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Coffee The Wonder Elixir

Gerty Theresa Cori and Carl Ferdinand Cori

Who showed how energy is produced
and distributed in human body



(1896-1984)



(1896-1957)



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Coach or Player



E-mail: sanuj@vigyanprasar.gov.in

Football is the ballet of the masses. Legions of fans all over the world are testimony to this as the current edition of the World Cup tournament progresses in South Africa. Football remains the most popular sport in the world since one can play it with minimum knowledge of essential dos and don'ts and even if all the rules of the game are not known. If my grandchild will see a rotund ball he will instinctively kick it.

For many, however, football is much more than kicking a ball and chasing it. It is a game that has honour, respect, courage, strategy, discipline, team work and celebration. Being part of a team involves contributing to the effort, sharing joys and sorrows, pushing for glory of the team over individual achievement and developing high level of camaraderie. The game is a metaphor for life – a struggle with rewards and recognition for good performances and immediate rebuke for indifferent contribution.

The media has been electrified the past few weeks bringing different perspectives of the activities in South Africa. Preparations by the hosts, inspections by organisers, visit of supporters and arrival of the teams have been played out in detail. In the tournament, star players have been able to protect their reputations when they have displayed their skills. Coaches have been praised and criticised for their team's performance in different rounds. Incisive reports have appeared analysing the strategies adopted in games against different teams. This edition has thrown up unexpected heroes among players and coaches. Soccer and soccer mania will serve as a metaphor for thoughts on the rest of this page.

Our society has many infirmities and adopting rational choices is the path to rapid

development. Reaching essential knowledge and skills to the community engages many science communicators. Leaders and their teams engage in specific tasks with objectives that will empower the people. Vigyan Prasar is a national resource for attractive and effective material in the form of books, kits, posters, CD ROMs and web-based resources. These are developed with inputs of field workers and researchers. Pilot testing helps to improve both the content and its presentation. Selected material is translated into other languages.

To develop effective resource material, contributors need domain knowledge and communication skills. This often calls for collaboration and cooperation by experts from different specialisations but with good understanding of the requirements of the initiative. (All material is uploaded on our portal from where it can be downloaded at no cost. Others place orders at selected temporary and permanent outlets for these at prices that barely cover our costs.)

Over the years we find that those with actual experience of interacting with the community make valuable communicators. The rich learning they bring to the material development assignment is reflected in obvious as well as subtle ways. Understanding the needs of the field worker they modulate the presentation to make the book, poster, script, CD ROM, etc., most useful.

Science communicators and resource persons in and those working with Vigyan Prasar are akin to soccer coaches. The best ones have been outstanding players themselves. Heads of NGOs, team leaders and field workers are quick to appreciate such support and use the material repeatedly for training and extension. Else these are confined to the rare of shelves to gather dust.

A coach has many attributes besides deep knowledge of the sport. S/he has to use psychological tools to get the best from the team and motivate each player to deliver up to his/her full potential. An unsatiated hunger for success is necessary in each team member and the coach. In spectator sports even the fans have a very important role.

Field communicators (the players) have to make longer commitments knowing that the community will progress gradually from the current state of acceptance as fate to a stage of improved awareness, move to a positive and receptive attitude and then express a change in behaviour. Beliefs, traditions, customs, social and economic disadvantages are inhibitory factors that need to be considered for an intervention to be effective. There are no accepted rules or a half time. Spectators are often hostile if their interests appear threatened. (In soccer, a game close to a religion for many, the coach can shout from the sidelines and guide during half time.) The change in the society must come and within a foreseeable time.

There is little by way of honour, respect, courage, strategy, discipline, team work or celebration. There is, however, a great need. Can the challenge of being pitted against such odds attract you and other talented communicators to volunteer as resource persons (coaches) in a campaign for stimulating scientific temper amongst neo-literates?

□ **Anuj Sinha**

Editor : Er Anuj Sinha
 Address for correspondence : Vigyan Prasar, C-24, Qutab Institutional Area, New Delhi-110 016
 Tel : 011-26967532; Fax : 0120-2404437
 e-mail : info@vigyanprasar.gov.in
 website : <http://www.vigyanprasar.gov.in>

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Editor: Er Anuj Sinha

Gerty Theresa Cori and Carl Ferdinand Cori

Who showed how energy is produced and distributed in human body



Subodh Mahanti

E-mail: smahanti@vigyanprasar.gov.in

She studied two years for preparing herself for the university entrance examination. She could qualify the examination and finally entered the Carl Ferdinand University in 1914 and where she met her future husband and research collaborator Carl Ferdinand Cori.

Carl Ferdinand Cori was born in Prague on 5 December 1896. He spent his childhood in Trieste where his father, Carl I. Cori was Director of the Marine Biological Station. He completed his school education in a gymnasium in Trieste in 1914. His father introduced him to zoology. In his childhood he spent time exploring caves and collecting insects. He also took active part in outdoor sports like tennis, swimming, and hiking. Like Gerty he also joined Carl Ferdinand University in Prague in 1914. During First World War Carl Cori served in the Austrian Army Sanitary Corps but returned to the medical school after the war.

In 1920, Gerty and Carl got married. Before marriage Gerty converted to Catholicism. Carl Cori worked for a year at the University of Vienna and for one year at the University of Graz. In post-First World War Europe there was food scarcity. Gerty was given dietary supplements but she did not accept them because she thought patients were in greater need than her. She developed an eye disease called xerophthalmia caused by vitamin deficiency. There was also rising hatred against Jewish people. The Coris decided to emigrate to USA. Carl Cori moved to the New York State Institute for the Study of Malignant Diseases (later renamed as the Roswell Park Cancer Institute) in 1922 when he got a faculty position there. Gerty Cori, who had been working at the Carolinen Children's Hospital, Vienna

“They (the Coris) formed a close team until her (Gerty Cori's) death (their research collaboration had began as students and their contributions are practically inseparable), moving to the USA in 1922 and sharing a Nobel Prize in 1947, the only other husband and wife pairs to do being the Curies in 1903 and the Joliot-Curies in 1935. Gerty Cori became the first woman medical graduate to receive a Nobel Prize.”

The Cambridge Dictionary of Scientists, Cambridge University, Press, 2002.

“Although the actual pathway of glycolysis is much more detailed and took several years to elucidate, the value of the Coris' work is undeniable. Above all they pointed the way to the crucial role of phosphates in the provision of cellular energy, the details of which were soon to be worked out by Fritz Lipmann.”

A Dictionary of Scientists, Oxford University Press, 1999

Gerty Theresa Cori (nee Radnitz) and Carl Ferdinand Cori discovered the process in which energy is produced and transmitted in the human body. They demonstrated how glycogen (animal starch) breaks down (for generating energy) and is synthesised (to be stored as source of energy). The pathway in which energy is moved in the body—from muscle, to the liver and back to the muscle is known as Cori cycle. They also discovered an important compound which is known as Cori ester.

Gerty Cori and her husband Carl Cori were awarded the 1947 Nobel Prize in Medicine or Physiology. They shared the Prize with the Argentine physiologist Bernardo Alberto Houssay (1887-1971). It may be noted that Gerty Cori was the first American woman to win a Nobel Prize in science. She was the third woman to receive a Nobel Prize in science the earlier two recipients were Marie Curie and Irene Joliot Curie.

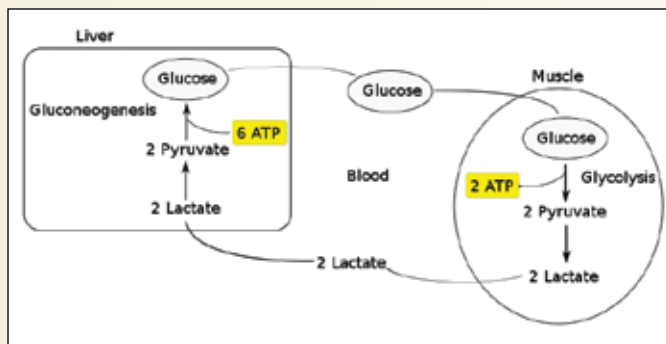
Gerty Cori was born on 15 August 1896 in Prague in a Jewish family to Martha and Otto Radnitz. In those days Prague was a part of Austro-Hungarian Empire. She was the oldest of three daughters. Her father Otto Radnitz

was manager of a sugar factory. Before entering a Lyceum (a high school) for girls Gerty Cori was taught at home by private tutors. In those days in Europe educational opportunities available in girls' school were limited compare to those available in boys' schools. The school which Gerty joined mostly taught culture and social etiquette. She wanted to pursue higher studied in university but her school education did not



Gerty Theresa Cori (right) and Carl Ferdinand Cori (left)

provide background in Latin, mathematics, and science for entering a university. Her uncle, who was a professor of paediatrics, encouraged her to pursue higher education.



The Cori cycle

joined her husband in USA after six months of his arrival. She managed to get a job as Assistant Pathologist in the same institute. They never returned to their homeland. They finally became naturalised citizens of the United States in 1928.

Gerty had to face gender discrimination throughout her career. The post given to her was much inferior, given her capabilities and training. She had the same qualifications as her husband. However, in spite of the discrimination she continued her research work with total dedication which resulted in about 150 research papers. She maintained a strong commitment to intellectual integrity. She was kind and passionate but at the same time she was tough.

Initially Gerty Cori studied the effects of X-rays on the skin and organs. But soon both Gerty and Carl developed a common interest in carbohydrate metabolism and started their life-long collaboration on the subject. They published joint papers but the first author of each paper was decided on who did most of the work for a given paper. Their first joint paper resulted from their immunological study of the complement of human serum. They also published papers as single authors. Carl Cori in his speech at Nobel Prize award ceremony in Stockholm said: "Our collaboration began 30 years ago when we were still medical students at the University of Prague and has continued ever since. Our efforts have been largely complementary, and one without the other would not have gone as far as in combination." Their research collaboration was so intimate that it was rather difficult to tell which Cori did what.

In 1931, Carl Cori became a professor of the Pharmacology Department of the Washington University School of Medicine and later became Professor of Biochemistry. But Gerty Cori was offered a position as a research assistant in spite of the fact that she had the

same qualifications as her husband. She was given a professorship in 1947, the same year she shared the Nobel Prize in Physiology or Medicine.

The Coris started their work on carbohydrate metabolism at the New York State Institute for the Study of Malignant Diseases in Buffalo and

they continued their work in this area at the Washington University. Before describing their work we shall talk about carbohydrates and their physiological importance.

A carbohydrate is an organic compound containing only three elements namely carbon, hydrogen and oxygen. The term "carbohydrate" refers to a group of compounds like sugars, starch, cellulose and other related compounds. The name carbohydrate arose from the belief that this class of naturally occurring substances could be represented as hydrate of carbon $C_x(H_2O)_y$, for example D-glucose $C_6H_{12}O_6 [C_6(H_2O)_6]$, and sucrose $C_{12}H_{22}O_{11} [C_{12}(H_2O)_{11}]$. But later new compounds were discovered which belonged to the class of carbohydrate by virtue of their properties but they did not have the required hydrogen-to-oxygen ratio to represent them as hydrate of carbon. However, the name has been retained more for its convenience sake rather than of exact definition. The carbohydrates are broadly classified into three main groups—monosaccharides, oligosaccharides and polysaccharides. The simplest carbohydrates



Claude Bernard



Bernardo Alberto Houssay

are the sugars, they are monosaccharides. However, sugars have the ability to join together to make polymer chains of great length, which are called polysaccharides. Glycogen, starch, and cellulose are examples of polysaccharides. Carbohydrates perform many vital roles in living organisms, both as structural elements and in the maintenance of functional activity.

Carbohydrates are an important source of energy in our bodies. Humans, like other animals, store carbohydrates in their bodies in the form of glycogen. As early as 1850 the French physiologist Claude Bernard (1813-1878) had shown that glucose was converted into glycogen, a more complex form of carbohydrate. The glycogen remains stored in the liver and muscle and is converted back into glucose to meet the energy supply required by the body. However, the fundamental problem was to elucidate the steps involved in the process. The Coris decided to solve this problem.

They undertook a series of studies for determining the rates of absorption of sugars from the small intestine and measuring the amounts of products of carbohydrate metabolism namely glycogen and lactogen. Based on their studies they came to a conclusion that there should be an intermediate between muscle glycogen and liver glycogen. Their conclusion was based on the fact that muscle glycogen did not increase blood glucose but liver glycogen did. Based on their studies they proposed metabolic a cycle of carbohydrates in 1929. The cycle discovered by the Coris was later called the Cori cycle.



Frederick Grant Banting

The Coris developed an interest on the effects of hormones on carbohydrate metabolism. Before the Coris entered the field the Canadian physician Frederick Grant Banting (1891-1941) and the Canadian physiologist Charles Herbert Best (1899-1978) had shown that the hormone insulin played a definite role in controlling blood sugar levels. In diabetic patients, if not treated, blood sugar level increased because the patient could not produce enough insulin. However, it was observed by Banting and Best that blood sugar level could be brought to normal level by injecting insulin. The Coris while studying the effect of insulin demonstrated that injection of insulin increased the rate of conversion of glucose to muscle glycogen but reduced the conversion to liver glycogen. They also studied the effect of epinephrine, a hormone also called adrenalin. But in case of epinephrine they found the effect was opposite. There was an increase in the conversion of muscle glycogen to lactate accompanied by the formation of hexose monophosphate, which was later identified by them as glucose-1-phosphate in 1936. They found that epinephrine not only increased the heart rate and blood pressure but also increased the availability of glucose for extra energy. The molecule glucose-1-phosphate, which is a glucose molecule with one phosphate group attached to the first carbon atom, is also known as the Cori ester.

The Coris discovered the broad steps involved in glycolysis, an essential biochemical process. Their work revealed for the first time the essential role played by

sugar phosphates in the process of glycolysis. It may be noted that the actual pathway of glycolysis is much more complex than originally shown by the Coris. The finer details of the glycolysis pathway were worked out by the German-born US biochemist Fritz Albert Lipmann (1899-1986).

In 1939, the Coris purified an enzyme to synthesise glycogen in vitro. This was an example of the first biochemical synthesis of a large molecule in laboratory condition. Towards the end of his career Carl Cori assumed more administrative responsibilities and during which period Gerty Cori shifted her research focus to glycogen storage disorders.

In 2004, the Coris were designated as American Chemical Society National Historical Chemical Landmark in recognition of their work on carbohydrate metabolism. The Coris were members of the American Society of Biological Chemists, the National Academy of Sciences, the American Chemical Society and the American Philosophical Society. Carl Cori was a member of the Royal Society of London and the American Association for the Advancement of Science. They received joint awards—the Nobel Prize in Physiology or Medicine (1947), the Midwest Award of the American Chemical Society (1946), and the Squibb Award in Endocrinology (1947). They also received individual awards. Gerty Cori received the Garvan Medal (1948), the St. Louis Award (1948), the Sugar Research Prize (1950), and the Borden Award (1951). In 1952, the US President Harry S. Truman named Gerty Cori to the National Science Board



Charles Herbert Best



Fritz Albert Lipmann

of the National Science Foundation. She was also one of the twelve women honoured at Hobart and William Smith Colleges in Geneva, N.Y., in 1949. Carl Cori received the Willard Gibbs Medal (1948) and the Sugar Research Award (1957, 1951). Carl Cori presided over the Fourth International Congress of Biochemistry held at Vienna in 1958.

Gerty Cori died on 26 October 1957 after fighting over 10 years a rare disease of the bone marrow called myelofibrosis, which affects bone marrow. Carl Cori died on 10 October 1984.

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(The article is a popular presentation of the important points of the lives and works of Gerty Theresa Cori and Carl Ferdinand Cori. The idea is to persuade the younger generation to know about the Coris. The author has given the sources consulted for writing this article. However, the sources on the Internet are numerous and so they have not been individually listed. The author is grateful to all those, whose works have contributed to writing this article.)

Lalita Balakrishnan

A pioneer who has spearheaded India's woodstove (chulah) programme

The All India Women's Conference (AIWC), one of the oldest voluntary organisations in the country, was founded in 1927 by Margaret Cousins, an Irish Lady, who had made India her home. AIWC's original concern was women's education but gradually it took up various social and economic issues concerning women, such as purdah, child marriage, trafficking and women's property rights. AIWC aims to work for a society based on the principles of social justice, integrity, equal rights and opportunities for all. Apart from this, it strives to create awareness among women about their fundamental rights and help them utilise these rights. It also manages a number of projects on women and children, both in rural and urban areas and runs short stay homes, old ages homes, counselling centres, hostels for working women, schools for tribal children and training centres for visually challenged.

Ms. Lalitha Balakrishnan, former Vice-President and Chairperson of the Rural Energy Department of AIWC, is a very well known name in social journalism and social service. With more than 35 years' experience in these areas Ms. Balakrishnan is a pioneer in the environmental field and has spearheaded the country's RETs programme which has been judged to be the best by the Government of India and other international agencies. She is India's National Coordinator for the International Forum for Sustainable Energy and was Director on the Board of India's Renewable Energy Development Agency.

Er Anuj Sinha, Director, Vigyan Prasar and Consultant, Department of Science & Technology, Govt. of India interacted with Mrs. Balakrishnan on the issues of gender equity, development and communication related issues, improved technologies for rural India, and activities of AIWC. Here are excerpts of the interaction.



Mrs Balakrishnan during interaction

Dream 2047: You have been associated with women's development for many decades. How did you get involved in this field? On the personal front, how has your family supported your passion for social work? Has it been a positive story or one of resistance and grumbling acceptance?

Lalita Balakrishnan: I have been brought up in a very learned family. My father was a close friend of Dr. S. Radhakrishnan, the former President of India. They were both teaching in the same college. Actually Mrs. Radhakrishnan gave me my name Lalita. My mother was a Gandhian and also a great follower of Paramacharya of Kanchi Mutt. When I was just 9 years old, my mother



Mrs. Lalita Balakrishnan (left) and Er Anuj Sinha with solar lantern and solar panel, developed by AIWC

used to take me along to collect money, medicines, jewels and all for victims of Navakali disaster. Though so far away in Kumbakonam, Navakali was very far but still it made deep impact on me because local people used to donate liberally and every month my mother would send the collection to Sucheta Kriplani. So that is how I started. Fortunately my husband and even my in-laws were all supportive; otherwise probably I could not have risen to this stage. My husband was the leader for setting up Bharat Heavy Electricals Ltd., (BHEL) and initiated the R&D

Centre in Hyderabad. It was his baby and I used to go with him to all the divisions/centres in Bhopal, Hyderabad, Haridwar, etc. I have observed the infrastructure for generating electricity. My husband had to visit various research laboratories in the country. He created a platform for renewable energy sources and that is where I got the first exposure.

Dream 2047: How rewarding has been your association with the All India Women's Conference?

L.B.: Actually I was connected with them right from the beginning of 1957. We lived in Delhi, Hyderabad, Bhopal, Haridwar and in all these cities I established AIWC offices. I have been a Secretary General, Vice-President in the organisation, and since 1984 I have been heading the rural energy department when Mrs. Sarojini Varadhappan was the President. The erstwhile MNES, Commission on Additional Sources of Energy wanted to take up programmes of renewable energy and offered support of IIT Delhi and other institutions. Our organisation was identified as a nodal agency for propagating these types of technologies. The journey has been pioneering and therefore very rewarding.

Dream 2047: You have worked extensively with technology generators and extension workers. Has AIWC

been considered reliable and credible by the peers?

L.B.: Yes, but we have a long track record. We started with the improved chulha and then moved to biogas. Lakhs of improved chulhas have been installed all over the country through our branches and also through other NGOs. We were initially apprehensive about working with the other NGOs. Then we introduced solar thermal devices. National level organisations like Solar Energy Society, Bio Energy Society, and World Energy Council have been closely involved with AIWC and we are one of the first organisations to support World Renewal Energy Network based in England.

Dream 2047: Which is your most coveted moment of recognition for your work?

L.B.: One day I got a phone call in the evening and I thought it was a nuisance call because I could not make out what someone on the other end was saying. I asked my son to listen in. I had been selected for the UNEP Global 500 Roll of Honor Award for my work in the improved chulha. So it was a pleasant surprise and the investiture function in Istanbul had 120 media people and representatives of all concerned world bodies. It was really something which I can never forget.

Recently Solar Energy Society of India gave me Lifetime Achievement Award 2008 and that also came us as a surprise. I don't remember the exact date but I was given a responsibility in Indian Renewable Energy Development Agency (IREDA) as one of the directors. In one term I learnt many things because I could go on tours and I could see policy papers. The Ministry of Power deputed me to a meeting at Bali. It was an experience to be a part of the government delegation. There is so much to learn and so little time.

Dream 2047: What are the keys of a successful social intervention? Please share some experiences as a development worker that will motivate the young generation.

L.B.: First we have to approach the elders and meet the women when they have time. Sensitisation and a series of training programmes of improved chulha and other

technologies are required and women then don't forget at all. Even today in Trichi, one lady is selling idlis from her stall that we built 14 or 15 years ago. We have been working in different parts of the country including Andaman and Nicobar, and Lakshadweep Islands. I have seen a success story in a very poor area of Orissa. On a visit recently a gentleman requested us come to his house. In his jhuggi, we found just a poor family with couple of things and few clothes. But he was proud that his daughter-in-law had a certificate of having participated in a training programme. This was framed and it decorated one wall in the jhuggi. A bigger impact on me was to see the clean kitchen of that jhuggi with a functioning improved chulha. That is one thing I really remember.



Mrs. Lalita Balakrishnan is demonstrating AIWC's solar units

Young people will have similar experiences if they stay involved with their projects and make extensive field visits.

Dream 2047: Is the new generation coming into the field of extension interested in social work-like issues of empowerment? What type of people are they? Are they really committed?

L.B.: Actually quite a few youngsters are open for careers in social work. At the same time, because of the high cost of living they want decent compensation. NGOs therefore can't attract good talent. Even with the limited salaries that we are offering we find some of them are really dedicated and prepared to sacrifice traditional jobs and shift to social work. We have to change our mind-set and give such people more recognition. At the same time they are

attracted by multinational companies and get such fabulous salaries. We can't match that. That is the problem.

Dream 2047: The poor of course are vulnerable to everything disasters, displacement or some new technology. Is there a ray of hope, do you see a future for them?

L.B.: The poor are the ones who are affected first. They do not have any basic amenities, not even drinking water. The gap between the rich and the poor is also growing. One thing I have found among the poor is that they want to send their children to good schools. They have realised that education is really important. This is very promising.

Dream 2047: You have conceived, developed, implemented and monitored several interventions which are empowering the community. Please share one such successful intervention and one failure. What are the lessons that we can learn? Failure analyses are very important.

L.B.: One successful thing that I was responsible for is a 20-bed hospital for treating the victims of drug abuse and alcoholics. This has been running for eight years. We trained people, social and self-help groups, who are looking after it now. Now they are also running counselling centres. The other day I met a person at the airport. He said "Ma'am don't you remember me, I took treatment in your centre, I am doing very well now, I have also won a championship". This was the thing we want to hear.

A failure – let me see! At the insistence of the government, we started working with the NGOs on biogas technology extension. Some of them cheated us, the government and the people. That really broke my heart. We had to return some money to the government because of NGO's wrong action. Many NGOs are very good but some of them are frauds.

Dream 2047: Do ex-servicemen show a progressive attitude when they settle down after retiring from the force?

L.B.: You will be happy to know that in a cluster of villages in West Bengal, many

continued on page 31

Coffee

The Wonder Elixir



N. Ramdas Iyer
E-mail: nriyer64@gmail.com

Monday morning. You wake up groggy and heavy headed. You are probably irritable. A cup of warm aromatic coffee gets you started on your daily chores. As you start your work in the office you are pepped up. As time passes, the tensions, the deadlines and the avoidable conflicts slowly build up and you get that familiar nagging headache. Time for a cup of coffee again? Finally the day is over and you return home drained. Another cup of coffee to help you unwind. Got to deal with some unfinished work late at night? Coffee could again keep you company. It is an elixir that helps you keep up with the daily numbing routine of modern life.

While coffee aficionados vouch for its worth, there are people who sound a word of caution too. Too much of a good thing could be bad. But good or bad, coffee has become a part of life in most countries of the world, so much so that it has spawned a subculture of sorts. But how did this ubiquitous drink come into being? What is its heritage and its history? How does it reach the cup from the shrub? Read on to find out more.

In the northern parts of India, where tea is more favoured, coffee is mostly consumed in its instant form, especially during winters. But in the southern parts of India, especially in Tamil Nadu and South Karnataka, coffee making and drinking is a daily sacred ritual. For most people in these parts, waking up in the mornings to the melodious strains music, settling down on the lawns in an arm chair with a newspaper, and a piping hot cup of decoction coffee is the only way to start a day.

The decoction is the essence of coffee, which goes in to infuse life into the cup. The preparation of the decoction itself is a ritualistic art using the unique contraption of a coffee filter, and roasted and ground coffee.

There are a number of differing stories as to the origin of coffee and how it was discovered. One story is that of an exiled Arab Sheik who saved himself from starvation by making a soup from the berries of the coffee shrub. The most common is, however, that of Kaldi the goatherd or shepherd, who, in around 600-800 AD, was tending to his animals on the mountainside one night in Eastern Africa, most likely modern day Ethiopia, when he noticed that they were acting strangely. On investigating this he realised that they had been eating the cherry-red berries of a nearby shrub. As a result of this they remained awake, jumping and leaping around the whole night – even the older goats. Curious, the goat herder picked some of the cherries and tasted them himself. He found that they invigorated him

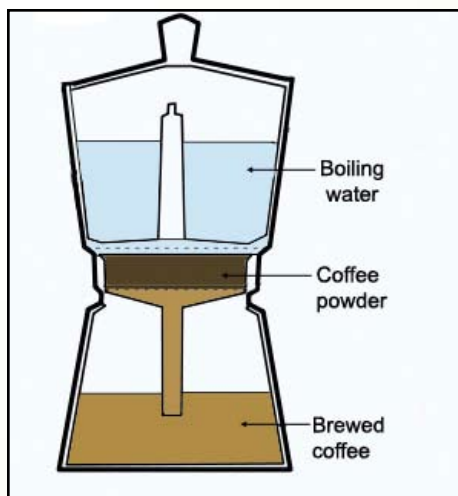


Coffee beans

and made him more wide-awake. A monk from a nearby monastery called Chadely who was passing by heard about this from Kaldi and went to investigate. It was the coffee shrub. The monk, wishing to try the effects of these berries, crushed a few into a powder and poured boiling water over them to make a drink. This was the first cup of coffee – it was not until much later, however, that coffee was first roasted.

The drinking of coffee spread to Arabia most likely by Arab traders and by the end of the 9th Century a drink known as qahwa (literally meaning “that which prevents sleep”) was being made by boiling the beans. Also it was not until much later, say between AD1000 and 1200, probably in Arabia that it was discovered, probably by complete accident, that by roasting the beans a delicious drink could be made. By the end of the 13th century, however, Muslims were drinking coffee religiously. Wherever Islam went coffee went too: from India to North Africa and the Eastern Mediterranean. Coffee was first cultivated in the Yemen area of Africa between 1250 and 1600 when extensive planting occurred.

The first coffee shop that is known to have opened was in Constantinople (later Istanbul) in 1475 after coffee was introduced to Turkey two years early by the Ottoman Turks. This was an important event in the popularisation of coffee. Coffee soon became a part of social life as coffee shops multiplied rapidly and within a few years there were hundreds of them in the city. People visited these coffee houses to talk, listen to music, watch dancing, play chess and other games, listen to the tales of wandering storytellers, or listen to other learned conversations and, of course, to drink coffee! The popularity spread through Europe to such an extent that, during the 17th and 18th centuries, there were more coffee shops in London than there are today. These old coffee shops were nothing like the trendy shops that we have today. A true coffeehouse was crowded, smelly, noisy, feisty, smoky, celebrated and condemned. It was the Dutch, however, who, with a coffee plant smuggled out of the Arab port of Mocha, became the first to transport and cultivate coffee commercially in 1690. They founded the East India coffee



trade by taking the coffee tree to Sri Lanka and their East Indian colony, Java, and as a result, Amsterdam became a trading centre for coffee. They also carried a few saplings to their colonies in South Americas and set up plantations there.

A popular legend attributes India's coffee industry to a Muslim pilgrim named Baba Budan, who smuggled seven coffee seeds out of Mecca in 1670. British colonial rulers developed coffee into a commercial crop that remained valuable until 1870 when Coffee Leaf Rust devastated virtually all the country's plantings. In 1920, cultivation of the species arabica was reintroduced and now accounts for about 50% of India's total crop. India is the second biggest producer in Asia and is responsible for 25% of Asian coffee production.

The word coffee is derived from the Coffea, which is the genus under which it falls in the scheme of botanical classification. This genus falls under the general family of Rubiaceae. Within this genus there are three main types of coffee – Arabica or Arabian coffee is scientifically classified as *Coffea arabica*, robusta or Congo coffee as *Coffea canephora*, and Liberian coffee as *Coffea liberica* or *Coffea excelsoides*. Coffee is the seed of a cherry from this tree which grows from sea level to approximately 1,850 metres in a narrow sub-tropical belt between the Tropic of Cancer and the Tropic of Capricorn around the world. When ready to be harvested, the fruit on the coffee tree turns a dark cherry colour - this is usually about 8

to 9 months after flowering has taken place. The time of harvest obviously varies but usually there is only one harvest per year.

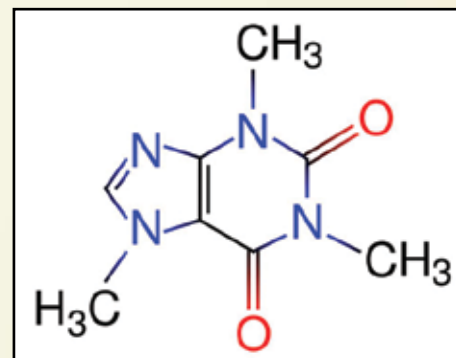
There are about 25 major species within Coffea, but the typical coffee drinker is likely to be familiar with just two, arabica and robusta. The arabica plant is an evergreen, typically large bush with dark green, oval shaped leaves that can reach a height of 4 to 6 metres when fully grown. After planting, arabica trees mature in three to four years, when they produce their first crop. The arabica plant can continue to produce fruits for about 50 years although the fruit yield decreases significantly after about 30.

Coffea canephora provides the robusta beans. Robusta, which can grow up to 10 metres in height as a shrub or tree, has a shallow root system. The fruits are round and take nearly a year to mature. The seeds are rounder and smaller than arabica beans. Robusta coffee was discovered in the Congo in 1898 and has become widespread since then – representing about 1/4 of the world's coffee production. Robusta tends to be a hardier, more disease-resistant bean than arabica which is less expensive to maintain and produces a higher yield. Consequently robustas are used for the less expensive canned and instant coffees.

Coffee contains a complex mixture of chemical components, some of which are not affected by roasting. Other compounds, particularly those related to the aroma, are produced by partial destruction of the green bean during roasting. Chemicals extracted by hot water are classified as non-volatile taste components and volatile aroma components. Important non-volatiles are caffeine, trigonelline, chlorogenic acids,

amino acids, carbohydrates, and minerals. Important volatiles are organic acids, aldehydes, ketones, esters, amines, and thiols (sulphur compounds also known as mercaptans). The principal physiological effects of coffee are produced by caffeine, an alkaloid that acts as a mild stimulant.

The coffee beans can be prepared for roasting in one of two ways. The oldest, simplest, and cheapest, is the dry method. This produces so-called 'Natural' coffees and is adopted mostly in Brazil and Western Africa. Firstly, the harvested cherries are



Caffeine molecule

usually sorted and cleaned to separate the unripe, overripe and damaged cherries and to remove dirt, soil, twigs and leaves. The harvested cherries are then spread out, in the sun, on large concrete or brick patios or on matting raised to waist height on trestles. The drying operation is the most important stage of the process, since it affects the final quality of the green coffee.

The other method of preparation is the wet method. It produces so-called 'Washed' or 'Mild' coffees and is adopted in Central America, Mexico, Colombia, Kenya and Tanzania. This involves more capital outlay and more care than the dry method. It does, however, help to preserve the intrinsic qualities of the bean better, producing a green coffee, which is homogeneous and has few defective beans. Hence, the coffee produced by this method is usually regarded as being of better quality and commands higher prices.

India's coffee grows between 900 and 1,850 metres above sea level, usually on terraces in the mountainous regions. Coffees produced in India have



Ripening coffee berries

more in common with Indonesian coffees than with coffees from Africa or the Arabian Peninsula. Good Indian coffees are grown in the states of Karnataka (approximately 80% of Indian coffee is grown here), Kerala, and Tamilnadu. In good years, these coffees can contain acidity typical of Guatemalan coffee, and the full body of a good Javanese coffee. In addition, these coffees incorporate the unique spicy flavours of nutmeg, clove, cardamom and pepper. India also produces monsoon coffees, in which green beans have been exposed to the monsoon winds, blowing through open warehouses in India's rainy season. This process reduces acidity and enhances sweetness, making them similar to Indonesian aged coffees.

The tasting of coffee is a rigorous and disciplined process. The taster would be looking for criteria such as acidity, body, aroma and flavour. Acidity is a desirable characteristic in coffee. It is the sensation of dryness that the coffee produces under the edges of your tongue and on the back of your palate. Body is the feeling that the coffee has in your mouth. It is the viscosity, heaviness, thickness or richness that is perceived on the tongue. Coffees with a heavier body will maintain more of their flavour when diluted with milk. Aroma and flavour contribute to the overall perception of the coffee in your mouth.

The twentieth century has seen a number of important developments in coffee



A South Indian traditional coffee filter

including the development of both instant and decaffeinated coffees. Decaffeinated coffee was invented in 1903 when a German coffee importer, Ludwig Roselius, turned a batch of ruined coffee beans over to researchers. Although not the first to remove caffeine, they perfected the process of removing caffeine from the beans without destroying any flavour. Decaffeinated coffee was introduced into the US in 1923.

The soluble coffee was invented by a Japanese-American chemist called Satori

Kato who lived in Chicago. However, the first mass produced instant coffee was the invention of George Constant Washington, an English chemist living in Guatemala. While waiting for his wife one day to join him in the garden for coffee, he noticed on the spout of the silver coffee pot, a fine powder, which seemed to be the condensation of the coffee vapours. This intrigued him and led to his discovery of soluble coffee. In 1906 he started experiments and put his product, Red E Coffee, on the market in 1909. In 1938, Nestlé, after being asked by Brazil to help find a solution to their coffee surpluses, invented freeze-dried coffee. Nescafe was developed and first introduced into Switzerland. Instant coffee really took off after 1956 when commercial television was introduced. The commercial breaks were too short a time in which to brew a cup of tea, but time enough for an instant coffee. The entrepreneurs of the coffee world like Nestlé and General Foods realised this was their big chance and advertised their instant coffee during the breaks.

That then is the story of the wonder bean in all its glory which revives and lifts the moods. Even if you are not a regular coffee drinker, the next time you visit an Udupi restaurant, do not forget to order a cup of this unique drink and as you savour it, do not forget to ruminate on the its long journey from the goatherd Kaldi to the table in the Udupi hotel. ■

(continued from page 34) Lalita Balakrishnan: A pioneer who has spearheaded India's woodstove ...

houses of the family of servicemen had biogas unit used for cooking in the kitchen. That means they had toilets, good kitchen with improved chulhas.. We found that many of them are very keenly interested on these things. The years they work in the forces help building their character.

Dream 2047: In addressing the requirements of rural communities what is the role that media is performing?

L.B.: Many homes have a television or they have setup a TV in a central place where they go and see programmes. TV and radio have an influential role to communicate about cleaning of the environment, health and environment. So probably you should sensitise all leaders who communicate with masses through any media and give them relevant knowledge for their programmes to make a big impact.

Dream 2047: You have begun in the forefront of the solar lantern project. How is it being received by the people?

L.B.: We initiated our solar lantern project some years back and today it is being appreciated by women as they think it's very important for them. They are willing to buy and pay in instalments. We have put up charging stations and the women bring their lanterns to get them charged there and in the evening rent it out to petty vendors (thela walas) etc. Gramin Shakti, is doing well for a long time. They are even recharging cell phones and other domestic gadgets. We have trained about 100 women on how to service the lanterns, to change bulbs, batteries, etc., and thus giving income generating opportunities to more women.

Dream 2047: What is the role of science communicators in these conditions?

L.B.: An effective science communicator can disseminate both new and traditional technologies at grass-root level, which is very much required today. Rural India has lots of traditional technologies and there is a need to communicate those technologies using a proper strategy. This also includes giving respect to the people in rural areas, taking time to make them understand, and once they understand they are willing to learn.

Effective science communication is required now. Actually many innovations in science and technology remain the lab and don't reach the land. Science communicators should work in local languages and cover all kinds of media. In the southern states many farmers listen to the radio and they apply their knowledge to supplement their income. ■

Depression

The Way Out

“The world leans on us. When we sag, the whole world seems to droop.”

—Eric Hoffer in *The Passionate State of Mind*



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

While some simple, common sense, age-old measures can help alleviate the milder form of depression, people with more severe type of depression require medical comfort. Effective treatment is possible with the help of medication and psychological counselling, but it usually takes at least six weeks of medication before the benefits begin to show.

Prevention

If you find yourself afflicted with a touch of depression, you may consider taking the following measures, which may help lift your sagging spirit:

Share your feelings

Be it a positive achievement or a setback—share it with people whom you love. In no case should you mull over negative thoughts or difficulties all by yourself. Discuss it out with your spouse, family member or a trusted friend. They can offer you support, guidance and perspective.

Spend time with other people

A sound social support group is the best tonic for the mind. Humans need to be with others, to belong, and to win approval. Spending time with others can shore up your low spirits.

Think positive

The ancient Hindu philosophy as well as modern thinking asserts that all our thoughts become reality. If we think negative thoughts, we are led to helplessness and hopelessness and ultimately we become victims of depression. On the other hand, if we are positive and optimistic in our approach, we protect our minds and bodies from harm, and help ourselves to live a longer, healthier, and happier life.

Give time to activities of your interest

Engage in activities that have interested you in the past, particularly activities that you

have enjoyed. Spend time on music, reading, watching movies, theatre, art exhibitions, picnics, visiting museums, rowing, playing cards, chess, carom or anything that you like.

Take regular exercise

Regular moderate exercise, like 20 minutes of brisk walk, workout or sport may lend much to lift your mood. It relieves you of stress and strain, and leaves you fresh, alert and rejuvenated.



Get adequate rest

Rest and sleep are the biggest balm for the body and the mind. Overwork, too much stress and anxiety do not help anybody.

Set realistic goals

Don't undertake too much at one time. If you have large tasks ahead, break them into smaller ones. Set goals you can accomplish.

Help others to help yourself

Look out for any opportunity to be of help to someone less fortunate. The benefits are immense. Your good deed for the day fulfils an inner human urge. Every religion and humanitarian philosophy teaches you that, and the goodness bounces back with more of the same. Researchers have found that it tones up the mind, the immune system, and physical health.

Medical Treatment

Never trust in the popular theory which claims that people with a strong will can shake off or will away their depression. If it were that simple, the incidence of depression would be much lower. If you suspect that you have a depressive illness or feel that a family member or friend is similarly affected, seek help. See a mental health physician. Without proper treatment the illness usually runs a long course.

Effective treatment is possible with the help of antidepressant medications, psychotherapy, or a combination of both. Unless the illness is severe and carries the risk of self-injury, suicide, or violence to others, or the support system of the person is weak, the treatment can be done at home. Few people require hospitalisation.

Medication

Antidepressant medications

Medications that can lift up the mood are the mainstay of the treatment. About 70 to 80 per cent of people with acute depression respond to them, but it generally takes at least two to three weeks before these medications become effective. They primarily work by restoring serotonin, norepinephrine, and other neurotransmitters in the brain to normal levels.

Antidepressant medications are not addictive, but they may produce unwanted side effects, which differ with each medication. They must be taken on a regular basis for several months and sometimes longer to avoid relapse. People who discontinue treatment midway or immediately after their symptoms improve usually run into depression again.

The commonly used antidepressant medicines fall into four major classes: tricyclics, tetracyclics, monoamine oxidase inhibitors (MAO inhibitors), and selective serotonin reuptake inhibitors (SSRIs).



Tricyclic antidepressants

Named for their three-ring chemical structure, the tricyclic antidepressants include imipramine, nortriptyline, doxepin, amitriptyline, trimipramine, dothiepin and clomipramine. The side effects of tricyclic antidepressants may include drowsiness, palpitation, dizziness upon standing, blurred vision, constipation, dry mouth, and confusion.

Tetracyclic antidepressants

Tetracyclic antidepressants have a four-ring chemical structure, and include mianserin and mirtazapine. Their possible adverse effects may range from weakness, flu-like symptoms, back pain, increased appetite, weight gain, constipation and dry mouth. There may also be abnormal dreams, abnormal thinking, tremors, and confusion.

MAO inhibitors

MAO inhibitors, which include moclobemide, have now largely been discarded in favour of safer alternatives. MAO inhibitors lead to many of the same side effects as tricyclics, and also carry the risk of a serious interaction with tyramine, a substance found in wine, beer, some cheeses, ripe bananas and many fermented foods. The interaction can produce dangerous increase in blood pressure. People who take

MAO inhibitors must therefore partake of a tyramine-free diet.

Selective serotonin reuptake inhibitors (SSRIs)

SSRIs include fluoxetine, sertraline, paroxetine, and venflaxine. These drugs generally produce fewer and milder side effects than the other types of antidepressants, although they may cause anxiety, insomnia, drowsiness, headaches, and sexual dysfunction.

Lithium

Lithium carbonate, a natural mineral salt, has been used in the treatment of bipolar disorder since 1949. The treatment is started after admitting the person if the person is unwell. It may also be prescribed during periods of relatively normal mood to delay or even prevent subsequent mood swings. Side effects of lithium include nausea, stomach upset, vertigo, and frequent urination. Regular estimation of plasma lithium is necessary to check adverse effects such as impairment of thyroid function.

Other medications

Even though lithium still remains the standard medication for bipolar disorder, a variety of other medications including carbamazepine, valproic acid, and verapamil have also been found useful.

Duration of treatment

Antidepressant medications must be taken regularly for some time before they show any benefit. Some early positive changes may appear in a space of two weeks of



commencement of treatment, however, the best benefit may require up to six weeks or more of regular treatment. A patient and his family may feel rather discouraged by this slow start, however, it is important that the family members should exercise patience and provide their fullest support and encouragement to the depressed.

The treatment with antidepressants must continue for at least a period of six months. Generally, it has to be continued for a much longer period lasting up to two years or longer. Antidepressant medications should never be stopped abruptly; the dose has to be gradually tapered before the medication is stopped.

Psychotherapy

Psychotherapy can be an effective treatment for a mild to moderate depression. There are many kinds of psychotherapy. While some forms of psychotherapy try to help people resolve their internal, unconscious conflicts, other forms teach people skills to correct their abnormal behaviour. Studies have shown that psychotherapy scores over antidepressants in at least two ways—it is free of physiological side effects, and leaves a lasting effect with a lower relapse rate than if the treatment relies solely upon antidepressant medication. However, psychotherapy usually takes longer to produce benefits and studies have



found that a combination of psychotherapy with medication works best.

Interpersonal therapy

Interpersonal therapy is a short-term psychotherapy, normally consisting of 12 to 16 weekly sessions. It has been developed to treat people with unipolar depressive illness on an out patient basis. The therapist helps a person resolve problems in relationships with others that may have caused the depression. The subsequent improvement in social relationships and support helps alleviate the depression.

Cognitive-behavioural therapy

The cognitive theory assumes that depression stems from negative, often irrational thinking about oneself and one’s future. In this type of therapy, a person learns to understand and eventually eliminate those habits of negative thinking. The goal of cognitive therapy is to alleviate depression and prevent its recurrence by developing more positive and flexible ways of thinking.

Psychoanalytically oriented therapy

The psychoanalytic therapy aims at effecting a change in the personality structure or character, and not just at alleviating the symptoms. This therapy focuses upon an improvement in the person’s interpersonal trust, intimacy with others, development of coping mechanisms, the capacity to grieve, and the ability to experience a wide range of emotions.

Behaviour therapy

Several behaviour therapies have been developed for the treatment of depression. The goal is to bring about a change in behaviour so that the patient does not relapse due to a faulty behaviour pattern.

Electro-convulsive therapy

Electro-convulsive therapy is effective in both major depression and bipolar disorder. It is found to be particularly useful in people who suffer from severe depression and are suicidal, and also in those who fail to respond to antidepressant medication and psychotherapy. In this type of therapy, a low-voltage electric current is passed through the brain for a few milliseconds to produce a controlled seizure. Usually six to ten treatments are needed, spread over a few weeks. ■

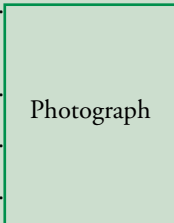
NOMINATION FORM FOR TRAINING PROGRAMME ON INNOVATIVE EXPERIMENTS IN PHYSICS

Vigyan Prasar is organizing six regional Training programmes in East, West, South, North, North-East, and Central India during August to October 2010. The objective of this training programme is to illustrate and demonstrate a series of novel activities that may help enhance interest in physics amongst students and teachers. Activities aim at conceptual understanding of Physical phenomena rather than verification of experiments described in a text book. The experiments were jointly developed by Department of Physics, Indian Institute of Technology, Kanpur and Vigyan Prasar.

If you are a physics teacher/science communicator and willing to attend this workshop, kindly send us information as per the details below.

INNOVATIVE EXPERIMENTS WORKSHOP 2010

1. NAME :
2. DATE OF BIRTH :
3. SEX :
4. PROFESSION :
5. ADDRESS (O) :
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- PIN.....
- (R) :
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6. PHONE :
7. E-MAIL :
8. Have you developed any low cost or otherwise Innovative experiments/teaching aid in physics? If yes, brief description with photograph. Use additional page, if required.
9. Have you attended any workshop based on innovative experiments in Physics? If yes, specify date, organizer and your contribution, if any?
10. If you are a working teacher, kindly give your School address, with phone/fax number and your nomination should be endorsed by School Principal)



(Signature)

(The workshops will be organized in Chandigarh, Mumbai, Hyderabad, Kolkata, Shillong & Bhopal. After the selection, each nominee will be informed by Vigyan Prasar individually about the exact dates/venue etc.)

Send nomination to : **Desk, Innovative Experiments Workshop 2010**
 Vigyan Prasar
 A-50, Institutional Area, Sector-62
 Noida – 201307 (U.P.)

(You can also fill nomination form online. Visit www.vigyanprasar.gov.in for online submission.

Recent Developments in Science and Technology



Biman Basu

e-mail: bimanbasu@gmail.com

Testing blood group with paper strips

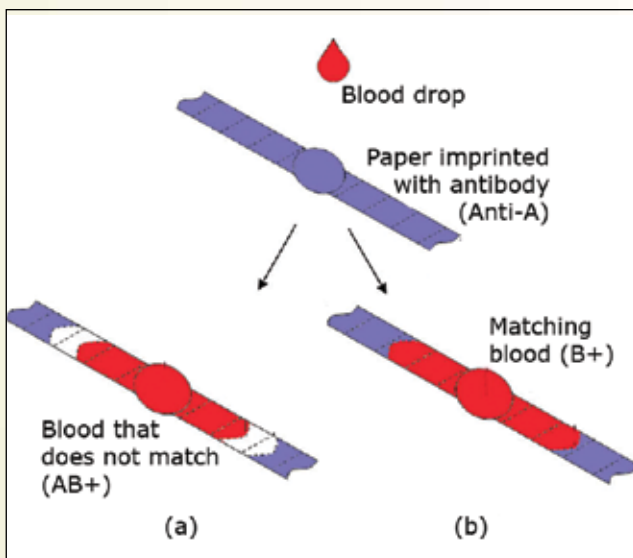
Blood typing is one of the most basic medical tests, but currently it takes time, requires delicate analysis, and costs a lot. But it may soon be possible to find out the blood group in a few minutes, using nothing more than a few strips of paper thanks to the research of a team of Australian researchers from Monas University in Victoria.

People have one of four main blood types, based on antigens on the red blood cells: A, B, AB, and O. Knowledge of blood type is essential for blood transfusion because transfusion of blood of the wrong group can trigger a fatal reaction. This is because when blood of two different groups are mixed they agglutinate or clump together, which can stop blood flow by clogging the blood vessels. This reaction is triggered by antibodies present in the blood, which attack blood cells with a different antigen. The Australian researchers have used this property of blood in an ingenious way to design a novel test for blood groups (Analytical Chemistry, 15 May 2010).

Individuals with blood group A have type A antigens on the surface of red blood cells and anti-B antibodies in plasma. Individuals with blood group B have type B antigens on the surface of red blood cells and anti-A antibodies in plasma. People with AB blood group have type A and type B antigens on the surface of red blood cells and no antibodies to A or B antigens in plasma. People with O blood group have neither type A or type B antigens on the surface of red blood cells but have anti-A and anti-B

antibodies in plasma. So blood of group A will clump if mixed with anti-A antibodies; blood of group B will clump if mixed with anti-B antibodies, and so on.

The principle of working of the new test is quite simple. Absorbent paper strips

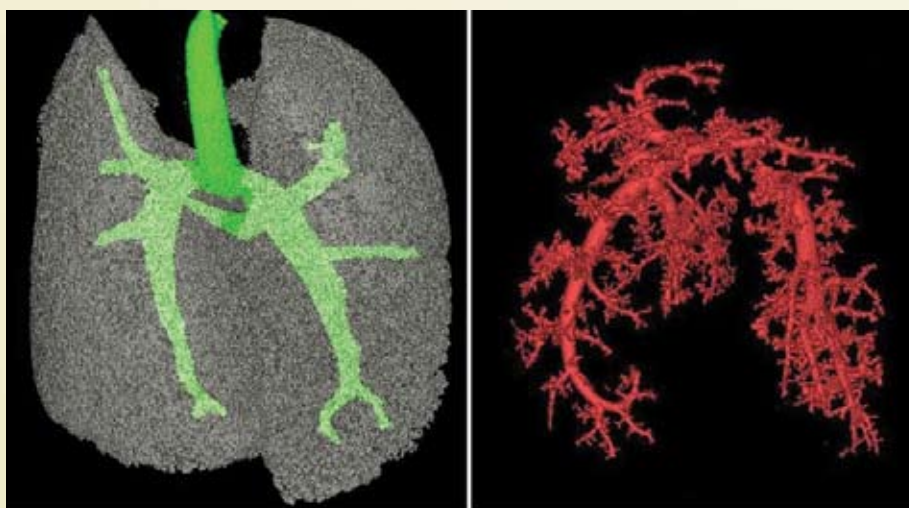


Schematic representation of the wicking of blood on paper treated with a specific and a nonspecific antibody (anti-A). (a) AB+ blood interacts with antibody-A on paper and creates a separate layer of RBC and plasma; (b) B+ blood wicks on paper without any distinctive separation.

are first coated with the antibodies for the different blood group antigens; separate

strips are used for different antibodies. When a drop of blood compatible with a particular antibody is placed on a paper coated with that antibody it is easily absorbed and 'flows' along the strip. But if the drop of blood is placed on a strip coated with an incompatible antibody it immediately agglutinates and becomes thicker and does not flow along the paper strip. So, by looking at the way a drop of blood behaves when placed on paper strips coated with known antibodies the blood group can be determined easily.

The Australian research team used a modified ink-jet printer in which the ink is replaced by solutions of antibodies to create the bioactive paper. The test involves putting a drop of blood onto a thin strip of paper that has been specially printed with antibodies; as the blood seeps into different parts of the paper, the blood type is revealed. The researchers say the test, which requires only a drop of blood and costs only a few rupees, could improve medical treatments in the developing world.



Lung "skeleton." The underlying air passages (left) and blood vessels (right) remain after lungs are decellularised. [Credit: Petersen et al., Science]

Lungs grown in the lab

People whose lungs are failing because of diseases such as emphysema or cystic fibrosis face a grim outlook. Only 10% to 20% of patients who undergo lung transplants survive for 10 years or less. There is hope for such patients going by the success of a new study. For the first



A rat lung, grown from the scaffold of an old lung seeded with healthy cells, is mechanically ventilated in a bioreactor. At the end of a week, the lung was transplanted into a rat, and was able to exchange gases, as a normal lung would, for two hours. [Credit: Thomas Petersen and Laura Niklason, Yale University]

time, a team of researchers led by Thomas Petersen of Yale University, USA, has created a functioning lung by growing cells on the skeleton of a donor lung. The engineered organ was transplanted in a live rat, where it exchanged carbon dioxide with oxygen in the blood – just as a normal lung would – for over two hours (Science 24 June 2010 | doi: 10.1126/science.1189345). The study is the first proof that old lung scaffolds can be used as a scaffold on which new lung tissue can grow. Although preliminary, the results might eventually lead to replacement lungs for human patients.

When lung tissue (the alveoli) are destroyed due to disease they do not regenerate, so the only way to replace a damaged lung is by transplant. But not enough lungs are available for transplant and the procedure is also complex. Even after successful transplantation, a large percentage of the transplanted organ is rejected. Scientists have now found a method of growing lungs by combining a donor lung seeded with a patient's own lung cells, which could reduce the chance of rejection.

What the researchers did was to remove all the cellular matter from the lungs taken from dead rats using a technique called decellularisation that involves using a detergent. This left a scaffold consisting of the fibrous material normally present between cells on which new cells can be grown. The researchers started with decellularised adult rat lungs, which had the organ's branching airways and blood vessel network intact, and injected a mixture of lung cells taken from newborn rats into the scaffold. The entire thing was incubated in

a bioreactor – a machine that mechanically ventilated the lung for a week. By the end of the week, the cells had multiplied, differentiated, and covered the scaffolding, thereby creating a new lung. The rebuilt lung was then implanted in a rat and hooked up to airways and key blood vessels. According to the researchers, the study has shown that it is possible to engineer a lung that can perform the single most important function – exchange of gases.

The present success is significant, but according to the researchers there are some advances in stem cell biology and lung cell biology that still need to occur before human lungs could be grown using repopulated scaffolds and it may take up to 20 years for that to happen.

Substitute pancreas for diabetics

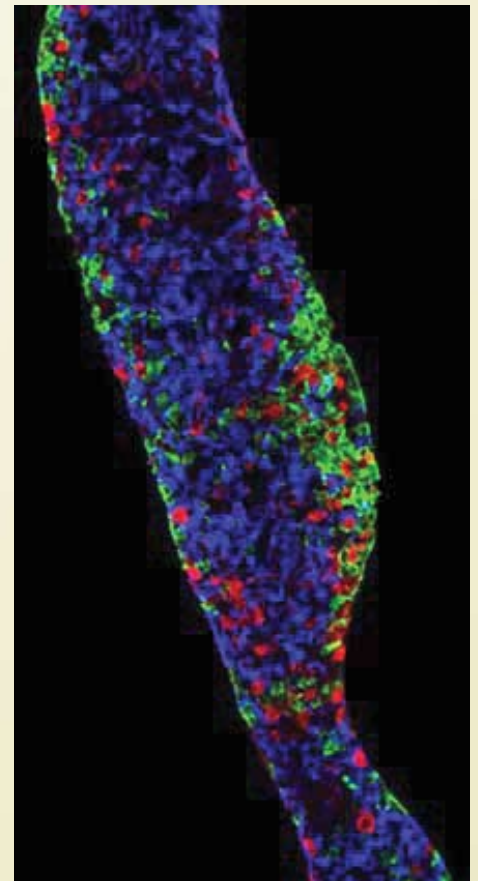
Diabetes mellitus, often simply referred to as diabetes – is a condition in which a person has high blood sugar, either because the pancreas does not produce enough insulin, or because cells do not respond to the insulin that is produced. Type 1 diabetes results from the failure of the pancreas to produce insulin, and presently requires the person to take insulin injections on a regular basis, which can be quite painful. Recently scientists have succeeded in implanting stem cells into pancreas and make it produce insulin. A report on using implants containing specially wrapped insulin-producing cells derived from embryonic stem cells to regulate blood sugar in mice for several months was presented at the International Society for Stem Cell Research conference held in San Francisco, USA from 16 to 19 June 2010. A San Diego-based firm named ViaCyte, which is developing the implant as a treatment for type 1 diabetes, is now beginning the safety testing required for approval from the U.S. Food and Drug Administration before human testing can start (online edition of Technology Review, 28 June 2010).

In type 1 diabetes, the body's immune system attacks the insulin-producing beta cells of the pancreas, which as a result is unable to produce insulin. This forces patients to rely on injections of the hormone to regulate blood sugar. In the past, pancreatic cells taken from cadavers and implanted in patients have been used to treat type 1 diabetes, as a result of which the patients were freed from the daily insulin injections.

But cadaver cells are not easily available and are not of uniform quality, which made this technique impractical for regular therapy. Scientists have been trying to find suitable alternatives, including the use of embryonic stem cells, for the last two decades.

After years of research, the San Diego-based firm was able to develop a recipe which can transform embryonic stem cells into immature pancreatic cells which could be implanted into pancreas. The recipe is a combination of three small molecules and five proteins, which attempts to replicate the conditions around the developing embryo in the womb.

In order to prevent formation of clumps of cancerous tissue called teratomas after transplantation of the cells, the researchers encased the stem cells in tea-bag like membrane. Encapsulation also allows the cells to be removed, if needed. The inner layer of the membrane has pores small enough to prevent the cells from leaking out,



Insulin-producing cells (shown here marked in blue), derived from stem cells and encapsulated in a special membrane, might one day regulate blood sugar in type 1 diabetics. [Credit: ViaCyte]

but the outer layer has pores large enough to encourage blood vessels to grow along the membrane. This is necessary because the implanted cells need access to blood in order to sense and respond to changes in blood sugar, as well as to deliver the oxygen the cells need to survive.

Although in the study, specially wrapped insulin-producing cells derived from embryonic stem cells could regulate blood sugar in mice for several months, which has been described as “astonishing progress,” the researchers feel a lot of research is still necessary before the technique can be used on humans.

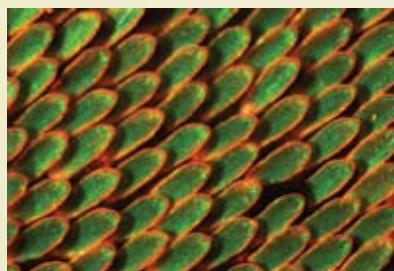
The secret of butterfly wing colour

Most butterflies show bright colours. But unlike flowers, which get their colours from pigments, the rich, shimmering colours of some butterfly wings are produced not by pigments, but by a special geometric



The colour of butterfly wings are not due to pigments but are produced by diffraction of light by certain crystalline substances.

formation of cells. This is the finding of a team of researchers led by Vinodkumar Saranathan of Yale University, New Haven, USA (Proceedings of the National Academy of Sciences, 14 June 2010, doi: 10.1073/pnas.0909616107). The researchers used an X-ray scattering technique to determine the three-dimensional internal structure of scales in the wings of five butterfly species. They found the wings contain tiny



The vivid green colour of the scales of the Papilionid butterfly are produced by optically-efficient single gyroid photonic crystals. [Credit: Yale University]

structures called gyroids that diffract sunlight like a crystal.

There has been a lot of interest in the colour of butterfly wings and it was known that they are not due to any pigment. But until now all the work was done using two-dimensional electron microscope images, and not much progress could be made.

The gyroid is one of four known structures that can be “self-assembled” at the nanoscale and resembles a fan or a pinwheel. It is made of chitin, the tough starchy material that forms the outer surface of insects and crustaceans, usually deposited on the outer membranes of cells. The researchers found that, essentially, the outer membranes of the butterfly wing scale cells grow and fold into the interior of the cells. The membranes then form a double gyroid; that is, two, mirror-image networks shaped by the outer and inner cell membranes. Chitin is then deposited in the outer gyroid to create a single solid crystal. The cell then dies, leaving behind the crystal nanostructures on the butterfly wing, which allows all wavelengths of light to pass through except for one, which is reflected. The size of the gyroid structure is what determines the colour. If the structure is shrunk it would become bluer, if it is expanded, it would turn red. So by changing the size of gyroids the colour can be finely tuned. Moreover, the gyroids are able to create a colour that stays true over time and does not fade like a pigment colour would.

Because of this ability, single gyroids are attractive for use in optics and even in solar energy technology. Photonic engineers are using gyroid shapes to try to create more efficient solar cells and, by mimicking nature, may be able to produce more efficient optical devices as well. According to Saranathan, “Butterflies have been doing it for millions of years. We can use this material in the butterflies as a template to manufacture these single gyroids.”

Letters to the Editor

Publish English and Hindi versions separately

Dream 2047 is a very good monthly newsletter containing good scientific information useful to our students. The biography of scientists covered in each issue is certainly an inspiration to many.

I have small suggestion. It would be better to publish the English and Hindi versions separately, as many students may not read both the versions. It may also save a lot of expenditure.

Prof.V.Sundara Raja,
Solar Energy Laboratory
Dept of Physics, S.V. University,
Tirupati-517502

Mendeleev's paper

The article in Dream 2047-June on Mendeleev in Dream 2047 (June 2010) was excellent. It has a lot of very interesting details. I hope students will read it and be inspired by Mendeleev's life. I heard a talk by Prof Edgar Heilbronner in Switzerland in 1980. The title of his talk was “Science thru stamps” in which he mentioned talked about Ramanujan, and Mendeleev among many others. He mentioned that Mendeleev's paper was rejected by the Journal of American Chemical Society's prestigious journal. The reason given by the referees was that the paper contains no chemistry and has only tables of elements!

I thought you might be interested to know this. However, as Prof Heilbronner is no more, it is not possible to know the source.

Venkatesan

Informative article on Mendeleev

The article Dmitri Ivanovich Mendeleev creator of the periodic table of elements published in Dream 2047 (June 2010) was a highly scientific and informative article for students, faculties, researchers and persons interested in science to know the background of periodic classification of elements. I am immensely benefited with the information provided in the article. I congratulate the author Dr.Subodh Mahanti for this article.

Dr.Sarat Chandra Das
Department of Chemistry
Salipur College, Salipur
Dt. Cuttack, Orissa-754202

Your Opinion

Dream 2047 has been inviting your opinion on a specific topic every month. The reader sending the best comments will receive a popular science book published by VP. Selected comments received will also be published in Dream 2047. The comments should be limited to 400 words.

This month's topic: "Can battery operated vehicles provide a viable alternative to petrol or diesel driven vehicles in view of the rising cost of fuel?"

Response should contain full name; postal address with pincode and email ID, if any; and should be accompanied by a recent passport size photograph. Response may be sent by email (opinion@vigyanprasar.gov.in) or by post to the address given below. If sent by post, "Response: Dream 2047 August 2010" should be clearly written on the envelope.



Vigyan Prasar

A-50, Institutional Area, Sector-62, Noida 201 307 (U.P.)

Phone: 91-120-240 4430/35 Fax: 91-120-240 4437

Email: info@vigyanprasar.gov.in Website: www.vigyanprasar.gov.in

Winners of "Your Opinion" contest for May 2010

Topic: "Will increased use of CFL increase the risk of mercury pollution of the environment?"

Ms. Bhawana Huidrom

C/o. H. N. SINGH
Type - III/25, IITM Colony
Dr. Homi Bhabha Road,
NCL Post, Pashan
PUNE - 411008 (INDIA)
Email: bhawanahuidrom@gmail.com



The use of compact fluorescent light (CFL) in homes has skyrocketed during the past few years though it was developed as an alternative to incandescent bulbs in mid 1980's. The amount of mercury used in a CFL is very small; maximum mercury content for CFLs is not more than 5 mg up to 25W and 6 mg for higher wattages. But the growing market penetration of energy-efficient lighting products, however, has generated increased concern over their disposal after their useful life. Till date, scientists have not been able to identify an energy-efficient eco-friendly material to substitute for the mercury which is linked with very high health risks. At the same time, an ordinary oral mercury thermometer used in our day to day life contains 500 mg to 1000 mg of mercury which is 100 to 200 times more than a CFL. But nobody talks about its mercury content. CFLs last six to twelve times longer than traditional incandescent lamps, which means fewer resources are consumed by their use and fewer lamps need to be disposed of at end of life. Thus the CFLs benefit consumers and help the environment healthy by reducing the pollutions including the airborne mercury emitted into the air from coal-burning power plants. For this purpose, the proper awareness of the consumers is necessary, along with an optimal solution to the problem of disposing CFLs at end of its life by the local NGO's as well as the government.

Debapriya Pal, Std-IX

Netaji Vidyapith, Kailashahar
State-Tripura, District-North

Instead of saving the nature, CFLs are actually harming it. Unless properly disposed of, CFLs should be thought of as toxic technology, when mercury contamination, radio frequency radiation, and ultraviolet radiation are

factored in. From cradle to grave, CFLs pose a danger to people's health and well being, as well as adding even more toxicity to the environment. In fact, CFLs do not reduce a person's carbon footprint and may even increase it in some situations. To make matters even worse, CFLs emit harmful levels of electromagnetic radiation.

More than 98% of used CFLs end up in landfills each year. That is 675 million for the year 2007 according to the National Geographic Society. Each CFL contains about 5 milligrams of elemental mercury as well as other poisonous gases. When mercury enters water sources, biological processes change the chemical form to methyl mercury which is the organic, more toxic form found in fish. Methyl mercury bio-accumulates through the food chain and once in the body can affect developing fetuses, children and adult nervous systems.

Pooja S.N (IInd P.U.C.)

C/o Suryanarayana S.R.
Sampekatte, Madhikai(p)
Hosanagar, Karnataka - 577 452

CFL stands for Compact Fluorescent lamp and it has been used as energy efficient light source for offices, factories, schools, etc. These CFL contain a very small amount of mercury of about 5 mg but this small amount is efficient to pollute the environment.

Mercury has been considered as a hazardous martial and it is deadly a neurotoxin. When CFL breaks or is discarded, mercury is released into the air. Every product containing mercury should be handled with care. Exposure to mercury, can affect our brain, kidneys, liver and spinal cord and it has its impact on memory, attention, language and other problems. Even 1g of mercury is enough to contaminate a lake and make its fish unfit for eating. Compounds like methyl mercury are the deadliest poison known to life, which travels globally and deposited in food chain. Mercury passes the placental and blood-brain barrier, passing on from mother to child and can cause overall reduction in IQ of exposed populations. So in order to prevent mercury pollution it would be better to switch over to other, mercury-free lamps like LED's.

Workshop on Linking Science to Society: A Report

Vigyan Prasar, organised a workshop on “Linking Science to Society” on 27 June 2010, as a part of 2nd Indian youth Science Congress (IYSC 2010). This year IYSC was organized jointly by M.S.Swaminathan Research Foundation (MSSRF) and SRM University at SRM University, Chennai during 26-28 June 2010.

The Workshop started with the keynote address by Er Anuj Sinha, Director, Vigyan Prasar and Chairman of the session. He said, application of science and development of technology has demonstrated its effectiveness in several spheres and has resulted in better quality of life. India, he said, has the daunting task of feeding 16 per cent of the world’s population using less than 2 percent of the world’s land. He urged scientists to work on increasing agricultural productivity and optimising the resources including water, energy, seeds, etc. Construction technology needs attention to meet aspirations of families living in rural and semi-urban areas. Improvements in design should address issues of ventilation and lighting in addition to shelter from the elements. Control of communicable and preventable disease remains a challenge for public health specialists. Malnutrition compounds problems of the poor resulting in low birth-weight babies, stunted growth, poor immunity, etc. Socially disadvantaged sections of the society have additional constraints and require concerted efforts to join the mainstream. Development of problem-solving skills and intuitive

thinking are largely missing in secondary and tertiary education. This is likely to erode the value of the dividend due to a



Er Anuj Sinha, Director, VP delivering the keynote address

young population. So these problems need to be addressed so that the youth keep the problems in their mind before selecting the area of research.

Vigyan Prasar had invited experts from diverse fields including science communication, technology communication, agriculture, health, development of socially challenged, and supporting innovation for this workshop. Around 300 participants including researchers, scientists and college students attended the workshop.

The first speaker, Dr Arul Alam, Associate Professor, Science and Technology Communication, Department of Media Science, Anna University, Chennai presented his views on “How do media grapple climate change?” He discussed how media covers science issues and make the news sensational. He mainly focussed the role and responsibilities of the journalists/communicators for improving the reporting on scientific issues.

The second speaker Ms Arpita Chakraborty from Kolkata, who has a long experience of working with prisoners’ children, discussed her views on “Development of socially challenged children”. In her talk she emphasised how the application of science and technology can help in boosting the confidence of the prisoners’ children for linking them in mainstream. She also urged the youth to do something for the development of socially neglected children.

Dr A.D. Karve of Appropriate Rural Technology Institute, Pune spoke on “Agriculture without fertiliser”. He suggested that by



Some of the speakers from (L-R) Ms Arpita Chakraborty, Shri Joseph Thomas, Er Anuj Sinha, Dr. A.D. Karve, Shri Sentamil Selven



A view of participants in the workshop “Linking Science to Society”



Visitors at VP exhibition stall

2nd Indian Youth Science Congress (IYSC2010)

The 2nd Indian youth Science Congress (IYSC2010) was organised jointly by M.S.Swaminathan Research Foundation (MSSRF) and SRM University Chennai at SRM University Chennai during 26-28 June 2010. The Congress started on 26 June 2010 with the inaugural session. Distinguished guests from very diversify fields like Prof. M.S.Swaminathan, Chairman, MSSRF, Dr T.R Pachamuthu, Chancellor, SRM University, Dr. V.S Hegde, Scientific secretary, ISRO, Dr. K.K, Dwivedi, Head NSCTC, DST, Er Anuj Sihna, Director, Vigyan Prasar, Dr.K.J.Ramesh, Ministry of Earth Science, Dr. George Johan, Advisor, DBT, Dr. Swapan Datta DDG,ICAR, Dr William Dar DG,ICRISAT Hyderabad, Dr. Lalji Singh CSIR, Bhatnager fellow and former Director, CCMB, Hyderabad, Dr. S.R. Rao, Director DBT, Dr Ajay Parida, Executive Director, MSSRF chennai, Dr.M.Parani, SRM University were present on the dais and all invited speakers address the young youth during this session.



Inaugural session of 2nd IYSC, 2010



A view of SRM University, Chennai

After the inaugural, plenary sessions were started. In these sessions several lectures like i) Excitements in defence research; ii) Early warning and disaster support initiative; iii) Innovation in science and entrepreneurship; iv) Serving small holder dry farmer; v) New generation of Indian agriculture; vii) Biodiversity is our life; viii) Mystery of our origins; ix) Relevance of the Darwinism in a warming planet; x) Taking science to the welfare of the community; and xi) Indian science technology and innovations eco-system were delivered by eminent scientists of India. These lectures were very informative and presented a roadmap of future of Indian science and technology. After this several young scientists, researches presented their papers through oral and poster sessions on different subjects like Agriculture, Medical science, Biotechnology, Information Technology, Space and Communication, Nano-technology, Biodiversity conservation, Traditional knowledge system, etc.

congress and successfully provided the forum to discuss, share experiences and expertise on how to tap and utilize science, technology and innovative for Indian's development.

applying an organic carbon source to the soil at regular intervals, one can increase the availability of mineral nutrients to plants, without applying chemical fertilisers.

Next speaker was Dr Ajay Parida, Executive Director, MSSRF, Chennai. He spoke on "Challenges in Agriculture" and presented a road map of future research in this area. He urged youth to come in this field and with innovations link applications of science and technology to society for making nation self-sufficient in the area of food.

Shri Sentamil Selven, Science Communicator, Tamilnadu Science Forum, Madurai presented data on various communicable diseases in India and said that several agencies are working but networking between them is very poor. He also said that better policy is required for spreading the awareness on health.

Last speaker of the workshop was Mr. Joseph Thomas, IITM Research Park, Chennai. He spoke about the movement that helps enrich rural lives through innovation. Through his movement he has linked around

3,60,000 rural people. He spoke about the different technologies on high-energy biomass cooking stoves, e-jeevika a rural job portal, weather station, wonder grass and innovator to entrepreneur.

Vigyan Prasar had also set up an exhibition on theme "Linking science to society" along with a book stall during the workshop. This was coordinated by Shri Kapil Tripathi, Scientist, Vigyan Prasar and assisted by Shri Chandrapal. During the workshop copies of Dream-2047 were distributed among the participants.