes, real numbers include not only integers, but their ratios, called fractions; for example, 2/9, 7/5, – 6/5, etc. Both integers and their fractions are called rational numbers. Real numbers also include irrational numbers, numbers which cannot be represented as the ratio of two integers. '

'Oh! There are so many types of




*Real number line with rational and irrational numbers*




numbers. I am lost in numbers!'

'Let me explain. The whole world of numbers may be divided into two types, 'real numbers' and 'imaginary numbers.' The real numbers include all the rational numbers, such as the integer –5 and the fraction 4/3, and all the irrational numbers such as $\sqrt{2}$, π, e, etc. Real numbers can be thought of as points on an infinitely long line called the number line or real line. Integers are equally spaced on real line.'

$\pi^e$, $\pi^\pi$, $e^e$, $e^\pi$

Are these numbers transcendental or algebraic?

'What is a rational number?'

'As I mentioned before, a rational number is a number that can be expressed as the quotient or fraction a/b of two integers, with the denominator b not equal to zero', uncle explained.

'Are all the integers rational numbers?' I wanted to know.

'Yes, you are right. For example, the number 4 is an integer as well as rational as it can be written as 4/1', uncle replied.

'You said integers are equally spaced; does it mean fractions are not equally spaced?'

'Fractions form a *dense* set of numbers. Between any two fractions, no matter how close we go, we can always find another number. Take the fractions 1/1001 and 1/1000 as an example. These fractions are certainly close. Yet we can easily find a fraction that lies between them, for example 2/2001. We can repeat the process and find a fraction between 2/2001 and 1/1000, for example 4/4001. Not only there is room for another fraction between two given fractions, there are infinitely many new fractions. Consequently we can express the outcome of any measurement in terms of rational numbers alone.'

'That means entire number line is populated by rational numbers', I said.

'That seems to be natural conclusion. However it is not true.'

'You mean to say that the number line is not continuous with rational numbers?'

'That precisely the point – within rational numbers there are many irrational numbers.'

'Yes, you have mentioned it earlier. What is an irrational number?'

'An irrational number is a real number that cannot be written as a simple fraction. It cannot be represented as terminating or repeating decimals. For example, square root of 2 ($\sqrt{2}$) is an irrational number as it cannot be represented as a/b form, where a and b both are integers and b is non-zero.'

'I did not get that – please give me an example.'

'The number 1.4 can be expressed as 7/5. This signifies 1.4 is a rational number. However number like $\sqrt{2}$ cannot be represented as a fraction. Use a calculator to calculate $\sqrt{2}$. You will find its decimal representation never repeats and never ends. Hence it is irrational.'

'How many irrational numbers are there?'

'Oh Googol – there are many. Square root of all prime numbers is irrational, for example $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$ and so on. Square roots of many composite numbers can also be irrational. For example, $\sqrt{39}$. However $\sqrt{16}$ is not irrational. Apart from them, there are a number of famous constants like Euler's number (*e*), pi (π), the golden ratio (Φ) – they are all irrational.'

'I have noticed many repeating decimal representations. For example, when I divide 2 by 3, result is 0.666....repeating, Does it mean 0.666.. is also an irrational number?'

'Good observation and the answer is hiding within your question itself. You said when you divide 2 by 3 you get 0.666. This signifies 0.666... could be represented as the ratio of two integers and hence it cannot be an irrational number.'

'So we have real and imaginary numbers. Within real numbers, there are rational and irrational numbers. Rational numbers can be integers of their ratios, called fractions. I guess there should be something more on irrational number'

'Oh great! I think that your logic of symmetry is going towards the right direction. Within irrational number there are transcendental numbers'

'What is a transcendental number?'

'A transcendental number is a type of number that cannot be a solution of any polynomial equation.'

'Please elaborate, uncle.'

'Consider a polynomial equation: $x^2 - 2 = 0$. One of the solutions of this equation is $\sqrt{2}$. Therefore $\sqrt{2}$ is not transcendental number, although it is irrational. However, a transcendental number cannot be a solution of a polynomial equation of any order. '

'Please give some examples of transcendental numbers'

'Most of the famous constants like *e*, π, the golden ratio (Φ) are all transcendental'

'This means that all transcendental numbers are also irrational numbers'.

'You are absolutely right. All transcendental numbers are irrational, but not vice versa.'

'Yes I understand now. So, *e*, π, Φ are transcendental and also irrational. But the

Continued on page 31

# How to get the best of nutrition from our food

**Dr. K. Srinivasan**
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## Beware of nutrients down the drain during food processing!

Food is a basic necessity for our life as it provides us energy for everything we do and also for all involuntary functions of our body. In addition, food supplies the nourishing substances our body requires to build and repair tissues and to regulate body organs and systems. All the food we eat comes either from plants or animals. Plants provide grains, vegetables and fruits, while animals provide meat, eggs, and milk. Certain basic foods may require little or no processing before they are eaten, while others are greatly changed by processing. Basic foods such as eggs, vegetables and fruits are commonly sold in their natural form.

All other foods we consume are subjected to one or the other form of processing in order to make them edible. Human diet has been based on grains for thousands of years. Rice, which is the main food in many cultures, is obtained from dehusking of paddy. Much of the world's grain, especially wheat, is ground into flour. Wheat flour is used in breads, pastries, and pasta and various kinds of noodles. Fruits and vegetables may be canned or pickled or made into juice and jams. In addition to fresh meat, it may also be processed (cured, frozen, and smoked meat, and sausages). Similarly fish and other seafood may be processed into frozen, canned, salted, dried, and smoked products. Urban supplies of milk will have undergone pasteurisation and homogenisation. In addition, milk may be made into such foods as curd, butter, and cheese. Thus, almost all foods consumed by humans are subjected to one or more methods of processing before they reach the table. Cereals and millets are subjected to milling and polishing at the commercial level, while pulses and legumes undergo dehusking. At the household level, the common methods of food processing include cooking (heat processing), soaking and sprouting, roasting and puffing, and fermentation. Another common type of processing is the addition of various additives intended to improve quality of food, such as its colour, flavour, or storage life. Processing changes basic foods in some way or the other. Most of the processing methods can result in considerable loss of certain nutrients, particularly vitamins and minerals, thereby leading to an inadequate intake of these nutrients.

## Nutrient losses encountered during processing

*Dehusking, milling and polishing:* The outer husks of grains such as rice, wheat, finger millet, etc. contain good amounts of vitamins and minerals. While pulses and legumes undergo dehusking, the process of milling and polishing of cereals and millets involves the removal of most of the husk, thereby leading to a loss of nutrients present in it. Thus, the less polished brown rice is nutritionally far superior to the highly polished white rice. Similarly, whole-grain wheat flour (*atta*) provides a higher complement of nutrients than the finely milled, refined wheat flour, especially which is used in bakery products. Many pulses consumed in India can be cooked whole while some of them are dehusked. Pulses contribute significantly to the protein content of vegetarian diets. Since the husks are poor sources of protein, their removal serves to raise both the proportion and the Protein Efficiency Ratio of the endosperm proteins. Therefore, dehusking of pulses would be advantageous in terms of protein quality.

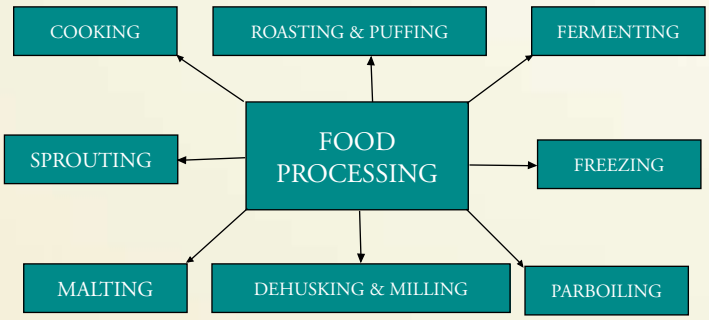



*Fig.1 Different types of food processing*

Parboiled rice is consumed in some parts of India in preference to raw rice. During parboiling of paddy, the nutrients diffuse into the grain and a protective gelatinised starch coating is formed on the surface of the grain, which prevents the leaching of vitamins and minerals. Thus, parboiling confers protection to nutrients, making it nutritionally superior to raw rice.

*Pre-cooking processing of foods:* Foods are readied for cooking by washing, cutting, peeling, grinding, etc. Washing food grains such as rice in copious amounts of water can result in loss of water-soluble vitamins, especially thiamine. Almost 40% of thiamine can be lost from rice as a result of excessive washing! Similarly washing of cut vegetables leads to significant loss of water-soluble vitamins. The outer peels of most vegetables are rich sources of vitamins, and a good amount of these nutrients are lost during peeling of vegetables. When fruits are cut and exposed to air, significant amounts of vitamin-C are destroyed.

*Cooking:* Cooking is inevitable to make foods palatable. Cooking methods commonly include: boiling, steaming or pressure-cooking, frying, roasting and baking. While cooking destroys harmful microorganisms and certain anti-nutritional factors, it also destroys certain nutrients. The loss of nutrients on cooking depends on the temperature, duration of cooking, and the nutrient concerned. Heat processing of foods improves the digestibility of starches, but subsequent cooling makes a small portion resistant to digestion. Resistant starch shares some properties with the non-starch polysaccharides of dietary fibre. During cooking, proteins in the presence of reducing sugars undergo Maillard reactions. These reactions impart a brown colour which is desirable in bakery products. However, Maillard reactions involving lysine

and other essential amino acids render them unavailable, thus reducing the quality of protein. The severity of the reactions depends on the temperature. Excessive heating can drastically reduce the protein quality of the product, while mild heating produces browning, and slight loss of lysine. Baking and toasting of cereals is associated with a loss of 10-15% of lysine. During heat processing in the presence of oxygen, unsaturated fatty acids in food react to form peroxides, which are highly reactive, and decompose to form a wide range of substances, some of which are potentially toxic. These reactions occur slowly at normal frying temperatures in pure fats, but are catalysed by traces of metals such as iron and copper, which are common constituents of foods. Over-heating or repeated heating of fats, as often practised by roadside vendors, result in an accumulation of the products of oxidation, thus making the fat potentially toxic. The use of iron pans for frying may accentuate this process. Many processed fats and oils contain antioxidants to minimise these changes, which take place slowly even at ambient temperatures.

Vitamins are most susceptible to losses during heat treatment; the magnitude of losses depends on the vitamin and the conditions employed. Loss of vitamins can occur by two major routes: (1) the leaching of water-soluble vitamins into the cooking medium, and (2) the destruction of unstable vitamins under certain conditions such as oxidation and presence of alkali. When foods such as rice are washed in large volumes of water prior to cooking, significant loss of the B-complex vitamin thiamine can occur. Root vegetables do not suffer much loss of nutrients by cooking, if cooked along with the outer skin. This prevents the leaching out of nutrients. Steaming prevents losses due to leaching. Cooking in a covered vessel is more advantageous in terms of preventing the loss of nutrients. Vitamin-C is almost completely lost during cooking. Similarly, when vegetables are subjected to excessive heating, β-carotene (provitamin-A) undergoes a change from the *trans-* to *cis-* form, which is less potent as provitamin-A. β-Carotene is highly susceptible to destruction by exposure to oxygen, heat, and alkaline conditions. Loss of β-carotene during cooking ranges from 50 to 90%. The use of food acidulants such as tamarind or lime and/or spices such as turmeric or onion reduces this loss and improves the retention of this provitamin.

Cooking grains or vegetables in large quantities of water results in leaching of water-soluble vitamins into the cooking water. When this water is discarded, so are the vitamins! Significant losses of riboflavin in milk can occur when milk bottles/sachets are left in sunlight or under fluorescent lighting. Reheating of cooked food too results in loss of some amounts of vitamins. Cold storage of cooked food for future use and reheating of such foods before consumption result in significant losses of vitamins, particularly vitamin-C and thiamine. Mere storage of green leafy vegetables and other vegetables results in substantial losses of vitamin-C, folic acid and pantothenic acid and moderate losses of thiamin and riboflavin. Substantial losses of thiamin, riboflavin and pyridoxine have been observed from frozen stored animal tissue.

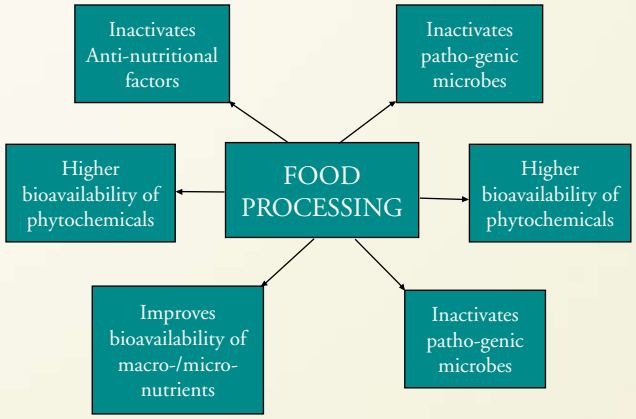



*Fig.2 Benefits of food processing*

*Roasting and puffing:* Roasting of food grains generally improves their palatability and confers new flavours, which render the food grains suitable for making ready-to-serve food products. Puffing is generally employed for food grains such as rice, maize, and chickpea, which render them crisp and tasty. Puffing improves the digestibility of starch, but it significantly reduces the levels of thiamine and riboflavin.

*Sprouting and malting:* Soaking of the food grains brings about hydrolysis of carbohydrates and proteins to a certain extent. This results in improved digestibility of foods. Sprouting of grains increases the vitamin contents, especially of vitamins $B_1$, $B_2$ and C, most of which are retained even during subsequent cooking. Malting involves sprouting of grains, mild toasting and powdering. Malted cereals and pulses have been extensively used in the preparation of weaning foods and geriatric foods. Such foods have the advantage of being nutritionally superior, and less viscous, thereby being more energy-dense. Weaning and geriatric foods made of malted grains are also easily digestible and do not cause flatulence.

*Fermenting:* This method food processing reduces the level of antinutritional factors such as phytates and trypsin inhibitors. Fermentation also produces small amounts of vitamin $B_{12}$, which is otherwise absent in foods of plant origin. Fermentation of milk into curd does not alter the nutritive value of milk. Curd, which contains the lactic acid bacteria *Lactobacillus* is regarded as 'probiotic' offering desirable health benefits linked to proliferation of desirable gut bacteria, while minimising the growth of undesirable ones.

Thus, although there are benefits of food processing, we are likely to lose some of the nutrients when we process our foods. However, there are ways in which we can overcome this problem by judiciously selecting food combinations, and processing them prudently. Nutrient losses can be prevented by adopting the following tips:

- Using minimum water for cooking, and retaining the cooked water in the prepared food.
- Cutting vegetables into larger pieces and cooking them for a short duration to prevent the loss of vitamins, particularly vitamin-C.
- Avoiding exposure of cut vegetables to light and oxygen (to prevent loss of vitamin-C, folic acid and other B-complex vitamins.
- Avoiding the use of baking soda when cooking vegetables/ legumes.
- Cooking green leafy or yellow-orange vegetables in presence of turmeric, onion, or food acidulants to minimise the oxidative destruction of carotenes to a great extent.

## We cannot utilise all that we eat!

'Eat plenty of green leafy vegetables, you must be anemic!' is an oft-heard advice

when you complain of fatigue, headache, and breathlessness. This advice is given to overcome possible iron deficiency causing the above symptoms, with the view that green leafy vegetables are ready suppliers of iron. However, people are less aware of the fact that all the iron that is present in foods of vegetable origin is not available to the body for absorption. So is the case with other micronutrients like zinc, calcium, β-carotene, etc. The bioavailability of the amount of a nutrient available for absorption of these micronutrients is influenced by several components present along with the micronutrients in our diets, which either inhibit, or enhance the absorption of these nutrients. In other words, only a fraction of what is consumed is actually absorbed in the intestines and is available to the body.

In order to adequately meet the physiological needs of each of the nutrients, precise amounts of consumption of these individual nutrients necessary in everyday meal have been recommended (Recommended Dietary Allowances, RDA). RDA values take into account the bioavailabilty of nutrients, nutrient losses during food processing, as well as individual variations in requirements. While poor absorption results in lesser amounts of the consumed nutrients becoming available to the body, considerable losses of nutrients during food processing leads to inadequate intakes of these vital food components. The nutrient content of raw food might be considerably compromised when it is subjected to various kinds of processing. Thus, bioavailability factor as well as nutrient losses during food processing could contribute to a failure in meeting the RDA.

## Inherent factors affect nutrient bioavailability

Foods of plant origin such as green leafy vegetables, cereals and legumes are very good sources of calcium, iron, zinc, and the B-complex vitamins. On the other hand, they also contain components such as protease inhibitors, lectin, polyphenols and phytate. Some of these components of our diets are inhibitors of absorption of essential macronutrients like proteins, as well as of dietary minerals, in particular non-heme iron and zinc.

*Macronutrients:* Dietary proteins are hydrolysed to amino acids during digestion by the successive action of gastric pepsin, pancreatic trypsin and chymotrypsin and intestinal amino peptidases. Anti-nutritional factors such as lectins present in legumes inhibit by direct binding the activity of the proteases, which are involved in the digestion of proteins in the gastrointestinal tract.

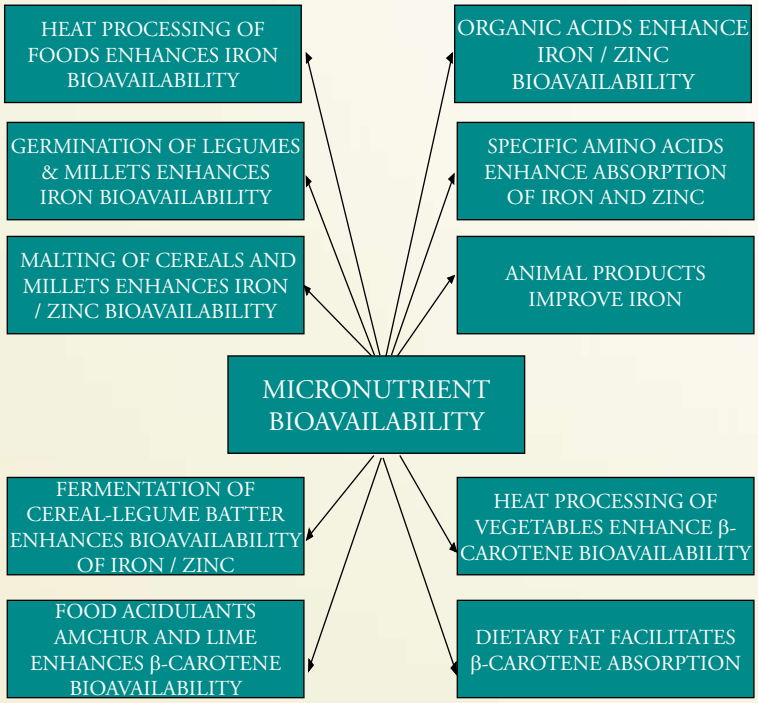



*Fig.3 Promoters of micronutrient bioavailability*

Therefore, presence of such factors in the diet will lead to the incomplete digestion of proteins and hence their poor bioavailability, in spite of an adequate intake. Cooking of legumes, however, inactivates these protease inhibitors and thereby improve the bioavailability of dietary proteins. The starch present in our diets undergoes hydrolysis to glucose during the process of digestion by the successive action of amylase and maltase in the gastrointestinal tract. However, a small portion of starch present in cereals and legumes turns resistant to the action of amylase during heat treatment, thus becoming unavailable for digestion.

*Micronutrients:* Our diets also contain several components that modulate the absorption of micronutrients such as vitamins and minerals. Iron in our diets is present in two forms – heme (ferrous) and non-heme (ferric) iron. Heme iron present in foods of animal origin as a part of haemoglobin and myoglobin is absorbed intact readily by the intestinal mucosal cells, and its absorption is not influenced by any dietary factor. On the other hand, the intestinal absorption of non-heme iron present in plant foods is subject to modulatory effect by various dietary factors. Phytates, the major phosphorous storage compounds abundantly present in food grains, nuts and oil seeds, strongly inhibit iron and zinc absorption by forming insoluble complexes with these minerals. Whole grain cereals and legumes are especially rich in phytates, since phytates are found in the outer husk or seed coat of these grains. Polyphenols present in plant foods are responsible for astringency, bitterness, browning reactions, colour, etc. Polyphenols such as tannins present in large amounts in tea, coffee, cocoa, spinach and several herbs or spices, are known to inhibit trace metal absorption.

Dietary fibre, both insoluble – cellulose, hemicelluloses and lignins – and soluble gums and mucilage have an important physiological role of filling the diet without adding calories (roughage value), thus increasing intestinal motility. Dietary fibre binds trace metals, making them unavailable for absorption. Calcium when consumed as supplement tablets markedly interferes with dietary iron and zinc absorption. Calcium is also known to potentiate the inhibitory effect of phytate on mineral absorption. Organic acids present in food acidulants such as ascorbic, citric, malic and tartaric acid have been found to enhance the absorption of non-heme iron by reducing ferric iron to ferrous iron, and/or forming soluble ligands with iron, thus rendering it available for absorption. Recent evidence suggests that these acids also promote the intestinal absorption of dietary zinc. Among the organic acids, ascorbic acid (vitamin-C) present in fruits and vegetables is the most potent promoter of trace metal absorption.

Amino acids such as glycine, histidine, lysine, cysteine and methionine can increase the solubility of iron and zinc and hence facilitate their absorption. Animal

products such as meat, fish and seafoods, in addition to being sources of heme iron, promote the absorption of non-heme iron. When these foods are added to a meal predominantly based on cereals, the iron and zinc bioavailability from that meal is improved. In addition, minerals – iron, zinc and calcium – present in the diet mutually interact with each other, thus influencing their bioavailability. For example, iron given at pharmacological doses has been shown to interfere with the absorption of zinc. Similarly, high doses of calcium interfere with both iron and zinc absorption. The amount of iron and zinc available for absorption from a particular meal, therefore, is the net result of the effect of both enhancers and inhibitors of their absorption present in that meal. The bioavailability can vary more than 10-fold in a meal with a similar content of iron, depending upon the other ingredients present. Thus, consumption of tea along with or immediately after a meal may reduce the bioavailability, while addition of fresh fruits containing vitamin C can increase the bioavailability of iron and zinc.

Calcium is an important macro mineral, involved in the formation of bones and teeth. The richest source of calcium among foods of animal origin is milk and its products. Among plant foods, finger millet, green leafy vegetables, particularly amaranth, fenugreek and drumstick leaves are rich in calcium. Phytates and dietary fibre present in cereals and millets, and oxalates present in some green leafy vegetables are potent inhibitors of calcium absorption. These dietary components form insoluble complexes with calcium, rendering it unavailable for absorption. Similarly, the absorption of calcium can be depressed in the presence of high levels of fat. Some unsaturated fatty acids also form calcium salts that are poorly absorbable.

β-Carotene is the precursor of vitamin-A present in green leafy and yellow-orange vegetables and fruits. β-Carotene is converted to vitamin-A in the body. Preformed vitamin-A is present only in foods of animal origin, therefore, vegetarians have to derive this vitamin mainly through β-carotene present in plant foods. Absorption of β-carotene is dependent on several dietary factors. The food matrix in which the provitamin is enmeshed influences the amount that is available for absorption. For example, β-carotene from green leafy vegetables is better absorbed than that from raw carrots. A small amount of fat in the diet improves the bioavailability of β-carotene. Food acidulants such as *amchur* and lime generally enhance the bioavailability of β-carotene from yellow-orange and green leafy vegetables. There is also evidence that turmeric and onion significantly enhances the bioavailability of β-carotene from vegetables. Thus, presence of food acidulants such as lime juice/*amchur* and turmeric/onion prove to be advantageous in the context of deriving maximum β-carotene from vegetable sources.

## Food processing affects nutrient bioavailability

*Cooking:* Cooking improves the digestibility of foods, particularly starch. During cooking, starch swells, and cell walls burst making it more accessible to the digestive enzymes. Cooking also destroys certain anti-nutritional factors present in food. Cooking egg helps in destroying avidin, a protein that binds biotin and makes it unavailable. Some legumes, particularly soybean, contain trypsin inhibitors. These trypsin inhibitors reduce protein digestibility by interfering with the action of this protein digestive enzyme. Cooking of legumes inactivates trypsin inhibitors and thus improves protein digestibility. Heat processing of food generally improves the bioavailability of iron, while it has a negative effect on zinc bioavailability. Carotenoids are usually bound to the proteins in plant cell. Mild cooking procedures loosen the food matrix and dissociate carotenoids from proteins, facilitating their bioavailability from raw vegetables. Thus, bioavailability of β-carotene from carrots increases as a consequence of heat processing.

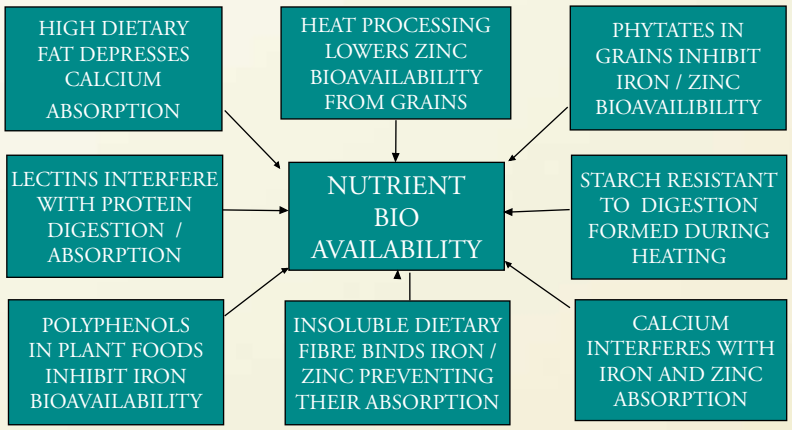



*Fig.4 Inhibitors of nutrient bioavailability*

*Sprouting and malting*: Green gram and chickpea are often germinated prior to use in the preparation of specific traditional salad dishes. Sprouting and malting have been found to enhance iron absorption due to elevated vitamin-C content or reduced tannin or phytic acid content, or both. These processes are known to activate endogenous phytases, which in turn hydrolyse phytate, rendering iron and zinc more available. Sprouting of green gram, chickpea and finger millet is associated with significantly improved bioaccessibility of iron, which is due to a reduction in tannin content. Studies have shown a two-fold increase in iron bioavailability upon germination and five- to ten-fold increase on malting of millets.

*Fermentation:* Fermented products commonly consumed are *idli, dosa, dhokla, curd,* etc. Fermenting of foods improves the bioavailability of essential amino acids and the B-complex vitamins, *viz.*, thiamine, riboflavin and niacin. Food processing by fermentation is known to improve mineral bioavailability by reducing the inhibitors of their absorption, such as phytate present in the grains. Fermentation of the batter of cereal-pulse combination in the preparation of *idli* and *dosa* enhances the bioavailability of zinc and iron. Fermentation of cereal-legume combinations of the *idli* and *dosa* batter significantly reduces both phytate and tannin associated with the legumes. Besides reducing such inhibitory factors, fermentation could also improve mineral bioavailability by virtue of the formation of organic acids, which form soluble ligands with the minerals, thereby preventing the formation of insoluble complexes with phytate.

## Effect of food processing on non-nutrient components

The non-nutrient phytochemicals which are gaining importance from human health point of view are susceptible to beneficial changes during food processing. Phenolic

compounds become more bioavailable upon cooking of vegetables. Processed carrot puree can thus offer higher antioxidant potential and protection against oxidative stress than raw carrots. The carotenoid lycopene, which is responsible for the colour in tomato and a powerful antioxidant, will become more bioavailable from heat processed tomato than from fresh fruit because of its transformation from *trans*-isomeric form in the fresh tomato into *cis*-isomeric form (which is more bioavailable) during heat processing. Processing can also enhance the antioxidant potential of certain phenols. Processing can also result in the formation of Maillard reaction products causing browning of cake crust, bread, biscuits and confectionery items, which are considered to have high antioxidant potential. These compounds are formed as a result of intense heat treatment.

Processed fruit juices such as apple, grape, pomegranate and *jamun* have phenolic content higher than their fresh fruit counterparts. This is because of the leaching of phenolic compounds from peels or seeds during extraction during commercial processing. Monoterpenes such as D-limonene present in citrus peel is known to have health beneficial property. Processed food products such as marmalade and pickle essentially include peel of citrus fruits such as orange, lime, bitter orange, etc. thus conserving significant amounts of health beneficial monoterpenes.

## Conclusions

The food-processing procedures commonly employed either commercially or at domestic level have several advantages in improving the nutrient quality, digestibility and palatability of foods, bioavailability of nutrients, and nutraceutical phytochemicals. Pre-processing of foods also adds considerably to the convenience and variety of food preparations. Food processing is thus indispensable in our life and culinary style. Nevertheless, food processing, particularly cooking, can reduce the vitamin and mineral contents. However, consumption of processed foods need not necessarily amount to compromising with nutritional value, if certain simple remedial procedures are adopted to minimise losses of nutrients. We stand to gain from food processing rather than lose, from the nutrition point of view, if we prudently minimise inevitable nutrient losses. All the nutrients we consume through our diets are not available to the body for absorption, which depends on other components present in the meal. However, there are ways in which we can overcome this problem by judiciously selecting food combinations and processing them prudently.

* Chief Scientist, Department of Biochemistry & Nutrition, Central Food Technological Research Institute, Mysore-570020

Continued from page 36 **(Niceties of Numbers)**

square root of 2 ($\sqrt{2}$) is irrational but not transcendental.'

'You're absolutely right!'

'Is there a name for those numbers that are irrational but not transcendental?' I asked.

'Yes, numbers that are irrational but not transcendental are called algebraic numbers. Therefore $\sqrt{2}$, $\sqrt{3}$ are all algebraic numbers.'

'How to prove an irrational number is transcendental or not?'

'It is not easy to prove that a specific number is transcendental. For this one must prove that the number does not fulfil a certain requirement. Among the numbers whose status has not yet been settled are $\pi^e$, $\pi^\pi$, $e^e$, and $e^\pi$.'

'Uncle, you have explained, within rational numbers, there are more fractions than integers. What about transcendental and algebraic?

'In 1847, German mathematician Georg Cantor made the startling discovery that there are more irrational numbers than rational ones, and more transcendental numbers than algebraic ones. In other words, most real numbers are irrational, and among irrational numbers, most are transcendental!'

'This is an amazing fact! There are infinite numbers and it is possible that there are many other facts that we do not know yet!'

'That's true, Googol!'

Most real numbers are irrational, and among irrational numbers, most are transcendental

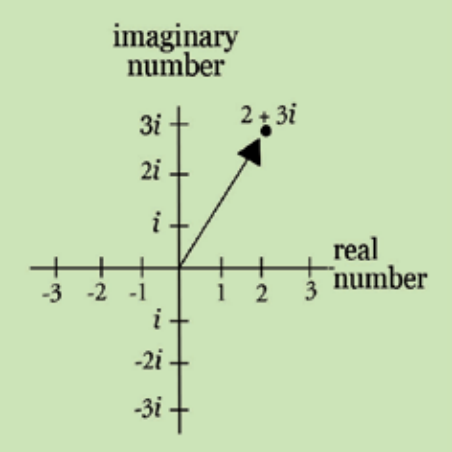
'There are real numbers and imaginary numbers. You have told me all about real numbers. Please tell me something about imaginary numbers.'

'Square root of any positive real number will give another positive real number. For example $\sqrt{2}$ = 1.414.. , $\sqrt{25}$ = 5. But if you want to do a square root for negative numbers, result will be an imaginary number. That means $\sqrt{-25}$ is an imaginary number.'

'How is an imaginary number represented?'

'An imaginary number can be written as a real number multiplied by the imaginary unit $i$, which is defined by its property $i^2 = -1$, or $i = \sqrt{-1}$. That means $\sqrt{-25} = i5$'

'I have heard about complex numbers.




Are imaginary numbers complex numbers?'

'An imaginary number $ib$ can be added to a real number $a$ to form a complex number of the form $a + ib$, where $a$ and $ib$ are called, respectively, the real part and the imaginary part of the complex number. For example $2 + i5$ is a complex number.'

'Uncle, please tell me more about the complex number.'

This time my uncle interrupted me.

'My dear Googol, we will miss our morning yoga session if we talk more on numbers now. So let's concentrate on the yoga now and we will ponder over numbers sometime later.

# Rolf M. Zinkernagel: Explorer of the immune system

**Biman Basu**
E-mail: bimanbasu@gmail.com

Winner of the 1996 Nobel Prize in Physiology or Medicine, Prof. Rolf M. Zinkernagel received his MD degree from the University of Basel in Switzerland in 1970. He moved to the Australian National University, Canberra, where he received his PhD in 1975. While in Canberra, when still a graduate student, Zinkernagel worked with Peter Doherty on the role of T lymphocytes and major histocompatibility complexes in fighting infection – the work for which the two shared the 1996 Nobel Prize. Their work showed that the body's infection-fighting capability requires simultaneous recognition of the "foreign" viral molecules and a group of "self" molecules known as histocompatibility antigens. It laid the foundation for a better understanding of both healthy immune systems and those compromised by autoimmune disorders such as rheumatic diseases and diabetes. Zinkernagel returned to Switzerland in 1979 to work at the University of Zurich. In 1992 he was appointed head of the Department of Experimental Immunology. In addition to the Nobel Prize, he is also winner of the Albert Lasker Medical Research Award in 1995 and the Cancer Research Institute William B. Coley Award in 1987. In 1999 he was awarded an honorary Companion of the Order of Australia (AC), Australia's highest civilian honour, for his scientific work with Doherty. He is a member of the Cancer Research Institute Scientific Advisory Council, The National Academy of Sciences, and The Academy of Cancer Immunology.

Prof Zinkernagel was in Bhubaneswar to attend the 99th Indian Science Congress, held from 3 to 7 January 2012, when Biman Basu interacted with him. This interview was done online.

**Biman Basu:** You started your carrier in surgery, but what made you change your field to immunology?

**Rolf Zinkernagel:** As an MD I liked to work with my hands as well and that's why I had chosen surgery. Unfortunately, the training program in surgery was rather slow and often not very intellectual. That's why I looked for alternatives.

**BB:** From your autobiography we learn that you had to face a lot of difficulty in getting a post-doctoral position despite applying to as many as 50 institutions around the world. Did you feel frustrated?

**RZ:** Of course having no or only negative answers on 50 applications is a bit frustrating, but in a way this was – even in the early '70s – not unusual and therefore we just tried again.

**BB:** Before talking about your Nobel Prize-winning work, please tell us how the human immune system functions and why it does not work sometimes.

**RZ:** The immune system consists of single cells that circulate throughout the vasculature and meet in so-called secondary lymphatic organs such as lymph nodes or the spleen. In these very complicated anatomical structures cells interact, guided by foreign substances, called antigens, which may be of viral bacterial or parasitic origin. Therefore, there is no immune response made outside of lymphatic organs and none if there are no secondary lymphatic organs. The immune cells act via secreted antibodies from so-called B cells or by direct cell interactions of lymphocytes (T cells) with infected cells or tissues.

*Rolf Zinkernagel, joint winner of the 1996 Nobel Prize in Physiology or Medicine (Photo: Biman Basu)*

**BB:** Could you explain in simple terms what is cell mediated immunity?

**RZ:** Cell mediated immunity – in contrast to humoral or antibody immunity – is mediated directly by a cellular interactions. Antibodies are secreted on mucosal surfaces and in serum and therefore can control infections at these sites. Cells can emigrate into solid tissue and therefore are better to deal with infections in solid organs, such as liver, muscles or connective tissue.

**BB:** Your Nobel Prize-winning research was done in Australia. Was there any reason that made you leave Switzerland and go to Australia?

**RZ:** I was very interested in so-called facultative intra-cellular bacterial infections – salmonella or tuberculosis. The lab in Canberra, Australia, has been a very important centre for such research, as well as on immunity against viral infections.

**BB:** You returned to Switzerland in 1979 to join the University of Zurich. What was your most significant research in Zurich?

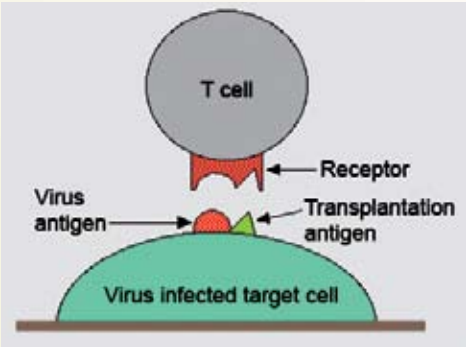
**RZ:** In Zurich and together with Hans Hengartner, our lab made the following discoveries. We showed first that perforin was one of the important molecules that enabled so-called killer T cells to destroy infected target cells. We also found that immunological memory was not responsible for protection by vaccines. We showed that newborn mice, which have no functioning immune system yet, are fully protected by maternal antibodies (this was well recognised before), but it was crucial that these newborns were also exposed to epidemiological infectious events in the herd to build up their immunity. The Zurich lab also showed that overwhelming infections by viruses that do not destroy cells of the host, can exhaust the cell mediated immune response, so that no or only very little damaging immunopathology occurs. The same infectious agents that cause no direct cell damage and can persist life-long constantly mutate their surface structures, so as to escape any upcoming antibody response that might neutralise persisting viruses. The same happens more or less with HIV and that is one of the major reasons why we do not have a vaccine against HIV. ■

**BB:** Tell us briefly about the experiments that led to the discovery of how the immune system recognises virus infected cells, the work for which you received the Nobel Prize along with Peter Doherty.

**RZ:** It had been known for a long time that foreign kidney or skin grafts are rejected by a recipient host predominantly via so called cell mediated immunity. It was, however, unclear why the immune system should bother to reject foreign grafts, because this is not something that happens naturally and only was introduced into medicine about 50 or 70 years ago. By chance we observed that virus-specific cytotoxic or killer T cells that recognise virus-infected target cells could only destroy these infected cells if they were derived from an identical host as the virus immune killer T cells. This indicated that cytotoxic or killer T cells recognised a virus induced modification on the cell surface, but in addition they had to recognise a self-component on the cell surface. Genetic analysis revealed that this self-component comprised the so called transplantation antigens responsible for graft rejection. Subsequently, other researchers showed that these transplantation antigens presented pieces of small peptides of 8-10 amino acids on the surface of the cell to T cells. The general conclusion was that killer T cells rejected virus infected cells of the host in a similar fashion as foreign tissue or organ grafts were rejected under the rather artificial conditions of transplantation surgery.

**BB:** Many viral diseases such as polio, measles, etc., can be prevented by vaccination, but why is it that there no vaccine against HIV that causes the dreaded disease AIDS?

**RZ:** The common characteristic of classical childhood infections by polio, measles, tetanus etc., is that these infections kill infants very rapidly within 7-12 days. TB, leprosy or HIV do not do so, they take 10-30 years to cause serious disease and death. Since evolution can only select for survival of the species, acute infections such as measles or polio must be dealt with efficiently by the immune system. The same is of course not true for HIV, TB, or leprosy, since these infections are much less efficient and kill very slowly. In addition, as pointed out above, many of these chronic persisting types of infections mutate all the time their determinants that can function as targets for neutralising or protective antibody responses. This is particularly the case for HIV but also for malaria or dengue. We cannot imitate the key characteristics of this second category of infections, i.e., first have persistence at low level without causing overt immunopathology and second repeat the mutational changes, so that all possible neutralising antibodies are eventually generated that protect against all possible mutations.




*The figure describes how a killer T lymphocyte must recognise both the virus antigen and the self histocompatibility antigen molecule in order to kill a virus-infected target cell. The figure is a modification of the figure published by Zinkernagel and Doherty already 1974 (Credit: Nature 251, p 547, 1974).*

**BB:** In your opinion, which areas in immunology need more attention?

**RZ:** While we tend to analyse at the molecular level all details of the immune system, we forget often that immunity only makes sense in the evolutionary context. Therefore, I feel we should promote more research on immunity than pure immunological research. We can measure enormous details and many things very accurately, but we often do not know whether what we measure is actually important. Therefore, we sometimes draw conclusions and promote hope for things that eventually will not work.

**BB:** Despite remarkable progress in medical science why do we still have no cure to fight diseases like HIV/AIDS, SARS, Ebola, multiple-drug-resistant tuberculosis, and many others?

**RZ:** My general rule in biology is that we usually cannot do better than evolution when using the same tools as evolution. Therefore, antiviral therapy against HIV has been extremely successful and this ingenious research has within few years brought a complete change of HIV / AIDS. The problem with multi-drug-resistant tuberculosis of course is that whenever in biology, we exert pressure somehow, e.g., with antivirals or with antibiotics, mutational adaption will cause escape and therefore the loss of a therapy.

**BB:** Is there any possibility that viral diseases like HIV/AIDS could be eradicated in future, as smallpox has been?

**RZ:** I do not think that we will have a vaccine that helps to eradicate HIV / AIDS as was the case for smallpox. But all major medical problems have so far been dealt with by hygienic and behavioural approaches, rather than anything else. Therefore, education, education, and education again is the most important aspect. Therefore it is particularly important to educate girls, because they look after their future families.

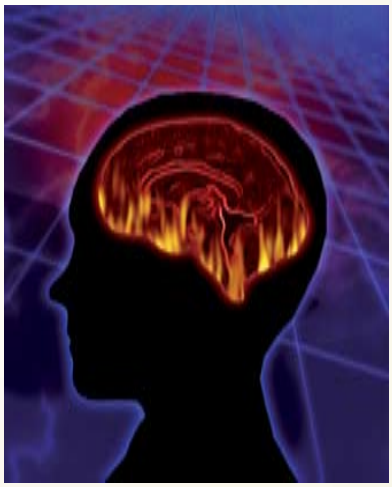
**BB:** Would you like to give any advice to students who are at the threshold of their scientific careers?

**RZ:** Choose an activity that you enjoy and like to do, work hard, stay honest and decent.

**BB:** Thank you Prof. Zinkernagel for sparing your valuable time for this interview. ■

# Brain Stroke
# Safeguard against the Risks

**Dr Yatish Agarwal**
e-mail: dryatish@yahoo.com



If the blood supply to a part of brain is interrupted or severely reduced, the affected region no longer functions normally. Deprived of its vital supply of oxygen and glucose, the brain cells begin to die within minutes. This condition is called a stroke, or cerebrovascular accident (CVA), apoplexy, and in common man's parlance, a 'brain attack'. In many ways, it emulates its more infamous cousin – heart attack.

Usually, a stroke occurs with little or no warning. All of a sudden, like a bolt from the blue, it strikes as a medical emergency, and requires critical medical attention. Immediate admission to a hospital and timely management are essential for minimising the damage to the brain and limiting its complications. The after effects of a stroke vary with the location and extent of the brain tissue that's affected. They range from mild, temporary symptoms, such as weakness of a limb, to lifelong disability or death.

The good news is that most strokes can be prevented. Medical researchers have identified the major factors which lead to brain stroke. The culprits include high blood pressure, smoking, high cholesterol, diabetes, ageing, and certain heritable defects. Fortunately, most of these risk factors can be acted against; this holds the key to prevention.

## What causes a stroke?

There are two main types of stroke. The most common type – ischaemic stroke – results from blockage in an artery. The other type – haemorrhagic stroke – occurs when a blood vessel leaks or bursts.

A transient ischemic attack (TIA) – sometimes called a ministroke – temporarily disrupts blood flow through the brain.

### Ischaemic stroke

Almost 90 per cent of strokes are ischaemic strokes. They occur when the arteries to the brain are narrowed or blocked, causing severely reduced blood flow, or ischaemia. Lack of blood flow deprives the brain cells of oxygen and nutrients, and cells may begin to die within minutes. This process may be further complicated by oozing of blood and fluid into the surrounding areas, a phenomenon known as cerebral oedema, which causes the brain to swell up, with dire consequences.

The most common ischaemic strokes are:

#### *Thrombotic stroke*

This type of stroke occurs when a blood clot, called thrombus, forms in one of the arteries that supply blood to the brain. A clot usually forms in blood vessels which have been damaged by atherosclerosis – a condition in which the arteries are clogged by fatty deposits or plaques. This can happen in one of the two carotid arteries of the neck that carry blood to the brain, or in other arteries of the neck or brain.

#### *Embolic stroke*

An embolic stroke occurs when a blood clot or other debris forms in a blood vessel away from the brain – commonly in the heart – and is swept through the bloodstream to lodge in narrower brain arteries. This type of blood clot is called an 'embolus'.

An 'embolus' is often formed by an irregular beating of the heart's two upper chambers, a condition called atrial fibrillation. This abnormal heart rhythm can lead to pooling of blood in the heart and the formation of blood clots that travel elsewhere in the body. A heart attack, a damaged heart valve, or a birth defect such as an abnormal hole in the heart can also produce blood clots that may find their way into an artery supplying the brain.

### Haemorrhagic stroke

Very simply, the medical term 'haemorrhage' stands for bleeding. A hemorrhagic stroke occurs when a blood vessel in the brain leaks or ruptures.

A brain haemorrhage can result from a number of conditions which affect the blood vessels. These include an uncontrolled high blood pressure and also, weak spots in the blood vessel walls, called aneurysms. A less common cause of haemorrhage is the rupture of an arteriovenous malformation (AVM) — an abnormal tangle of thin-walled blood vessels, present at birth.

There are two types of haemorrhagic stroke:

#### *Intracerebral haemorrhage*

In this type of stroke, a blood vessel in the brain bursts and spills into the surrounding brain tissue, causing damage to the brain cells. In addition, the brain cells beyond the leak are also deprived of blood and are damaged.

The most frequent cause of this type of haemorrhagic stroke is high blood pressure. Over time, high blood pressure, especially if uncontrolled, tends to weaken the small arteries within the brain. They tend to become brittle and are susceptible to cracking and rupture.

#### *Subarachnoid haemorrhage*

In this type of stroke, bleeding starts in an artery on or near the surface of the brain and spills into the space between the surface of the brain and the skull. This bleeding is often signalled by a sudden, severe 'thunderclap' headache.

This type of stroke is commonly caused by the rupture of an aneurysm, which can develop with age or be present from birth.

After the haemorrhage, the blood vessels in the brain may widen and narrow erratically, a condition doctors call 'vasospasm'. This vasospasm further reduces the blood flow to parts of the brain and worsens the damage in the brain cells.

### The Little strokes

So-called 'little strokes' result when long, thin arteries penetrating deep into the brain get blocked by arteriosclerosis, causing areas of surrounding tissue to lose their blood supply. The brain tissue supplied by these vessels may then wither, creating minute holes, called lacunas.

A succession of these little strokes over the years can riddle the brain, causing dementia similar to Alzheimer's disease.

### Transient ischaemic attack

A transient ischaemic attack (TIA) — sometimes called a mini stroke — is a brief episode of symptoms similar to those a person would have in a stroke. The cause of a transient ischaemic attack is a temporary decrease in blood supply to a part of the brain. Many TIAs last less than five minutes.

Like an ischaemic stroke, a TIA occurs when an artery in the brain undergoes spasm or a clot or debris temporarily blocks blood flow to a part of the brain. But unlike a stroke, which involves a more prolonged lack of blood supply and causes permanent damage to the brain tissue, a TIA doesn't leave lasting effects because the blockage is momentary.

A TIA should always be taken as a red flag. Emergency medical care must be sought even if the symptoms seem to clear up. If a person has had a TIA, it means there's likely a partially blocked or narrowed artery leading to his brain, putting him at a greater risk of a full-blown stroke that could cause permanent damage later.

## What are the risk factors?

Many factors can increase the risk of a stroke. A number of these factors can also increase the chances of having a heart attack. The stroke risk factors include:

### *Familial risk*

If a person has a family history of stroke, heart attack or TIA, s/he must stay warned. Even if there is little that you can do about your genes, look at other ways that can cut the risk.

### *Getting older*

Being age 55 or older accentuates the risk. As the risk of stroke increases with age, and women tend to live longer than men, more women than men have strokes and die of them each year.

### *High blood pressure*

The risk of stroke begins to increase at blood pressure readings higher than 130/85 millimetres of mercury (mm Hg). Your family doctor could help you decide on a target blood pressure based on your age, whether you have diabetes and other factors.

### *Wonky cholesterol numbers*

A total cholesterol level above 200 milligrams per decilitre (mg/dL) or 5.2 millimoles per litre (mmol/L) is a risk that can be easily downsized.

### *Smoking*

Cigarette smoking or exposure to second-hand smoke worsens the risk in many ways: it tends to damage the blood vessels and promote arteriosclerosis, is bad for the blood pressure and tends to lower the good cholesterol.

### *Diabetes*

High blood sugar, or diabetes, if uncontrolled, is a sure-shot recipe for disaster. If the average blood sugar is kept under check with diet, exercise and pills, the risk stands diminished.

### *Obesity*

Being obese – body mass index of 30 or higher, increases the risk of a stroke. This risk however may be multifactorial and be associated with high blood pressure, diabetes and wonky cholesterol numbers, common accompaniments of obesity.

### *Physical inactivity*

A totally couch-potato kind of lifestyle is a definite risk factor for a number of diseases. This includes the risk of brain attack.

### *Alcohol*

Heavy or binge drinking has also been found culpable. The healthy daily limit is 60 mL for men and 30 mL for women.

### *Heart disease*

Cardiovascular disease, including heart failure, a heart defect, heart infection, or abnormal heart rhythm can precipitate a blood clot in the circulation and cause stroke.

### *Oestrogen pills*

Use of birth control pills or hormone therapies that include oestrogen have also been found guilty.

## Prevention is the best remedy

Knowing your stroke risk factors, following your doctor's recommendations and adopting a healthy lifestyle are the best steps you can take to prevent a stroke. If you've had a stroke or a TIA, these measures may also help you avoid having another one. Many stroke prevention strategies are the same as for preventing heart disease.

In general, a healthy lifestyle means that you:

### *Control high blood pressure*

Keep your blood pressure under control. If you've had a stroke, lowering your blood pressure can help prevent a subsequent transient ischemic attack or stroke. Exercising, maintaining a healthy weight, managing stress, and limiting the amount of sodium in your diet are all ways to keep high blood pressure in check. Adding more potassium to the diet may also help. You just need to focus on fresh fruits and

vegetables. Also, take no more than one or two drinks, if you must enjoy alcohol.

Besides these lifestyle changes, your doctor may prescribe medications to treat high blood pressure, such as diuretics, beta-blockers, calcium channel blockers, angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers.

### *Control diabetes*

You can manage diabetes with diet, exercise, weight control and medication: target at keeping the glycosylated haemoglobin (HbA1c) lower than 7 per cent. A glycosylated haemoglobin test offers a fair estimate of the average blood sugar over the past three months.

### Check cholesterol

Lower the amount of cholesterol and saturated fat in your diet. Eating less cholesterol and fat, especially saturated fat and trans-fats, may reduce the plaques in your arteries. Eat a diet rich in fruits and vegetables. A diet containing five or more daily servings of fruits or vegetables may reduce your risk of stroke.

If you can't control your cholesterol through dietary changes alone, your doctor may prescribe a statin such as Simvastatin or Atorvastatin or another type of cholesterol-lowering medication.

### Don't smoke

Smoking raises the risk of stroke for both the smoker and non-smokers exposed to second-hand smoke. Quitting smoking reduces your risk — several years after quitting, a former smoker's risk of stroke is the same as that of a non-smoker.

### Maintain a healthy weight

Being overweight contributes to other risk factors for stroke, such as high blood pressure, cardiovascular disease and diabetes. Weight loss of as little as four or five kilos may lower your blood pressure and improve your cholesterol numbers.

### Exercise regularly

Aerobic exercise reduces your risk of stroke in many ways. Exercise can lower your blood pressure, increase your level of high-density lipoprotein (HDL, or 'good') cholesterol, and improve the overall health of your blood vessels and heart. It also helps you lose weight, control diabetes and reduce stress. Gradually work up to 30 minutes of activity – such as walking, jogging, swimming or bicycling – on most, if not all, days of the week.

### Drink alcohol in moderation

Alcohol can be both a risk factor and a preventive measure for stroke. Binge drinking and heavy alcohol consumption increase your risk of high blood pressure and of ischaemic and haemorrhagic strokes.

However, drinking small to moderate amounts of alcohol can increase your HDL cholesterol and decrease your blood's clotting tendency. Both factors can contribute to a reduced risk of ischaemic stroke.

### Preventive pills and medications

If you have had an ischaemic stroke or TIA, your doctor may recommend medications to help reduce your risk of having another. These include:

### Anti-platelet pills

Platelets are cells in your blood that initiate clots. Anti-platelet drugs make these cells less sticky and less likely to clot. The most frequently used anti-platelet medication is aspirin.

Your doctor may also consider prescribing a combination of low-dose aspirin and the anti-platelet drug dipyridamole, to reduce blood clotting. If aspirin doesn't prevent your TIA or stroke or if you can't take aspirin, your doctor may instead prescribe an anti-platelet drug such as clopidogrel or ticlopidine.

### Anticoagulants

These drugs include heparin and warfarin. They affect the clotting mechanism in a different manner than do anti-platelet medications. Heparin is fast acting and is used over the short term in the hospital. Slower acting warfarin is used over a longer term.

Warfarin is a powerful blood-thinning drug, so you'll need to take it exactly as directed and watch for side effects. Your doctor may prescribe these drugs if you have certain blood-clotting disorders; certain arterial abnormalities; an abnormal heart rhythm, such as atrial fibrillation: or other heart problems.

# Recent developments in science and technology

**Biman Basu**
E-mail: bimanbasu@gmail.com

## Neutrinos not faster than light

After the startling announcement in September last year of neutrinos travelling faster than light in an experiment conducted by the OPERA team at the Gran Sasso National Laboratory in Italy (*Dream 2047* December 2011), CERN announced on 16 March that the result could have been an artefact of the measurement. Recent studies conducted by the ICARUS team at CERN have found that the earlier timings could have been flawed, likely caused by a faulty cable. The ICARUS measurement, using last year's short pulsed beam from CERN, indicates that the neutrinos do not exceed the speed of light on their journey between the two laboratories. The ICARUS experiment thus provided an important cross check of the anomalous result reports from OPERA last year. The new results should put to rest all doubts about the validity of Einstein's theory, but CERN plans to make new measurements with pulsed beams from CERN in May to give the final verdict, because "this is how science works."

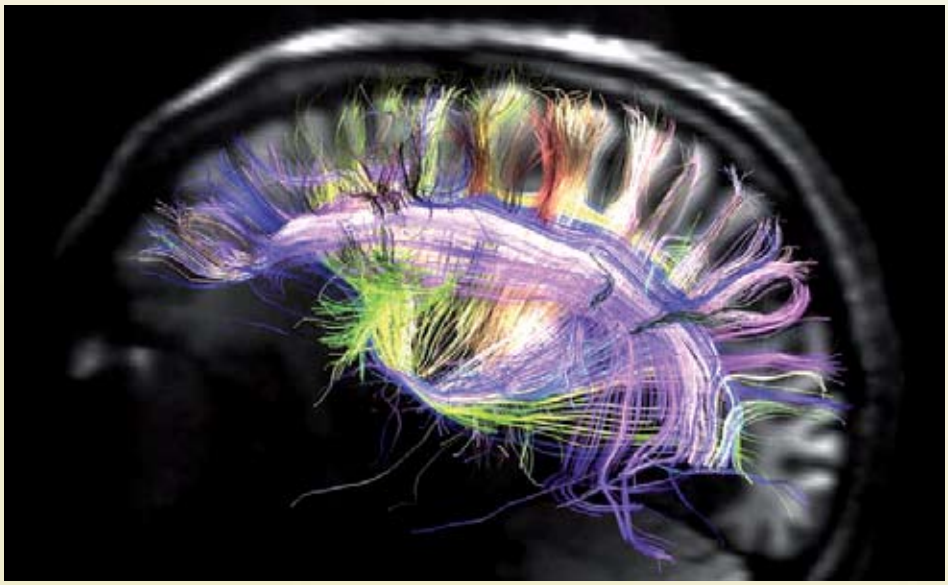
## New species of legless amphibians discovered

After a digging through the monsoon-soaked soils at 250 locations of remote northeast India for over five years, a team of researchers led by Sathyabhama Das Biju of Delhi University came up with an entirely new species of legless amphibians till recently unknown to science. According to the researchers, the new species – called chikilidae – is endemic to the region but has ancient links to Africa (*Proc. R. Soc.* B, 22 February 2012, doi:10.1098/rspb.2012.0150). Interestingly, these worm-like animals are closer to frogs than worms! The new discovery gives yet more evidence that India is a hotbed of amphibian life with habitats worth protecting. According to the researchers, Chikilidae is a group of extremely dedicated burrowers. They exhibit an intriguing and highly specialised reproductive behaviour. The mother builds underground nests for her eggs and guards her egg-clutch by coiling around them until the embryos hatch after 2-3 months.

*In this photo released by www.frogindia.org, an adult chikilidae sits on its eggs in the soils of northeast India. (AP Photo/www.frogindia.org, Sathyabhama Das Biju)*

## Brain's superhighways revealed

The human brain is a complex organ. It is the single most complex device in the known universe, and it works by nerve cells talking to each other. The surface of the brain contains about 40 billion nerve cells, each making about 1,000 connections in a pattern that brain researchers have yet to decipher. But a recent study of brain activity using a scanning technique called diffusion spectrum magnetic resonance imaging (MRI), researchers have unravelled an extraordinary simplicity in the pattern of connections that brain cells make while communicating (*Science*, 30 March 2012). According to Van Wedeen, a neuroscientist at Harvard Medical School and Massachusetts General Hospital who led the study, "What emerged was astonishing." He found that "the set of fibres that crossed a given fibre, invariably look like mutually parallel fibres all coming in like the teeth of a comb and crossing it in one direction." The scans revealed that brain signals form a grid, made up of parallel and perpendicular tracts woven together into curved sheets. According to Wedeen, someday, doctors may be able to diagnose brain disorders by identifying variations in this regular brain pattern.



*Curved sheets of fibres in the left hemisphere of a human brain are woven together like fabric, a new study reveals. (Credit: MGH-UCLA Human Connectome Project)*

# National Workshop on Science Communication in Hindi through Digital media

A two-day national workshop on "Science communication in Hindi through digital media" was organised on 28-29 March 2012 with the objective of using information and communication technology (ICT) for communicating S&T and to prepare road map for future strategies. The event was jointly organised by Vigyan Prasar, Department of Science and Technology, Government of India, and National Centre for Innovation in Distant Education (NCIDE), Indira Gandhi National Open University (IGNOU), New Delhi.


*Inaugural session : (L to R) Smt. Kinkini Dasgupta Mishra, Dr. C. K. Ghosh, Prof. Pushpesh Pant, Dr. Subodh Mahanti and Dr. D.P. Sharma*

The chief guest of the two-day national workshop, Prof. Puspesh Pant, former Dean, School of International Studies, JNU, emphasised the need for seamless flow of science communication/science writing in Hindi and for differentiating between pure and complex Hindi. Prof. Pant said that there is need to communicate science and technology through digital media among farmers in their own language. This information should be in simple Hindi. Prof. Pant urged scientists to write popoular science articles in Hindi and also mentioned about the need to popularise software that can overcome the problem of fonts used in popularising science. Prof. Pant insisted on the need for standardisation of scientific terminology and more use of newly created words. Dr Subodh Mahanti, Director, Vigyan Prasar, in his inaugural address emphasised the need for science communication through the digital media and said there is urgent requirement of standardisation of scientific terminology in Hindi. There is also need for strong promotion of scientific terminology; spread and adoption. Digital media can play a useful role in this direction. He said that there are many words in English such as black holes, which individually are used in different means such as *krishna viver*, *krishna paksh*, and so on. Therefore caution is required in the use of such words and their standardisation is necessary. Dr Mahanti emphasised on popularisation of Hindi related science websites which includes science communication in Hindi.

Dr C. K. Ghosh, Director, NCIDE, IGNOU, in his welcome address said the language of science should be simple and colloquial. Scientific approach is seen to be believed. Today is an era of ICT, but 'I' meaning information vanishes and only CT is discussed.

Ms Kinkini Dasgupta Mishra, President of Scientific and Official Language Committee of Vigyan Prasar, emphasised the need to prepare a roadmap to facilitate science communication in Hindi through digital media and overcome the hurdles in the way. The workshop covered a total of five technical sessions and a total of 26 experts participated and provided meaningful inputs. Science communicator, scientists, official language officers, software engineers, and experts in Hindi and science bloggers were present in the workshop.

*Workshop in progress*

The first technical session was focussed on "Science communication in Hindi through digital media – Changing scenario" and four speakers presented their views. Mr Dinesh Bhatt, science teacher from Chhindwara, discussed about physics teaching through digital media and Mr Panchal Hardik, blogger from Ahmedabad spoke the importance of scientific websites in removing myths and superstitions and linking youth to science. Smt R. Anuradha, Editor, Publications Division, discussed problem of fonts in science communication in Hindi and also suggested its solution. Mr Rintu Nath, scientist from Vigyan Prasar, talked about status of Hindi websites, their challenges and future strategies. Dr. Krishna Kumar Mishra, from Homi Bhabha Science Education Centre, Mumbai, highlighted the usefulness and importance of an e-learning portal developed by his institute

The second session was focussed on "ICT supported science communication in Hindi – Challenges and prospects". Dr Ajay Shivpuri, scientist from NISCAIR discussed in detail about the importance and usefulness of 'NISCAIR-Tube' in science populaisation. Mr. Navneet Gupta and Dr. Irfana Begum, Project Officer, EduSat, Vigyan Prasar, respectively talked about the TV series telecast on Lok Sabha TV on science-based weekly program "Vigyan darpan" and "Science This Week" and discussed the development and diffusion of science by use of ICT. Chair of the session, Dr. Arun Dev, Associate Professor, Sahu Jain College,


*Speaker of the first technical session : (L to R) Dr. K.K. Mishra, Shri R. Nath, Shri Dinesh Bhatt, Smt. R. Anuradha and Shri Hardik Panchal*

Najibabad, Bijnor and an active Hindi blogger, in his statement said that science is a social motive, and it cannot be separated from society and the public. Digital media will play a leading role in connecting science to villages.

The third technical session was focussed on "Science communication in Hindi through digital technology." The first speaker of the session was Mr Kapil Tripathi, scientist, Vigyan Prasar, who spoke about effective communication of science through radio. Mr Bharat Gupta, Senior Engineer, CDAC, New Delhi, spoke about Hindi on the Web. Dr. Kewal Krishan, Director, Department of Official Language (Ministry of Home Affairs), mentioned about efforts of the Department of Official Language in popularisation of Hindi through digital media. Dr. Zakir Ali Rajneesh, science blogger and highlighted the significane of science related blogs in science popularisation through digital media. Chairman of the session, Dr. O.P. Sharma, Deputy Director, IGNOU, said there are scattered efforts at communicating science in Hindi through digital media and there is need to bring all these efforts on one platform.

Topic of forth technical session was "Innovative methods of science communication through digital media". Mr Abhay Rajput, scientist from IITM, Pune in his presentation said that there will be larger impact if science is communicated through poetry by digital media. Mr Shashank Dwivedi, Assistant Professor from Alwar said due attention should be given to innovative methods in communicating science through digital media in villages. Dr. Surjit Singh, Scientist, NISCAIR said there is minimum science for everyone and we need to define one's need for a balanced dessimination of science. Dr. Anurag Sharma, science communicator said that digital medium is need of modern times and through which society may develop scientific temper. Mr Vishwa Mohan Tiwari, president of the session and senior science writer in Hindi, emphasised that there are some disadvantages of the digital medium but we need to consider only the positive things.

Theme of the final and fifth technical session was "Digital translation and use of scientific terminology for science communication". Dr D.K. Pandey, Joint Secretary, Department of Official Language, Ministry of Home Affairs, spoke about Hindi font, terminology, translation solutions and many associated problems and the efforts being undertaken by the department. Dr Ashok Shelwatkar, Scientific Officer, Scientific and Technical Terminology Commission, spoke about the efforts of commission in developing scientific terminology in Hindi and said that till now a total of 8 lakh 50 thousand scientific terms in Hindi have been standarised. Mr Pankaj Chaturvedi, Editor, National Book Trust, said in his presentation that scientific language should be simple, comprehensible, and should be flowing. Translations should be such that they have the clarity and simplicity are not difficult to read and understand. Mr Shanbunath, science journalist, Zee News, New Delhi, said the language of translation should be as simple as the language in which we talk with our mother. Mr Prempal Sharma, Director, Railway Board and popular science writer, said if we have to popularise science and develop scientific temper, then we have to link youth through print media, electronic media and digital media. Dr Paritosh Mani, Head of Hindi Department, Kisan College, Meerut and a Hindi blogger, emphasised the importance of blogs and digital media in disseminating science to the wider public. The session chairman and pioneer of popularisation of Hindi through digital media, Dr. Om Vikas said, science and technology communication organisations should work jointly through institutional effort and the target should be identified

Speaking at the closing session, Dr Subodh Mahanti, Director, Vigyan Prasarhas emphasised that the dissemination of science in Hindi language is still full of challenges. There is need to explore this new digital media. Er Anuj Sinha, former Director, Vigyan Prasar, described the workshop as a commendable initiative by Vigyan Prasar and IGNOU. Dr C.K. Ghosh, Director, NCIDE, IGNOU said with collaborative effort we can achive the biggest targets. Dr OP Sharma, Deputy Director, NCIDE, IGNOU said that we have to clear hurdles in the way of science communication in Hindi through digital media. Dr Sharma, expressed gratitude for the cooperation of officers, employees, all the participants, experts and scientists from Vigyan Prasar and IGNOU. Manish Mohan Gore, Secretary, Vigyan Prasar Official Languages Committee presented a summary of the technical sessions of workshop. The workshop was coordinated by Mr Nimish Kapoor and Dr Bharat Bhushan, Scientists, from Vigyan Prasar.


*Speakers of the fourth technical session (R to L) Dr. Anurag Sharma, Shri Shashank Dwivedi, Shri V. M. Tiwari, Shri Nimish Kapoor, Shri Abhay Rajput and Dr. Surjt Singh*

**(Report: Manish Mohan Gore)**

# VP activities to popularise transit of Venus-2012

Vigyan Prasar always utilises important celestial events like eclipses, occultations and transits to do the large-scale astronomy popularisation activities in the country. In June, Vigyan Prasar completed the year-long activity related to theTransit of Venus (TOV-2012). For this, VP scientists worked in collaboration with research scientists, planetarium directors and a few science communicators to design and structure the plan for a national campaign. Institutions like Inter-University Centre for Astronomy and Astrophysics, Pune; Indian Institute of Astrophysics, Bengaluru; Aryabhata Research Institute of Observational Sciences, Nainital; and the University of Delhi were a few of themwhile planetarium directors from Mumbai, Kolkata, Bengaluru,and some otherswere also involved.Over a period of nine months, Vigyan Prasar brought out the following material as resource material for TOV-2012:

1. Activity kit on 'Transit of Venus' consisting on activities, poster, solar filters, etc. It wasbrought out in association with Gujarat Council of Science City, Ahmedabad.
2. Documentary on 'Transit of Venus 2012', covering details of history, expeditions, safe viewing, etc.
3. Documentary on 'Discovery of theAstronomical Unit', covering how the transit of Venus helped to measure the Sun-Earth distance.
4. A resource CD consisting of PowerPoint presentations on various topics of transit of Venus and safe observations.
5. Booklet with compilation of articles on transit of Venus.
6. Reprint of the book *Venus and its Transits* by S. P. Pandya and J. N. Desai
7. 50-mm simple refractor telescope with solar filter.
8. A video guide DVD covering various day-time astronomy activities. It has been brought out in association with BhartGyan Vigyan Samiti, Karnataka and Navnirmiti, Mumbai.

A special training workshop on Day-time Astronomy in association with HomiBhabha Centre for Science Education (HBCSE), Mumbai and All India Peoples Science Network (AIPSN) was organised on 1 and 2 March at HBCSE, Mumbai.

**Orientation Workshops on Transit of Venus-2012:** Vigyan Prasar in association with various state/central as well as non-government agencies organised national level workshops at Jawahar Planetarium, Allahabad and Mohan LalSukhadia University, Udaipur (16-28 April), Osmania University, Hyderbad and Guwahati Planetarium, Guwahati (7-9 May), PushpaGujral Science City, Kapurthala (9-11 May), MGM Campus, Nanded (12-14 May), State Council of Educational Research and Training, Raipur (18-20 May), M P Birla Institute of Fundamental Research, Bengaluru (21-23 May), Anna Science Centre-Planetarium, Tiruchirappalli (25-27 May), and Nehru Planetarium, New Delhi (23, 30 April and 7 May).

**Master Resource Persons' Training Workshops with NCSTC:** To have the maximum utilisation of resource material, VigyanPrasar,jointly with National Council of Science and Technology Communication (NCSTC),organised five Master Resource Persons' training workshops at Chandigarh (9-10 April), Chennai (24-25 April), Mumbai (30 April, 1 May), Shillong (8-9 May), and Bhopal (14-15 May), with State S&Tcouncils.

Vigyan Prasar in association with other agencies had also planned live telecast and webcast of the transit from Leh and Hanle in Ladakh.

Jagadish Bose National Science Talent Search (JBNSTS), Kolkata, in association with Vigyan Prasar, organized programme of observation of the transit of Venus from Kolkata on 6 June 2012.

Vigyan Prasar also organised a special programme of observation of the transit of Venus from its NOIDA campus on 6 June 2012. Telescopes were set up for direct viewing as well as for projection of the Sun's image with transiting Venus. Film shows and a quiz programme and various competitions for the school studentswas also organised on the occasion. Nearly 450 people visited the campus to watch the transit.

## Letters to the editor

### Wanted article on nanoscience

Thanks for the first issue of *Dreams 2047*. I liked Dr. Subodh Mahanti's editorial on Venus transit. I would request you to publish an article on nanoscience in one of the forthcoming issues.

Ashish Hegde
Senior Executive - Material
Crompton Greaves Limited (Fans Division)
Bethora Industrial Estate, Bethora 403 409, Goa
www.cgglobal.com

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### History of zero

I have gone through your article 'A brief history of zero' and I am very pleased to read it. It is very well written. I got to know that there is a book named Elements written by Euclid, which emphasised the number sequence with the help of geometry. Could you please give me information about Elements by Euclid?

Dr. Ram Kuntal Hazra
Assistant Professor,
Department of Chemistry, University of Delhi -110007.
Email: rkhazra@chemistry.du.ac.in

*[You may download a free pdf copy of the e-book The First Six Books of the Elements of Euclid by John Casey and Euclid from http://www.gutenberg.org/ebooks/21076 - Editor]*

*****

### A roundabout approach to *e*

I read with interest your article 'The enigmatic *e*' in the latest issue (June 2012) of Dream 2047. You have taken roundabout approach of compound interest calculation for introducing *e*. An easier and more mathematically sound approach would have been to introduce a function with the property of its derivative being equal to itself. You do touch on this property in a quoted paragraph. Value of *e* then could have been introduced as the value of exponential function for its argument equal to 1. There is nothing special about ln x to base e except its derivative is equal to 1/x, which you have used in ln a as the area under the curve of the function between 1 and a. Logarithm with respect base 10 or any other base have the same property as logarithm with base *e*. You would agree that readily available log tables are with base 10.

Expansion of $e^x$ as an infinite power series in x has the property that its derivative is equal to itself. The series is convergent for all finite values of x positive or negative. Once the power series of e has been given, which you have given in the purple box, its equivalence to binomial expansion of $(1+1/n)^n$ in the limit n going to infinity can be shown.

Prof. A. N. Maheshwari
anmaheshwari@hotmail.com

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### Wonderful magazine

*Dream 2047* is a wonderful magazine because it gives us very good information about S&T and I have not seen any science magazine like *Dream 2047*. It is an ideal magazine for all readers interested in knowing about science. I thank to whole team of Vigyan Prasar for publishing such a wonderful magazine.

Shri Mukund Kumar Tiwari
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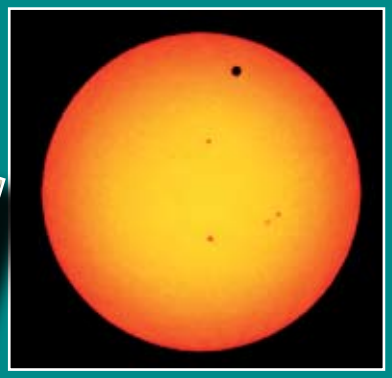
# Transit of Venus



*Venus at 9-05 am*

*Venus at 9-13 am behind light clouds*

*Demonstration on how to view through telescope at Novodaya School in Leh*

*Clouded out at Noida*

*Smiling faces as the Sun comes out*

*The long queue to have a look at the transit through telescope*

*The projection method produced a better image of Venus*

# 06 June 2012

*Venus near the third contact at 10.00 am*

*Almost at the end of the transit at 10.13 am*
*(Photograph by: Biman Basu)*

*Orientation workshop at Hydrabad*

*Orientation workshop at Allahabad*

*Media covering the celestial spectacle*

*Orientation workshop at Kapurthala, Punjab*

*Orientation workshop at Raipur*